Demand Forecasting In Manufacturing Pharmaceutical Small and Medium Enterprise's (SME's) In Ghana

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Submitted in Partial Fulfilment of the Requirements of the Degree of Doctor of Philosophy, 2021

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Acknowledgements

Firstly, I give thanks to the Almighty God for ordering my steps to Salford University and seeing me through my PhD.

I would like to express my sincere thanks and gratitude to my supervisor, Dr Yiannis Polychronakis for the continuous support, guidance and patience throughout this research, without his guidance and persistent help this research would not have been possible.

Thank you to the University of Salford Business School and its academic staff especially my supervisor, for the opportunity to study and work as part of the team initially as an HPA and now as a Lecturer. A special thank you to all the senior academic colleague's Dr Stylianos Sapountzis, Dr Moheeb Abualqumboz, Dr Christos Papanagnou, Dr Kostas Chaldoupis and Dr Neil Malone who mentor and advise me. You were angels in disguise, appearing along my PhD journey when I needed you most.

Dr Jonathan Owens - the conversation that prompted this journey right after my MSc led to this. I am sure you won't remember but I do, thank you.

Immense gratitude to Amos Adiekor through whom I gained access to the SME's used in this study.

Betty my wife what can I say, you have been there right from day one, your valuable contribution to this thesis is very much appreciated, thank you for being my rock.

To my kids – Fedora, Adryell and Jodayne you have proved to be an invaluable source of inspiration throughout this journey.

Finally, to my mum, brothers and sisters-in-laws, thank you for encouraging me in my darkest moments, it would not have been possible without you all.

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Abbreviations

CAQDAS	Computer-Assisted Qualitative Data Analysis Software
ECOWAS	Economic Community of West African States
EDM	Earned Duration Method
ERP	Enterprise Resource Planning systems
ES	Earned Schedule
ESM	Earned Schedule Method
EVM	Earned Value Management
FDA	Foods and Drug Authority Ghana
IID	Independent and Identically Distributed(i.i.d.),
KPIs	Key Performance Indicators
MAPEs	Mean absolute percentage errors
MeTA	Medicine Transparency Alliance
MNCs	Multinational Companies
Mpharma	Manufacturing Pharmaceutical
NBSSI	National Board for Small Scale Industries
NHIS	National Health Insurance Scheme
PMAG	Pharmaceutical Manufacturing Association of Ghana
PVM	Planned Value Method
R&D	Research and Development
SME	Small and Medium Enterprise
UK	United Kingdom
UNIDO	United Nations Industrial Development Organisation
USA	United States of America
VAT	Value Added Tax
XSM	eXponential Smoothing-based Method

Abstract

Forecasting is a ubiquitous, multi-discipline area which has received much attention from practitioners and researchers for many several years. It permeates every facet of an organisation's life as the bedrock of planning and decision making. An organisation's ability to accurately predict future demand affect cost, supply chain and customer service generating significant gains for an organization. Organisations need to forecast to meet the increasing expectations of customers, shorten lead times and for production and procurement decisions. A plethora of studies have established the damaging impact of poor forecast, from excessive inventory to reduced customer service. A poor choice of forecast method and neglect of high forecast errors is a common cause of organisation's problems and supply chain disruptions.

This thesis focuses on demand forecasting in Manufacturing Pharmaceutical (Mpharma) SMEs in Ghana to address the gap of insufficient research within the context and the calls for empirical studies on forecasting in emerging economies. The pharmaceutical industry is constantly forecasting to tackle current unfulfilled needs and for drug innovation; from manufacturing of drugs till the time it reaches the customer. Forecasting's role in the pharmaceutical sector is to inform both clinical and non-clinical decisions and determine how a drug will perform commercially. This study investigate how Mpharma SMEs in Ghana forecast demand, the methods used in forecasting, the importance of accurately forecasting demand as well as the barriers they encounter and how they mitigate these challenges. The investigation was exploratory, framed on phenomenological philosophy and inductive approach. face-to-face semi-structured interviews which involved 14 pharmaceutical manufacturing SMEs were conducted and the qualitative data collected thematically analysed.

The findings confirmed that MPharma SMEs in Ghana forecast demand and encounter divers' challenges though the forecasting practices differ to an extent among the participating SMEs. It confirmed the lack of formal organisation structures and dedicated /expert forecasters for SMEs, and this is due to their size, limited financial and manufacturing resources. The activity is generally performed by the marketing, sales or purchasing managers or owner CEO'S. Judgement approach was the preferred forecasting approach and technology adoption significantly low. All the SMEs are challenged due to lack of data, lack of training and introduction of new legislations to mention a few. A significant finding of this study is the non-existence of intermittent/ irregular demand forecasting among all the participating SME's echoing the forecasting gap in the industry.

Though typically the forecasting process of pharmaceuticals is long and winding, the case is different for generic drug manufacturers. Most MPharma in Ghana produce generic drugs explaining the flexibility but lack of structure of their forecasting processes. The thesis concludes and makes recommendations and suggestions for further research highlighting limitation to the study.

Chapter One
Introduction

1.0 Introduction

This chapter introduces the topic being researched which is, demand forecasting in manufacturing pharmaceutical SMEs in Ghana. It provides an overview of the themes that are discussed in the subsequent chapters and states the aim, objectives, and rationale for this study. The chapter begins with the background to the study. It provides definitions and concise description of forecasting, stressing the significance of forecasting with particularly emphasis on demand forecasting. Subsequently, it looks at the need for this study, and provides a succinct overview of Ghana's pharmaceutical industry, the nature of small and medium size enterprise, their contribution to Ghana's economy as well as challenges. Following on, it briefly states the research aim, objectives, questions along with the contribution of the research. The final section presents the structure of the study.

1.1.1 Background to the study

Demand forecasting for eons has been a major challenge for manufacturers, wholesalers and retailers in any sector or industry, it is a widely researched topic attracting interest from both researchers and practitioners. Some researchers have sought to understand forecasting accuracy and methods for intermittent demand, demand forecasting and inventory control, qualitative demand forecasting methods of for SMEs (Syntetos and Boylan 2005; Bartezzaghi and Kalchschmidt 2011; Doberanzke, 2021;) however the extant literature on demand forecasting in pharmaceuticals is very scanty. Demand forecasting simply means predicting the future demand of a company's products and services by its customers.

For an organisation, forecasting may take different forms; they may apply forecast to demand, sales, profitability, revenue planning and production. Purposely, demand forecasts are undertaken to plan inventory levels to provide acceptable level of service to customers (Kolassa, et al., 2016). This is very typical of companies that operate in consumer markets, they are found to commonly apply demand forecasting approaches. The manufacturing sector in particular had for years sought to properly manage demand uncertainty which has given rise to the development of many forecasting methods and techniques (Makridakis and Wheelright, 1987).

As stated by Chase Jr, (2013)

"companies can no longer wait for demand to occur and then react with the right product in the right place at the right time, instead they must sense demand signals and shape future demand in anticipation of customer behaviour so as to react immediately to customer orders".

This statement reinforces the importance of demand forecasting to an organisation's success; the pharmaceutical industry not exempted. This current study explores demand forecasting in manufacturing pharmaceutical SMEs in Ghana and seeks to find out the forecasting process in these pharmaceutical SMEs. The below highlights some forecasting definitions to give general overview of what forecasting entails.

1.1.2 Forecasting Definitions

Forecasting has been described in many different ways by different commentators. It has been described as the capacity of a company to anticipate and satisfy customer demand which is critical to a business decision making process by supporting mangers to make decisions about resourcing the organisation for the future (Makridakis, 1998). It basically involves gathering and analysing repeated observations (Data).

Thomopoulos, (2015) defines forecasting:

"as the estimation of some future events or conditions outside an organisations control which provides a basis for management planning".

In a similar contribution to Thomopoulos, (2015), Cook (2015) described forecasting

as "an accurate picture of the future; a measure of uncertainty, a guidepost to mark the path into the future and or the best judgement of the future".

Thomopoulos (2015) and Cook's (2015) definitions demonstrate that forecasting provides an accurate and relevant prediction and realistic assessment of future uncertainties. For executives to have the needed information to develop effective foresight about the future depends on an accurate prediction of the major future environmental and technological changes, and identification of future opportunities and threats.

Additionally, forecasting has been described by Land (2015) as

"The formation of expectations about future states or processes of specific historical entities".

Finally, Moon and Mentzer (2011) defined forecasting as

"…a projection into the future of expected demand given a stated set of environmental conditions" (Moon and Mentzer, 2011).

Land (2015) in elaborating the definition of forecasting submitted that forecasting comprises estimating or computing expected future occurrences from a theoretical model founded on an individuals' life experiences and the specific social, cultural, and economic environments they exist within, or it may be an analytic, formal and complex model created on *statistical measurements*, equations, simulations and projections. This definition assumes forecasting is based upon historical data however, Makridakis (1998) contends that replicating past successes will not solely determine future success instead being cognisant of emerging trends in the environment, and an accurate prediction of imminent changes is essential for future success.

1.1.3 Significance of Forecasting

Forecasting signifies the capacity of a company to anticipate and satisfy customer demand by supporting mangers to make decisions about resourcing the organisation for the future. The benefits of forecasting to any organisation's profitability and success including manufacturing pharmaceutical companies cannot belaboured although predicting the future is quite difficult and the accuracy of forecasts are generally challenged by uncertainties around its key assumptions. Forecasting is equally crucial for identifying potential threats and opportunities in the business environment and predicting future uncertainties and its likely impact (Makridakis et al 1993).

A sound forecasting system according to Thomopoulos (2015) is essential in the ever-increasing world of supply change management, thus permitting organisations to cope with the constant changes in the demands for their products and resources. Accordingly, organizations need accurate forecasts for better planning to meet demand for their goods and services (Armstrong and Green, 2017). Accurate forecasts can increase the efficiency in all sectors of the economy including the pharmaceutical industry. As a process, forecasting feeds into and influences many other functional

areas within an organization such as the finance, marketing, operations etc, and drives most supply chain decisions.

In the health sector, many of the decisions depend on forecast quality, from capacity planning to daily schedules (Rostami-Tabar. 2021). Forecasting is useful in the health and pharmaceutical sectors for informing both clinical and non-clinical decisions. It informs decisions on both patients care (Makridakis et al., 2019), management/policy as well as the supply chain. Pharmaceutical manufacturers may forecast how a drug will perform commercially either at the clinical development stage or once the drug is approved and, on the market, (Cha, Rifai and Sarraf, 2013). Similarly, the pharmaceutical sector constantly seeks to predict its future with the object of tackling current unfulfilled needs and for drug innovation.

In summary, a plethora of reasons has been cited in the existing literature (Cook, 2016, Chase, (2013) to underpin organisations need for forecasting and this includes rising expectations of customers, reducing lead times, and resource scarcity. To the retailer, forecasting informs inventory, order and sales decisions; and for suppliers it informs production and procurement decisions; for distributors, for capacity allocation decisions.

1.1.4 Overview of Demand forecasting

The term demand forecasting is narrowly described by Thomopoulos (2015) as a recent term devised to describe forecast of demands from customers for items in stock for their immediate use. Kerkkanen et. al (2009) adds, it is generally applied by organisation operating in consumer markets.

Demand can be demarcated into either dependent or independent demand (Lewis 1997). Independent demand describes the type of demand for a product or service which does not depend on demand for other related products or services. Dependent demand on the other describes the demand for an item or product which is dependent on demand for another item. The process of ascertaining dependent demand is deemed as comparatively simple (Ptak and Smith 2011). According to Slack and Cooper (2015) independent demand is less predictable and random since the causes for such demand are not clearly understood. For such demand, planning and control decisions are based on demand forecasts as opposed to customer orders (Slack and

Cooper (2015); and form the basis for conventional forecasting assumptions (Hanke and Wichern, 2009).

Lewis (1997) opines that even within manufacturing environments where demand at lower levels of the production process is clearly dependent on demand at higher levels, it makes more sense to ignore this self-evident dependency and assume that trends identified in past data using a forecasting procedure could be more reliable and cost-effective indicator of future demand. This assumes that demand is independent.

As suggested by Moon (2018), in reality organisations are doubtful about how accurately demand can be forecast, questioning the forecasting process itself. According to Makridakis, (1980), forecasting assumes constancy and a stable demand process in the models without considering uncertainty in forecasting modelling (Mahaso, 2012) resulting in disparity between research and practice. Makridakis (2021) reinforces the point, asserting that the greatest drawbacks to systematic forecasting methods are the expectation for forecasts to be accurate, thus the relationships and patterns must reasonably be constant during the forecasting period, and uncertainty fat-tailed so it can be measured quantitatively.

The accuracy of forecasting process largely depends on the forecasting practices adopted as well as influence of the external environment as provided in the extant literature. The choice of forecasting method or approach is of essence in either increasing the accuracy or reducing forecast errors. Forecast errors have been found to cause different kinds of impacts on production planning and inventory management (Kerkkanen et. al, 2009). Ramlan, Atan and Rakiman, (2012) concluded that a poor choice of forecast method and neglect of high forecast errors is a common cause of high inventory levels justifying the use of forecasting techniques in inventory demand as economical and rational. Ramlan, Atan and Rakiman, (2012) proposed that the best forecasting method can be determined by considering data pattern, forecast accuracy and forecast error.

Smith III et al (2006) classified forecasting methods into three main groups which are Judgemental, Causal and quantitative Methods. Makridakis and Wheelwright (1989) indicates that both judgmental and statistical forecasting work on the same basic

principle – the identification of existing patterns (data) and the superimposition of method. Opinion has been divided as to the role of judgement in forecasting. Some (e.g. Makridakis, 1988) are of the view that judgement cannot be trusted yet others (e.g. Dalrymple, 1987, Lawrence et al., 2006) concluded that judgement is strongly preferred as the most important method of practical sales forecasting. Judgemental forecast is found to be an inexpensive method even though unscientific. Similarly, Moon (2018), stated that judgemental forecast is often preferred and widely used. According to Syntetos et al., (2011, 2010) judgmental forecasting directly affects supply chain performance and is very central to the forecasting processes in many organisations (Fildes et al. 2008). However, judgmental forecasting introduces an avalanche of inherent biases of human decision-making which can affect the forecast adversely (Lawrence et al., 2006), and may not be accurate and effective as systematic approaches to forecasting (Makridakis and Wheelwright, 1989).

Quantitative methods of forecasting are usually centred on extrapolation from past patterns and interrelationships. This method only works well when the future pattern is similar to the past (Davydenko and Fildes 2013).

The difference between purely judgmental and quantitative forecasting lies in the method by which the information is observed and recorded, therefore, to minimise forecasting errors the data and the method has to be right confirming Ramlan, Atan and Rakiman, (2012) proposal that the best forecasting method can be determined by the data pattern, forecast accuracy and forecast error.

In their submission, Ramlan, Atan and Rakiman, (2012) recommended future studies can focus on combining forecasting methods and how that could improve forecasting accuracy (Maher, 2010; Daganzo, 2014); and lower forecast error on average, (echoing Li, F. and Tkacz, 2004). Suganthi, and Samuel (2012) posits that, judgemental adjustments which involves a voluntary integration of statistical forecasts, recognises that all forecasts require human judgments even in the case of mathematical forecasts, since judgments interfere in the choice of mathematical methods, variables used, data sets and others. Winter (2011) however disagreed with Suganthi, and Samuel (2012) indicating that judgmental adjustments do not contribute to increasing accuracy when forecasting in special situations, such as forecasting the Gross Domestic Product (GDP) of a nation during crises.

Armstrong (2006) also identified judgmental bootstrapping as a benefit in combining forecasting methods. Judgmental bootstrapping integrates judgment and quantitative methods. Many surveys including Mathews and Diamantopoulos (1986, 1989, 1990, 1992), Fildes and Goodwin, (2007) and Fildes et al. (2009); have examined the use of judgmental and quantitative methods in practice the evidence documented in those surveys indicates that both large organisation and SMEs use these forecasting methods in practice. (De Winter 2011; Lawrence, 2006).

As stated earlier this research focuses on the forecasting practices in manufacturing pharmaceutical SMEs in Ghana; focusing on how they forecast demand in the market after the approval process. Although the Ghanaian pharmaceutical SME manufacturers are not oblivious to forecasting there is however less literature on the subject. This study seeks to contribute to the discourse and to add to the few existing literature on forecasting in the pharmaceutical sector. The next section discusses the pharmaceutical Industry with emphasis on Ghana where this research is conducted

1.1.5 The Pharmaceutical Industry

The pharmaceutical business landscape is relatively complex and challenging to manage. It is also very sensitive since it is responsible for developing new medications for general healthcare improvement of humans (Haloub 2013). Although this is the general perception of the industry, the challenges in the developing countries such as Ghana are more severe. The complexity is largely owed to the huge variations and combination of innovations in Research and Development (R&D) and the management of the outcome of the product manufactured. The pharmaceutical industry constantly seeks to predict its future with the objective of tackling current unfulfilled needs and drug innovation. The accuracy of the forecast or predictions may be in doubt due to unforeseen uncertainties: for example, uncompleted trial; regulators yet to weigh in; and clinicians yet to use the drug (Cha, Rifai and Sarraf, 2013).

The success of research and development innovation is determined basically by achieving the forecasts made from the start of the R&D projects; and failure to achieve the approved figures might affect future investment decisions in the field of new developments of drugs by both manufacturers and investors. Manufacturing the drugs

till the time it reaches the customer also requires forecasting and planning. Sales and demand forecasts processes are applied to achieve proper inventory management.

The Ghanaian pharmaceutical industry is influenced by the laws and regulations of the health authorities, registration status of drugs, political atmosphere and the number of patients and schools of medicine, all these contribute to the complexity in the sector and hence affect forecasting.

The pharmaceutical industry comprises companies that manufacture and market several categories of drugs. This study is however centred on the manufacturing pharmaceutical SMEs currently operating in Ghana to explore how they forecast demand, forecasting methods employed – whether judgmental, quantitative or mixed methods and the challenges forecasting presents Pharmaceutical SMEs in Ghana.

1.1.6 The Nature of Micro, Small and Medium sized Enterprises

The Micro, Small and Medium Enterprise (SMEs) industry is relatively nebulous with no universally accepted definition. Some define them in terms of total revenue, while others use the number of employees as an indicator. The government agency responsible for SMEs in Ghana, the National Board of Small-Scale Industries (NBSSI) describe SMEs in terms number of employees. Figure 1.0 below is the NBSSI's categorization of SMEs in Ghana.

Figure 1.0 NBSSI's Categorization of SMEs

One of the earliest definitions of small business is what The Bolton Committee Report (Bolton, 1971) presented, describing a small business as independent, sole proprietor or partner managed business with a small share of the market. The Committee categorised small businesses based on economic and statistical characteristics. This

categorisation has however been criticised by Kayanula and Quartey (2000) for its lack of consistency and the fact that small businesses are not homogenous therefore no one definition fits. Within the definition of the committee is a suggestion and implication that firms may not grow from small, medium to large companies which defies reality (Kayanula and Quartey, 2000). Submitting that there is no formal management structure for small business; and are managed only by its owners or part-owners as stated by the committee report is argued by Kayanula and Quartey (2000) as incorrect since manufacturing firms may have employee count of up to 200 which would require owners or part-owners to delegate management and decision making.The Bolton Committee's definition based on the statistical dimension (Table 1.0) allocates three different upper limits of turnover for different sectors but this is criticised for being complex, causing confusion and does not allow general comparison.

The below table 1.0 depicts the classifications based on the statistical definition

Table 1.0 Bolton Committee's Classification of SME's

Sector	Number of Employees	Turnover	Number of Vehicles
Manufacturing	**200 or fewer**		
Construction, Mining, & Quarrying	**25 or fewer**		
Retailing & Miscellaneous Services		**£50,000 or less**	
Motor Trades		**£ 100,000 or less**	
Wholesale Trades		**£200,000**	
Road Transport			**5 vehicles or fewer**

Source: The Bolton Committee report 1971

The United Nations Industrial Development Organisation (UNIDO) (1999) also classifies small firms based on the number of employees, differentiating small firms in industrialized countries from developing countries. For industrialised countries, medium firms employ between 100 and 499 employees but for developing nations medium size firms have between 20 and 99 employees.

Essentially, the maximum number of employees of SMEs depends on the nation. For instance, the United States of America fixed the maximum number of employees for SMEs at 499 and 199 in Australia (Berisha and Pula, 2015). France defines SMEs as enterprises employing less than 250 employees as recommended by the European commission. The European Commission categorised Small and Medium Enterprises based on number of employees and turnover. For small enterprises, employees do not exceed 50 with turnover and balance sheet not exceeding ten million Euros. Medium sized enterprises have employees not exceeding 250, a balance sheet not exceeding forty-three million Euros and turnover not exceeding fifty million Euros. In the UK, the Department for Business Innovation and Skills identify a small enterprise as an organisation with employees ranging from 1 to 49 and a medium organisation as between 50 to 250 employees and large organisations as being over 250 (BIS, 2010). The classification of SMEs in this study was based on Ghana's NBSSI classification.

Table 1.1 European Union Classification

Type of Enterprise	Number of Employees	Turnover (Euros)
Micro Enterprises	Those of between 0 and 9 employees.	
Small Enterprises	Those of between 10 and 49 employees	Not exceeding 10M
Medium Enterprises	Those of between 50 and 249 employees	Not exceeding 50M

Source: EC (2005) in Deakins and Freel(2012)

1.1.7 Significance of SMEs to Ghana's Economy

The National Board of Small-Scale Industries (NBSSI) presents that 92% of all registered businesses in Ghana fall within SMEs and contribute about 70% to Ghana's GDP and forms 92% of all businesses in Ghana, this being indicative of the vastness and importance of the sector (Augustine and Asiedu 2017). The huge contribution of SMEs cut across nations, for example in Europe 99% of all enterprises are SMEs (European Commission, 2014). SMEs are recognised as instrumental to the social and economic development of any country. As articulated by Abor and Quartey (2010) and Oppong et al. (2014) SMEs in Ghana are seen as a source of employment and accounts for a significant proportion of the labour force and are a substantial source of total national output (50%). According to the available statistics SMEs accounts for about 60% of employment and generate 85% of manufacturing sector employment (Oppong et al. 2014). Additionally, small and medium enterprises through their innovative and entrepreneurship characteristics help reduce poverty in developing economies, facilitates competition; industrial and rural development; improves job creation and increase government revenue (de Wit and de Kok, 2014, Beck and Demirguc-Kunt, 2004). They also deliver value added manufacturing products and service to numerous customers and market (Abor and Quartey, 2010), pharmaceutical manufacturers included.

1.1.8 Challenges of Ghanaian SMEs

Despite the considerable role of small and medium enterprises in the Ghanaian economy, development and growth of the sector has been riddled with many challenges and hurdles. Some of the challenges and barriers to growth and profitability of the sector includes difficulties in accessing credit facility or raising capital even accessing funds provided by government due to poorly developed institutions rooted in bureaucratic red tape. low managerial skills, poor infrastructure such as power cuts and poor roads constraining growth especially in the manufacturing firms, politics, low level technology access and adoption, weak regulatory framework, globalization, high rates of taxes reducing available funds for business growth (Asare, 2014; Arnold et al. 2010; Green at al 2002).

Small and medium enterprises are typically family owned, financed largely from owner entrepreneur's personal savings, family, friends, or micro finance institutions. Monies raised from these sources may be enough to sustain the day to day running of the

business but largely not sufficient to finance innovation, growth and development. Micro finance facilities charge exorbitant interest and where used, most of the revenues received are used to finance the loan debt. Access to finance from banks is difficult for SMEs arguably due to the impossible requirement and standards set by banks. The document or evidential requirement only deter SMEs from approaching them.

Rapid technology changes mean organisations can better serve their customers with innovative products and services quickly, but for SMEs these changes present varied challenges. SMEs adoption of technology is generally low hindering their ability to grow and develop. Consequently, they are unable to conduct research for innovative products or services. Globalisation, market uncertainties and high level of competition enjoins SMEs to adopt technology- incorporating technology in their production systems and marketing activities for efficiency. Although initial investment in technology may be costly, in the long term it can help cut costs and ensure consistency in delivery of products and services to customers.

Additionally, the management knowledge of owner entrepreneurs is usually low compared to large corporations (Kayanula and Quartey, 2000). This also affect access to finance as lenders are unwilling to commit funds to businesses and entrepreneurs without the know how or skill to manage the funds efficiently and effectively to benefit the business. Investment in training and consulting services are relegated to the bottom due to finance or simply because it is not prioritised. For SMEs to overcome this obstacle, there should be concerted efforts to invest in skill and entrepreneurship development.

In Ghana successive governments have attempted to safeguard SME's by introducing laws and policies which serves the interest of SMEs, reduce the cost of doing business, protect them from exploitation, unfair competitions from multi-national companies or large established businesses. This notwithstanding, most government institutions have been slow in their dealings for example licensing, new business registration; making the processes costly and time consuming (Abor and Quartey, 2010), government initiatives circumvented usually through bribery and corruption a menace to the society.

1.2 The Need for this Study

As detailed in the preceding sections, demand forecasting is significant in every organisation but for the pharmaceutical industry, it is a relatively new task (Merkuryeva et al, 2019) and accurate forecasting continues to be a big challenge (Durbha, 2016). Inaccuracies in forecasts for the industry affects not just the profits of the organisation but the health of nations and the costs not only monetary. Cha, Rifai and Sarraf. (2013) have shown that competitive advantage can be gained by applying forecasting tools in the pharmaceutical industry; contending that such scenarios as: a new competitor and or a restrictive regulatory environment may be avoided by accurate and informed forecast in the pharmaceutical industry. It can be inferred therefore that for Pharmaceutical SMEs in Ghana to stay competitive and have advantage over competitors both internal and external, accurate forecast is vital. This notwithstanding, there is little to no research done in this area to specifically support Pharmaceutical SMEs in Ghana.

A handful of previous studies (Filipe, Grammatikos and Michala 2016; Kalak and Hudson, 2016; Ramlan, Atan and Rakima, 2012; Holmes, Hunt, and Stone, 2010; Altman and Sabato, 2007) have contributed to the overall literature on forecasting, particularly in SMEs, they however did not emphasise demand forecasting in Pharmaceutical SMEs, this confirms the assertion of scanty and inadequate research on forecasting in SMEs. Smith III et al, (1996) focused on forecasting behaviour between large and small firms; whilst Altman and Sabato, (2007); Holmes, Hunt, and Stone, (2010) studied SMEs failure and the effect of size on the failure probabilities of SMEs. Likewise, Kalak and Hudson (2016) research concentrated on forecasting distress in European SME portfolios (Filipe, Grammatikos and Michala 2016); and Demand forecasting in SMEs inventory management by Ramlan, Atan and Rakima, (2012).

Concerning demand forecasting methods, the many research papers suggest using statistical methods for demand forecasting (Fumi et al 2013) such as exponential smoothing and regression analysis (Gutierrez, Solis and Bendore 2004). Traditional forecasting methods, such as exponential smoothing (Syntetos and Boylan 2021) is thought to be applicable for high-volume and smooth demand and not intermittent or erratic demand. Correspondingly, traditional time-series methods have been

demonstrated not to always take into account nonlinear data pattern. Judgement has been found to involve in formulating a forecasting model or applying forecasting method, making judgemental methods also very important in forecasting (Arvan, *et al*, 2019). Judgemental methods may be applied where there is insufficient or no demand history. There is however consensus among many scholars that the model or method used should depend on the attributes.

From the review of the existing literature, a gap was identified regarding the lack of adequate research on the topic, consequently, authors such as [Kalak and Hudson (2016), (Beck et al. (2008), Berger and Udell (2006) and (Dietsch and Petey, 2004)], expressed the need for SMEs specific research internationally. Though this clarion call was made over a decade ago, the situation has not changed evident from the lack of research papers, consequently, this study's focus is to explore the forecasting approaches or practices of pharmaceutical SMEs in Ghana. The study seeks to contribute to fill the gap of forecasting research in the pharmaceutical SMEs in Ghana as well as the sub-Saharan Africa region as the industry in this part of the world is still in its infantile stage and developing.

Additionally, a survey conducted by CIPS concluded that demand forecasting is the biggest supply chain problem facing Asian SMEs (CIPS, 2007). Though the need was identified in Asia, considering Ghana like most Asia countries are emerging economies with rapid economic growth (world Bank 2021), this finding can apply to Ghana. However, this survey or similar has not been replicated either in Africa or specifically Ghana especially because supply chain and procurement is still a developing phenomenon in Ghana (Dey, 2016) and there is little interest and funding for such research. This research seeks to contribute to fill the existing gap in forecasting for the pharmaceutical SMEs in Ghana as well as sub-Sahara Africa.

1.2.1 Why Ghana

The World Bank classifies Ghana as a political stable lower-middle income country with the industry and service sector contributing about 30% and 43% respectively to national GDP. In 2020 the world bank selected Ghana and Nigeria to be a pharmaceutical hub for the west African sub region investing substantially in both countries (world Bank 2021), however not much research has been carried out especially in Ghana to support the sector. Unlike other African countries, reliant on

agriculture has shifted with the focus now on industry, retail and tourism. The pharmaceutical industry is likewise budding, and it is one of the most attractive pharmaceutical markets in sub-Saharan Africa even though currently 70% of the required pharmaceutical products are imported. Government has plans to grow the industry so it can locally manufacture the medicines needed as well as become ECOWAS' hub for pharmaceutical investment. There are however reports of a lack of industry-focused research to develop the country's research institutions and University teaching policy. Research commissioned by the UK Department for International Development reported that most universities in Ghana perform very little research and this partly is due to the lack of research funding to undertake industry focused research to inform policy and support industry. As a developing sector it will benefit from contextual studies to understand the issues salient for a sustainable growth. Considering that universities are underfunded for research purposes and companies make little or no investments in research and development a collaborative effort is needed since no individual company, government can address the issues of human resource capacity, poor procurement and supply chain systems, training, technology as well as infrastructure that accompanies developing a robust industry.

Moreover, SMEs are Ghana's singular most contributor to GDP contributing about 70%, in this regard, the current government (2019) declared its commitment to implement a comprehensive programme for SMEs development and "the expansion of the domestic production of pharmaceuticals" (SONA, 2019) making research in the sector and industry very timely and relevant.

In view of the above argument and considering the recent pandemic which places an added pressure on decision makers on deciphering how to make informed decisions, on the data needed and how to obtain reliable data (Nikolopoulos, Tsinopoulos & Vasilakis, 2021); a study into this phenomenon is both timely and relevant. This research will not only provide theoretical basis for further studies in forecasting in SMEs, but it will also provide an empirical framework of barriers and enablers to forecasting which practitioners in the sub region can benefit from. The study will provide a reference for industry players on the need for forecasting and how to circumvent the challenges that may arise as they employ forecasting methodologies.

Forecasting practice will be explored to determine how manufacturing pharmaceutical SMEs in Ghana forecast demand, the methods they use when forecasting, investigate the barriers pharmaceutical SMEs encounter when employing forecasting tools in Ghana and the importance of accuracy when forecasting demand. The next section outlines the aim, objectives and research questions.

1.3 Research Outline

To address the need discussed above the following research questions, aim and objectives highlighted below were developed.

1.3.1 Aim

The principal aim of the research is to explore forecasting process in manufacturing Pharmaceutical SMEs in Ghana. It centres on how manufacturing Pharmaceutical SMEs in Ghana forecast demand, the methods used in forecasting, the importance of accuracy when forecasting and the challenges they encounter in forecasting demand and how these challenges can be minimised.

1.3.2 Research objectives

The following objectives have been outlined to help answer the research questions:

To investigate manufacturing Pharmaceutical SMEs forecasting methods in Ghana.

To investigate the importance of forecast accuracy in demand forecasting and how errors are mitigated.

To identify the forecasting challenges within the Ghanaian Pharmaceutical SMEs.

To identify forecasting gap within the manufacturing Pharmaceutical SMEs in Ghana.

To develop a framework that will capture and address theoretical and empirical findings within the case organisations.

1.3.3 Research Questions

This research will seek to answer these questions:

- What forecasting methods are used by manufacturing Pharmaceutical SMEs in Ghana?
- How important is accuracy in demand forecasting to manufacturing Pharmaceutical SMEs in Ghana?
- What challenges manufacturing Pharmaceutical SMEs in Ghana encounters in forecasting,
    - *why they exist and*
    - *how are these challenges managed?*
- What forecasting gap exist in practices i.e manufacturing Pharmaceutical SMEs in Ghana?

1.4 Contribution

The purpose of this research is to contribute theoretically to the existing literature on forecasting in Pharmaceutical SMEs as well as providing an empirical framework for practitioners.

There is limited number of studies and even less research that focuses on demand forecasting in SMEs particularly in the pharmaceutical industry. In the recent past, some researchers as mentioned in section 1.2 identified a gap in forecasting research in Pharmaceutical SMEs proposing the need for Pharmaceutical SME specific research, but for so long the call was not heeded to. This research augments the existing literature in three different ways, firstly it contributes to the literature on forecasting in general, forecasting in SMEs as well as forecasting in the SME manufacturing pharmaceutical companies particularly in Ghana and the sub region.

Secondly it fills the gap in practice; it is said by Pfizer (2011) that the supply chain of pharmaceutical industry is very complex to understand. These studies provide a forecasting framework identifying the barriers and enablers of forecasting in SME pharmaceutical industry of Ghana as well as support other pharmaceutical manufactures in Sub-Saharan Africa. It will inform management decision making in

the choice of forecasting method which best fit the needs of SMEs and also inform organisational policy especially on procurement.

Finally, the findings and conclusions of this study will be a good source of reference for subsequent studies on this phenomenon and beneficiary to forecasters specifically Pharmaceutical SMEs in Ghana. It provides a comprehensive perspective on the subject intended to help bridge the gap in the research.

1.5 Methodological Consideration

This research follows the epistemological phenomenology stance of inductive case study research using qualitative data collection methods mainly face to face interviews. Phenomenological philosophy advocates an attempt to understand social reality as it has been grounded in people's experiences throughout the years of life and employment within organisations and nations. Phenomenology generally attempts to understand specific phenomena by establishing the meanings that people assign to them (Walsham, 2015) and, as a result, unlike positivism, does not view 'reality' as objective, measurable and external.

This view will allow the researcher to interact with the subject being studied, so that the researcher can explore and understand forecasting in the manufacturing pharmaceutical SMEs in Ghana. The purpose of this research requires a deep understanding of the social context within which it is set and will rely on data gathered, from which ideas can be induced. In answering the question of how Manufacturing pharmaceuticals SMEs forecast, it is necessary to study the details motivating practitioner's decision to forecast and the methods they employ when they do. The focus of this study is to explore how Manufacturing Pharmaceutical SMEs in Ghana forecast demand and the methods or tools used in forecasting. It will also investigate the barriers SMEs face when employing forecasting tools.

According to Saunders et al, (2019) qualitative methods of research are established on phenomenological perspectives (social constructivism). Yin, (2014), also states that case study research uses diverse data collection methods such as interviews, documents, observations, and archival records.

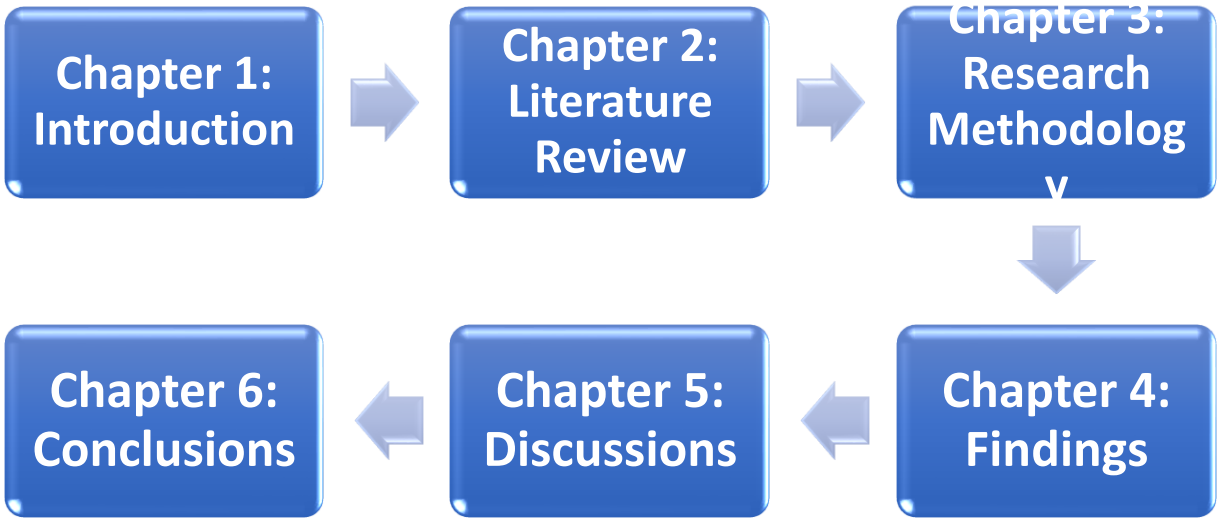
Based on the aim, objectives and research questions, the phenomenological philosophy is considered as the most appropriate for this research as it investigates

a contemporary phenomenon in depth and within its real life context (Yin, 2014). The approach will be inductive in nature with no predetermined hypothesis. A case study is used as a vehicle to realise the research aim and objectives. As stated by Silverman, (2017) there are different methods of generating qualitative data, this research uses face-to-face semi-structured interviews as a main source of evidence, the data is then analysed allowing for textual/contextual information to be linked to text document). The coding enables labels to be assigned to a piece of data or group of data with the aim of facilitating such data to be analysed in qualitative terms.

1.6 Structure of Thesis

The outline of the thesis is illustrated below

Figure 1.0: Structure of dissertation



Source: The Author

Chapter One: Introduction- This chapter to this point gives the reader an overview of the topic being researched providing the need for the study, aims and objectives as well as the questions it seeks to answer. It also delineated the contribution to knowledge. To illustrate what is covered in the subsequent chapters of the study, the next section of this chapter (one) outlines the structure of the thesis.

Chapter Two: Literature Review- this chapter has been organised into two main sections with each section having a plethora of sub sections to help the reader navigate the different concepts views and theories. It critically reviews the literature on

forecasting rudiments and demand forecasting as well as the pharmaceutical market. The first section discussions centres on forecasting stating the different definitions of forecasting and also the importance of accurate forecasting. It also accentuates the cost of inaccurate forecasting giving on forecasting methods, method selection criteria and barriers to forecasting. The next section of the literature review focuses on the pharmaceutical industry with emphasis on Ghana's manufacturing pharmaceutical sector.

Chapter Three: Research Methodology- this chapter is the methodology. Based on the research aims, objectives and questions, the appropriate methodology, method and philosophical approaches is adopted following Sunders et al research onion. It basically shows the research design and the justification for the choice. From the methodology and in conjunction with the literature review, the conceptual framework is developed. Before the approach for the research is declared it is important to appraise the other potential paradigms to justify the particular leanings or lens chosen. This research is an inductive, interpretivist philosophy adopting semi structured interviews as the data collection technique. The chapter also report technique utilized in analysing and reporting the data collected.

Chapter Four: Findings: the fourth chapter of the study presents the views, perceptions, attitudes and insights of the research respondents within the context of the study. It provides a solid account of the views of participants who were generally involved in the demand forecast of their respective organisations. The structure of the chapter is such that it first summaries the key findings of the semi structured interview followed by a thematic presentation of the findings. The chapter ends with a summary of the findings.

Chapter Five: Discussions: the chapter discusses the themes that emerged out of the findings or participants assertions incorporating the theoretical underpinnings and empirical findings from the literature review in chapter two. The key findings are analysed, compared and contrasted with the literature to determine the extent to which the findings agree or disagree with the theory, in other words how much of the practice is mirrored in theory. The chapter reveals the enablers and barriers to forecasting and as a precursor into understanding why organisations forecast in the manner they do

and the possible impact. It also highlights the consensus albeit relative amongst the different manufacturing SMES.

Chapter Six: Conclusions- The final chapter largely addresses the extent to which the research question posed, the objectives set, and the aim of the study have been fulfilled. Beyond this, it gives a litany of recommendations for best practice, proffering how the study contributes to knowledge and addressing the research gap identified. The chapter concludes with a list of limitations to the current study.

1.7 Chapter one Summary

In summary the foremost chapter of this thesis provides an insight and synopsis of the research topic and the issues being explored setting it in its proper context. It outlined the research question that the study attempted to answer, the aim and objectives. The concepts that were later developed in subsequent chapters were introduced in this chapter. Following on, the rudiments of the topic, the theoretical and empirical basis of the research were critically reviewed in the next chapter.

The next chapter therefore examines, evaluates, and critique the barrage of literature and theories for this research.

Chapter Two
Literature Review

2.1 Introduction

Literature review according to Saunders et al (2019) is an important aspect of every business research that involves the critical evaluation of peered reviewed journals, scholarly articles, books, and other research materials in relation to the research topic to provide context and theoretical framework. Colquitt (2013) states that literature review also helps the researcher to connect what is being studied with what has already been said.

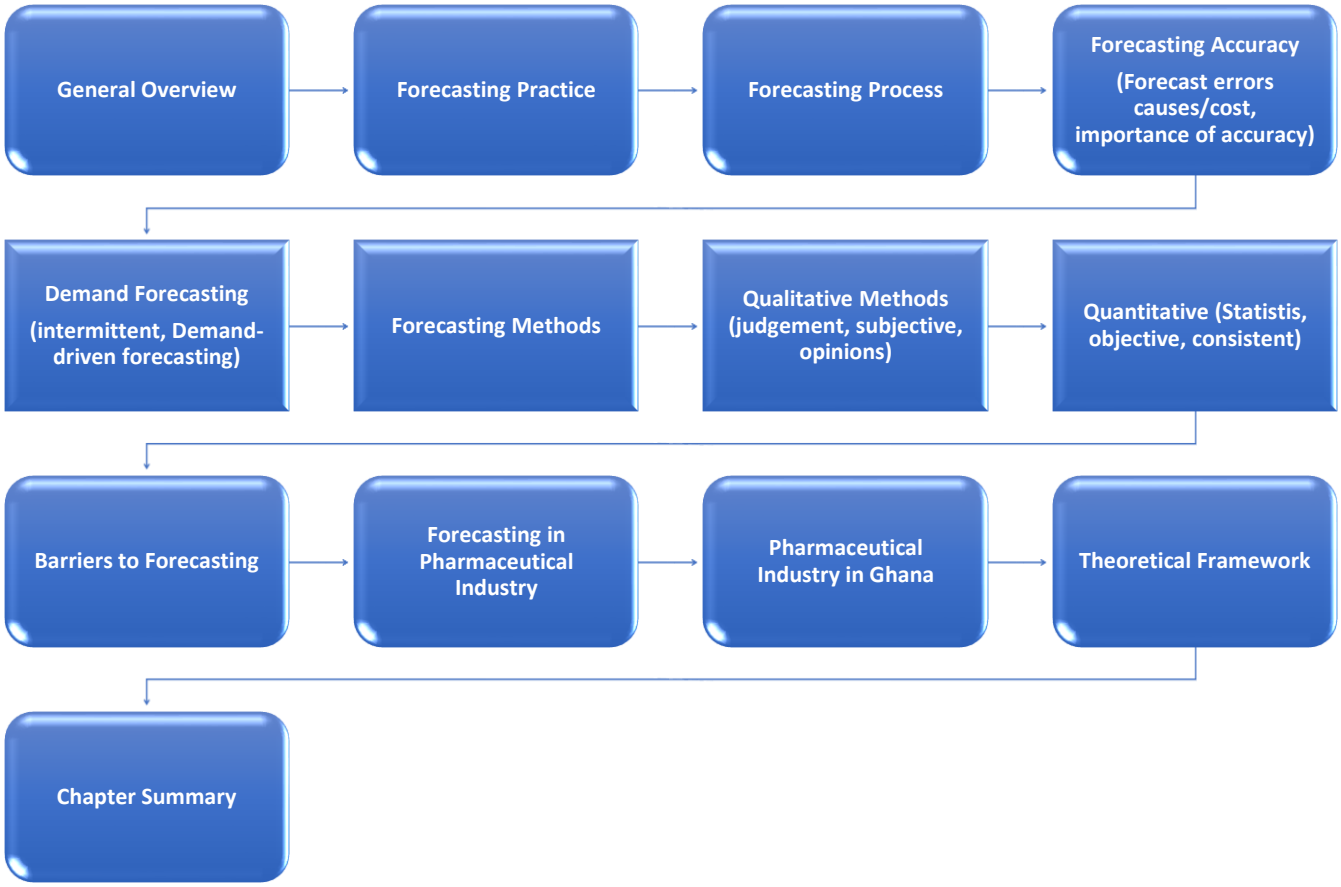
It also demonstrates the researcher's understanding of the field of study, its key theories, concepts and ideas, as well as the major issues and debates about the topic (Denyer and Tranfield 2009).

In the light of the above this chapter focuses on critically reviewing relevant literature and arguments on demand forecasting to position the study in its context of manufacturing pharmaceutical SMEs. The aim is to create a framework from the previous literature which helps identify the themes in the literature and subsequently help answer the questions that this research will address. The literature review is divided into two main sections; the first section focuses generally on forecasting and demand forecasting. It begins with a brief overview of forecasting stating how it has evolved, then, the practices and process of forecasting highlighting the need for forecasting. It proceeds to accuracy when forecasting and the cost of inaccurate or forecasting errors exploring the significance of forecasting accuracy. Subsequently, an extensive discussion on the methods of demand forecasting based on previous seminal and empirical studies, the method selection criterion, and considers the obstacles and enablers of demand forecasting.

The second section of the literature review focuses on forecasting in pharmaceutical industry with emphasis on Ghana's manufacturing pharmaceutical sector, it concludes with a theoretical framework summarising the themes raised in the literature review into either barrier to demand forecasting or enabler.

The literature review is mapped out as below in figure 2.0:

Figure 2.0 Structure of the literature review



Source: The Author

2.2 General Overview of Forecasting

The relevance of forecasting in both research and practice is not in doubt. Researchers for many several years have devoted attention to this area. For practitioners forecasting is very significant because all other business decisions are based on a forecast (Sanders, 2017). Practitioners are interested in how the process can be optimised to improve the performance of forecasts. Since accurate forecast affect both cost and customer service, it can significantly reduce cost which is beneficial to organizations.

The topic of forecasting is extensive and varied (Petropoulos, et al 2020); research on the topic encompasses various disciplines with the literature having contributions from econometrics, finance, statistics, political science as well as health sciences. Demand forecasting in particular is of much interest to an organisation and over the

years has seen contribution and different point of views on the forecasting practices, the exact process companies utilise, techniques that will better model future demand, focus on qualitative techniques, analysis on the tools and structure organisations adopt. These different aspect in the forecasting literature reflect the complexity of the forecasting process. As submitted by Zotteria and Kalchschmidt (2007) companies have to first gather correct information which is fed into a forecasting process, then using some tools or methods, generate forecasts. Any new information which was not available at the time of the initial forecast requires forecasts to be modified accordingly after which performance can be measured to ascertain the accuracy of the forecast. The process may be influenced by factors in the external environment as well as the internal environment which may affect the accuracy of the forecast generated.

In recent past and on the advent of advanced technologies, forecasting has been hugely impacted. As Sanders (2017) put it “Nothing has changed forecasting as much as technology.” Some companies have adopted advanced analytics as well as data collection, storage and processing and software (Chase, 2010) and the new concept of demand driven forecasting. According to Chase (2010) companies are now leveraging predictive analytics to uncover patterns in consumer behaviour to make predictions about the future and measure the effectiveness of their marketing investment strategies. Despite these advancements many organisations continue to struggle in the forecasting function, some struggle to analyse and make sense of data collected.

Below highlights some research on Forecasting and the focus of the research.

Table 2.0 Forecasting Research and focus

Authors	Focus
Brown (1959), Holt (1957) and Winters (1960)	**Exponential Smoothing and Forecast Models**
Reid (1972) Makridakis and Hibon (1979)	**Time series Forecasting**
Makridakis and Wheelwright (1989)	**Forecasting Methods**
Mentzer and Cox (1984)	**Forecasting Approaches**
Watson (1996)	**Forecasting in Electronics Industry,**
Mentzer and Kahn (1997)	**Forecasting practices within US companies.**
Mentzer and Bienstock, (1998)	**Sales Forecasting Management**
Mentzer and Bienstock, 1998; Helms et al., (2000),	**Inter-functional Integration**
Mathews and Diamantopoulos (1986, 1989, 1990, 1992)	**Judgemental Interventions.**
Armstrong, (2001b)	**Forecasting Principles**
Hughes (2001)	**Forecasting Practices**
Fildes, Nikolopoulos, Crone & Syntetos, (2008)	**Forecasting and Operational Research**
Litsiou, K., Polychronakis, Y. and Nikolopoulos, K., 2018.	**Forecasting for Social Good**
Arvan, M., Fahimnia, B., Reisi, M., Siemsen, E., (2019).	**Integrating Judgement into Quantitative Forecasting Methods**
O¨ nkal, D., Go¨nu¨ l, M. S., De Baets, S., (2019).	**Trusting Forecasts.**
Litsiou, K., Polychronakis, Y., Karami, A. and Nikolopoulos, K., (2019)	**Forecasting Megaprojects**
Nikolopoulos, (2020)	**Intermittent Demand Forecasting**
Rostami-Tabara, B. and Boylan J. E. (2021)	**Forecasting Beneficiaries**
Petropoulos et al (2021)	**Forecasting: Theory and Practice**

Source: The Author

2.3 Forecasting Practices and Context

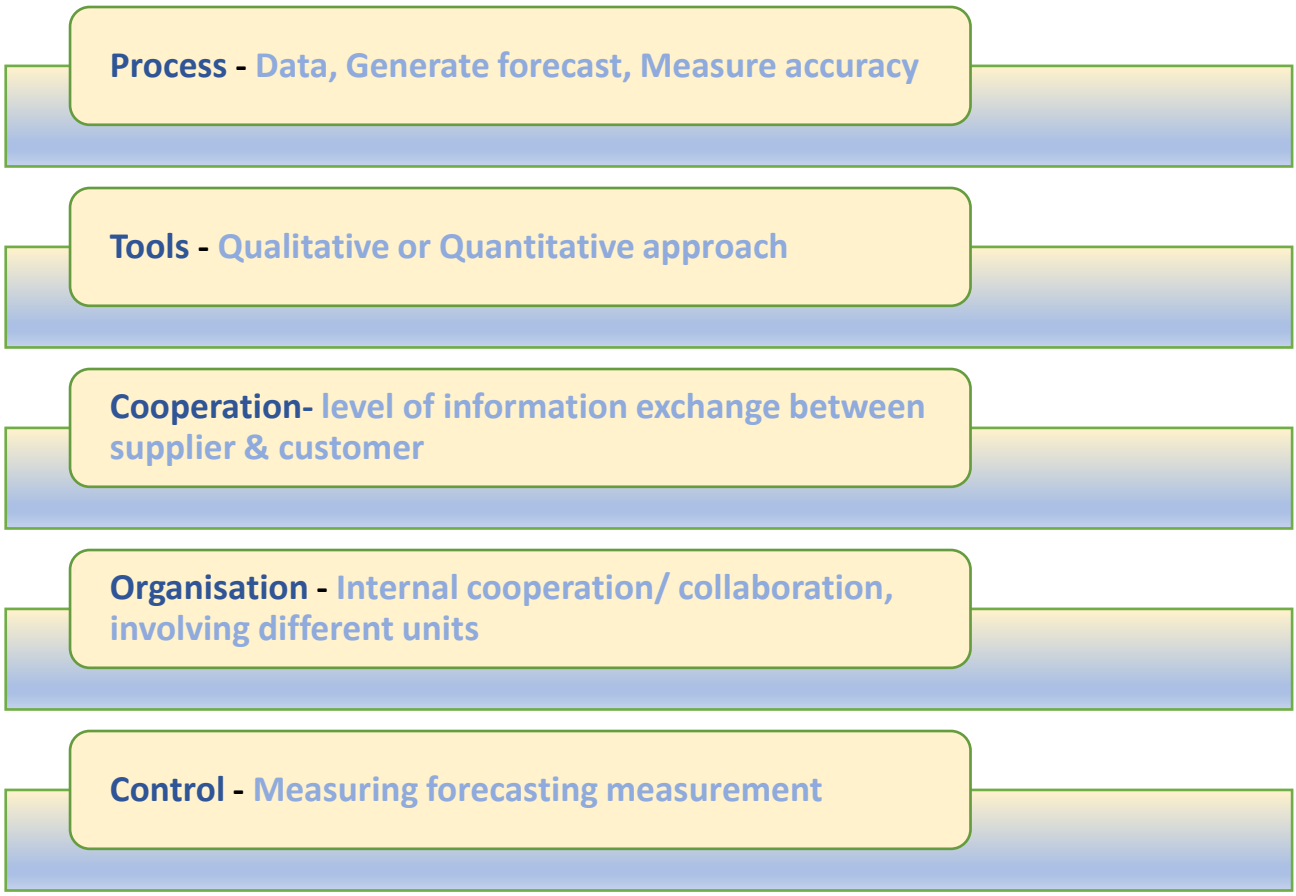
There has been a niche researches which has focused specifically on the forecasting processes companies adopt giving rise to the study of forecasting practices of firms and the best practices that results in best performance (e.g. Cerullo and Avila, 1975, Dalrymple, 1987, Reyna et al., 1991, Sanders and Manrodt, 1994, Mentzer and Kahn, 1997, Lawrence et al., 2000, McCarthy et al., 2006, Zotteri and Kalchschmidt, 2007). Research on the forecasting practices of organisations have described, reviewed, analysed, and studied the forecasting methods organisations used, the type of data or information gathered as well as the department or unit which manage or are responsible for forecasting. These studies sought to identify models or practices which impact positively on performance which can be adopted by the wider business world (Kalchschmidt, 2012). Indicative Fildes and Goodwin (2007) presented eleven principles on how forecasters may apply judgement in forecasting likewise Armstrong (2001) specified principles to be applied in each stage of the forecasting process. This however has raised some issues, with some researchers proposing that context is important when applying forecasting best practice (Sousa and Voss, 2001; Ketokivi and Schroeder 2004; Voss 2005; Sousa and Voss, 2008). Some forecasting authors have acknowledged the significance of context by taking a contingent view, thus the practices may change to reflect some specific variable such as the size of a firm, the specific industry, uncertainty and environmental factors (Peterson, 1993, Winklhofer and Diamantopoulos, 1997, Peterson and Jun, 1999, Sanders and Manrodt, 1994; Sanders, 1992; Sanders and Manrodt, 1994, Diamantopoulos and Winklhofer, 1999, Watson, 1996). These authors provided evidence to indicate that forecasting practices may perform differently dependent on the context. For instance Diamantopoulos and Winklhofer, (1999) submit, judgmental methods may be appropriate where there is uncertainty but less effective where several products need to be forecasted. Notwithstanding, Zotteri and Kalchschmidt (2007) argued that forecasting practices are usually connected since companies adopt consistent practices with context partially explaining the connection.

Market information collected from customers either internally or externally has been found to assist organisations to better understand the market dynamism (Helms et al., 2000). Knowledge of customers' orders or sales plan in advance helps manufacturers better plan production cycles (Stalk and Hault, 1990). Equally, incorporating market

research information especially from multiple sources into the forecasting process as well as analysing market trends help reduce uncertainties in demand (Helms et al., 2000).

Zotteria and Kalchschmidt (2007) describes forecasting practices by classifying it under five variables which are process, tools, cooperation, control and organization. The Forecasting Practices is depicted in figure 2.2 below:

Table 2:1 Outline of Forecasting Practices



Source: Zotteria and Kalchschmidt (2007)

The process encompasses the activities for building forecasts. This involves collecting information, generating and modify forecasts and finally measuring forecasting accuracy (Zotteria and Kalchschmidt, 2007). The degree of attention given to any of the activities may differ based on internal and external attributes. Also, the tools describe the approach adopted whether quantitative or qualitative approach (Kahn and Mentzer, 1995). Cooperation however denotes the degree of cooperation along the supply chain, thus the level of information exchange with

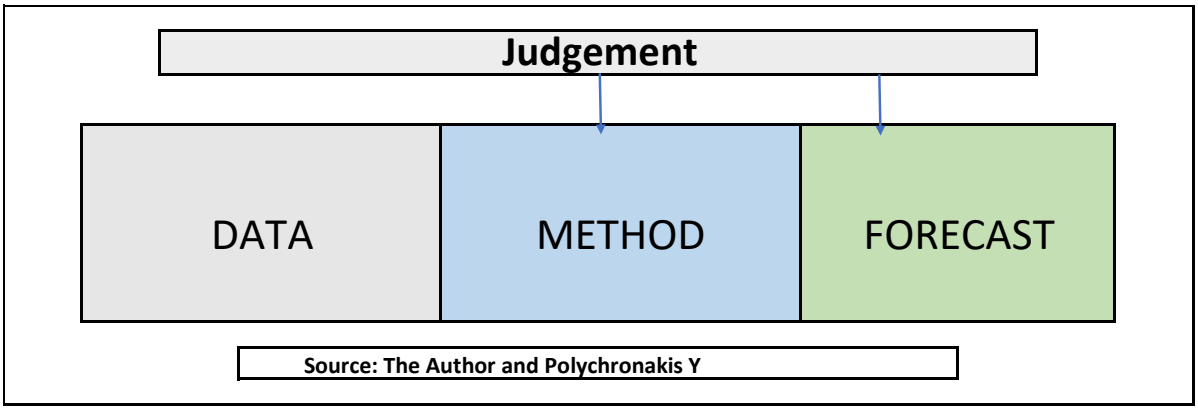
suppliers and customers. The literature is inundated with evidence (Kahn and Mentzer, 1994; Mentzer and Kahn, 1997) of the benefits of internal cooperation or collaboration as it is perceived to substantially improve accuracy of forecasting and referred to as organisation. The involvement of all department especially those affected by the forecast in the forecasting process is necessary for ensuring accurate forecasts. Finally, control involves measuring whether accuracy is measured formally or informally.

2.3.1 Forecasting Process

The forecasting process involves the gathering of repeated events or historical data and superimposing a method (*Quantitative or Judgemental*) to predict future events. Figure 2.3 shows the basic forecasting process. The process can be inferred from Armstrong (2001) publication of the Principles of Forecasting which outlines the process as formulating a problem, obtaining information about it (data), selecting and applying methods, evaluating methods and using forecasts, and these activities make up the forecasting process.

Impliedly and as mentioned earlier there are two pervasive components in the forecasting process, which are Data and Method. These two elements (Method/ Data) must be in sync for accurate forecast to occur. As in any process, to achieve the desired output, the input must be right. Both data and method must be good for accurate forecasts. Good set of data with a wrong choice of method will likely produce a low-quality forecast likewise, if the data is wrong but the method is right, forecasting accuracy is marginalized. Judgement however plays a crucial role in forecasting decision-making process. All forecasting assignments such as choosing the suitable quantitative technique or selecting the datasets to utilise are influenced by human judgement. This is backed by results of field studies which gives an indication practically that forecasting relies heavily on human judgement (Hofer et al 2015, Sanders and Manrodt, 2003). This assertion is depicted figure 2.1 below:

Figure 2.1 Forecasting Process Model



For most forecasting processes, consumer demand forms the input whiles the desired output is satisfied consumers (suppliers, retailers). The input and output are however influenced by data, the choice of method to produce the accurate forecast which ensures consumers are satisfied, stock out or overproduction is avoided at the same time minimising holding cost. To achieve the desired result the process must be effectively and efficiently managed. Adebanjo and Mann (2000) identified four main issues which impact the forecasting process, and these are: communication; organisation; information and forecast generation.

2.3.2 Factors Impacting Forecasting Process

a) Communication

In their study Adebanjo and Mann (2000) highlighted how the three forms of communication namely internal, external and technology impact on the forecasting process. Rostami-Tabar and Boylan (2021) suggested effective communication between forecasting 'actors', customers' and 'owners' is essential if forecasting will be beneficial in organisations. In the supply chain also Liravi (2020) researching into resilience in the food supply chain concluded that ease of communication amongst the different levels of an organisations employees can effectively result in a resilient supply chain. Effective communication channels amongst internal actors are imperative in the forecasting process to ensure they all work with one forecast throughout the organisation (O¨nkal, Go¨nu¨ and De Baets., 2019). It has been reported consistently that internal communication in most companies is poor with different departments

generating individual separate forecasts based on inadequate information and undiscussed assumptions. It is not uncommon to find the sales force rejecting forecasts by the marketing departments as too high. This may be a lack of trust in the forecaster's expertise and objectivity. Communicating the rationale behind the prediction and providing explanations to users (O¨nkal, 2021) can help cure the lack of trust among users and also through building relationship that are mutually beneficials both to the forecast provider/s and users.

Conversely, where there are internal politics and many human interventions, it introduces all kinds of instability in the forecasting process (Rostami-Tabar and Boylan 2021). Makridakis et al., (2020) acquiesces that every intervention becomes an avenue for bias and needless inaccuracies; the forecasting process may be skewed due to each participant's unique political interests within the organisation. Decision makers or people in power positions may not support forecasting output if it does not confirm their forecasts (Cipriano and Gruca, 2014). They may lack an appreciation for the benefits of forecasting or an understanding of investing in the forecasting process and this can hinder progress in the forecasting process. Decision makers will ignore forecasts produced where there is mistrust and this is usually due clarity of communication aside issues with competence and integrity (G¨on¨ul, 2019). For forecast outcomes to be used in decision making, lines of engagement should constantly open with both users and decision makers throughout the forecasting process to enable users openly communicate their expectations rather waiting till forecasts are produced a then communicating their (G¨on¨ul et al., 2019).

To address the issue of internal wrangling and politics requires carefully considering the reward systems prevalent in the organisation and promoting collaborative approach among the various forecasting actors (Rostami-Tabar and Boylan 2021). Ensure buy-in of the forecast by each sectional or functional interest, each manager's domain knowledge must be incorporated in the forecast (Armstrong and Green 2005). This requires discussions of the forecast and inputs from all parts of the business, example marketing, sales, finance, logistics and production. A consensus building occurs having considered the various assumption enabling all parties to take part and exercise ownership.

External communication is also important in forecasting. As consumer expectation and needs increases, and competition also increase, organisations must be more responsive and at the same time reduce the cost of the product. This demands timely information sharing between both suppliers and retailers to aid both parties agree on future demand forecasts. Advances in communication technologies facilitate rapid exchange of information, for example through the internet. Electronic interchange (EDI) of information is cost effective compared to the traditional forms.

b) Organisation Structure

Another challenge to the forecasting process according to Adebanjo and Mann (2000) is the issue of organisational structure. Organisational structures must indicate agreement amongst the functional areas spelling out which functions or person is responsible for different aspects of the forecasting process. Where the organisation structure is not properly designed disagreement over the ownership of the forecast is inevitable.

c) Forecasting training / Expertise

Training is another source of issues with the forecasting process. Most forecasters rely on personal experiences without any formal training in forecasting which tend to negatively impact the quality of forecasts as they may not fully appreciate the appropriateness of the different forecasting models on offer and may not understand the risk of incorrectly interpreting statistical results (Armstrong and Green 2017). The necessity of developing the skills and knowledge of forecasters is not fully understood especially in developing countries and the case is not too different in developed economies also, submits (Rostami-Tabar and Boylan 2021). Where data availability and quality are an issue, organisations rely on judgemental forecasting approaches such as Delphi method, surveys, forecasting by analogy, scenario forecasting (Altay and Narayanan, 2020). These requires an appreciable level of training for forecasters to understand fully the forecasting process and models, their application and practical implementation for effective forecasts (Rostami-Tabar and Boylan 2021). Adequate training mitigates the danger of blind application of forecasting methods and principles resulting in efficient and effective forecasting processes. Users of forecasts can be trained on how forecasts impact and inform decision making so the full benefits of forecasting can be realised. Boylan and Syntetos (2021) however suggest that training

has many variations. The training should go beyond teaching how to click buttons to an in-depth tuition to understand what needs to be done when forecast accuracy decrease.

Likewise, the availability of software packages in the open market threatens the need for forecasting expertise (Rostami-Tabar and Boylan 2021). This all-important development in forecasting automating aspects of the process cannot replace experts who are fundamental to the interpretations of forecasts. As suggested by Panagiotelis Athanasopoulos, Gamakumara and Hyndman (2021) rigorous forecasting process involves domain knowledge as well as forecasting model testing. Forecasts are not always produced by running codes or using statistical software. Expert forecasters have the requisite technical and non-technical skills which some organisations lack but vital for utilising forecasting models in practice, and this leads to poor decisions (Rostami-Tabar, 2021b).

d) Information and Presentation of Forecast

Data is critical to the forecasting process. Demand history of a product is essentially relied upon when forecasting especially for seasonal products. How promotions impacted demand can also be assessed to determine current demand. Adebanjo and Mann (2000) opine that previous history must be gathered at various levels for specific types of products with similar demand characteristics. Organisations should endeavour to develop a structured approach to identify their information needs.

Rostami-Tabar and Boylan (2021) opines that to increase the chance of forecasts being accepted and used will depend on what information is communicated and how forecasts are communicated with participants. The information required for decision making, managing risk, and assessing the impact on decisions should be visually displayed for effective communication. Forecasts should also be presented in a way easily understood by its users either by comparing with alternatives or previous forecast measures. This fundamentally helps to understand the context of the forecast. Past forecast, actual performance and budgets can be presented either through tables or graphs for better understanding, as well as stating the assumptions behind any forecast. It is essential to note that inadequately defining the basis of the forecast and selecting inappropriate presentation style may cause confusion.

e) Access to Resources

The forecasting process requires various resources without which the forecasts development and implementation become difficult (LeVee, 1992). These resources include skilled forecasters and software, the funds required to acquire software, forecasters, and also to train and retain them but the cost involved can be huge (Sanders, 2017). Recent development of free open-source forecasting software has been a breakthrough development for most organisation since it makes available and accessible sophisticated forecasting methods at no cost to organisations (Rostami-Tabar and Boylan 2021). This notwithstanding, depend on the commitment and support of those in decision making positions to make decisions that will ensure the adoption and successful implementation of new forecasting processes. Lack of the needed investment in the needed resources hinders forecasting.

2.4 Accuracy in Forecasting

Many authors have touted accuracy as the most appropriate measure of performance in the forecasting process (Mentzer and Bienstock, 1998, Chase, 1999) though some have expressed misgivings about using accuracy as a factor for comparing the performances of different companies' since companies differ in how accuracy is measured and the internal environment for each company is different and may be difficult to control. Accuracy however remains as the expected outcome of the forecasting practice.

2.4.1 Causes of Forecast Error (Chase Jr.2013)

Sanders, (2015) defines forecast error as the difference between forecast and what happened. Forecast errors as presented by Armstrong (2006) provides very useful information about the present state of the organization and its analysis of the errors will determine systematic changes in past patterns/relationships. Demand forecasting errors if not timely addressed may escalate in the supply chain and cause supply chain disruptions because of the ‘bullwhip effect’ (Khosroshahi, Husseini and Marjani 2016). Errors may also occur when the variability and dynamism of business context is not fully captured by time series. For example, when new product development and or promotional activities are excluded, any quantitative methods which extrapolate historical sales information may produce inaccurate forecasts

(Arvan et al. 2019). Barrow and Kourentzes, (2016) investigated properties of the distribution of the forecast error beyond accuracy considering issues such as normality, variance, and in out-of-sample performance of relevance to decision making.

Chase Jr (2013) in their submission indicated however that, the size and consistency of these errors is contingent on three situations:

1. Mistakenly sensing demand signals (or patterns) and causal relationships.
   This error can occur in both statistical and judgmental forecasting. It occurs when a false pattern or relationship is predicted between a causal factor and the product being forecasted to indicate a strong relationship with the product being forecasted, rendering all other causal factors insignificant. Insufficient information or the identification of wrong information can also result in identifying incorrectly existing patterns. Such situations may be too complex to forecast resulting in errors. It is therefore imperative to integrate domain knowledge which will assist in identifying and interpreting patterns and relationships to make sense without relying entirely on pure judgment in making decisions with little regard for the dynamics of the marketplace.

2. Unstable patterns and unreliable relationships.
   Statistical forecasting assumes constancy and attempt to identify patterns and relationships using averages thereby reducing error; however, there are inherent fluctuations in averages which make such patterns inaccurate and the relationships vague.

3. Changes in patterns and relationships overtime

Over a time period, patterns and relationships continuously change which make these patterns impossible to forecast. These changes may cause continuous errors which may not be predicted. Longer time horizon means less accurate forecast; and this may have a significant effect on forecast accuracy. Such changes as stock price fluctuations, interest rates, exchange rates, and commodity price cannot be accurately predicted due to unknown factors that may influence the price.

Domain knowledge is however essential in forecasting since it can help counteract some of the inherent errors. (Kolassa and Siemsen, 2016) Domain knowledge may assist in determining price changes over time/ future. It is critical for predicting

average cyclical patterns, seasonal patterns, emerging technological trends and its corresponding influencing factors and general influencing factors.

Using advanced forecasting techniques (Varian, 2014; Swanson and Xiong, 2018; Hassani and Silva, 2015) may also provide fewer forecasting errors, but these techniques require heaps of data, which may be difficult to acquire either because the organisations do not keep those data or not available for example in the case of new products.

2.4.2 The Importance of Accuracy in forecasts

Accurate forecasting is necessary for management and operations to achieve organisational objectives. Besides, reliable forecasts produce better outcome for planning and decision making. Equally, accurate forecasting is essential for planning for supply, finance, sales or marketing. As the accuracy of forecasts decrease, decisions that depend on these forecasts are more likely to be wrong with disastrous outcomes (Graefe, Green and Armstrong 2019; Mandel and Barnes 2014). It is argued that where there is stability in the external environment, forecasting is an extension and continuations of established patterns/relationships and therefore accurate; however, where there is turbulence in the environment, forecasting errors are likely to be high since such occurrence as high inflation rates and or recession cannot be predicted (Davydenko and Fildes 2013).

A plethora of reasons has been cited in the existing literature to underpin organisations need for accurate forecasting and this among others are increasing customer expectations, shortening lead times, scarcity of resources and to avoid the 'bullwhip effect' [(Cook, 2016, Chase, 2013, Porasmaa and Ojala, 2011; Monczka et al., 2009; Handfield and Nichols, 2002)]. Makridakis et al (1993) mentions how crucial forecasting is for identifying potential opportunities and threats in the business environment and for predicting future uncertainties and its likely impact on the business.

Inaccurate forecasting may be very costly and may include trade promotions but also the costs of ineffective advertising, new products development without adequate demand, pricing at the level that does not maximize profit contribution and inappropriate sales quotas (Nikolopoulos et al 2016). Low service levels caused by inaccurate forecasts may cause loss of sales, loss of customers, or even loss of

potential customers. Davydenko and Fildes (2013), note that there is a lack of error measures that rate the forecast accuracy with the actual use of the forecasts. In measuring forecasting accuracy, it is necessary to observe the forecasting method's performance as well as the forecasting team.

As depicted in the table below, in other to minimize forecasting errors and produce good forecasts, both data and method must be right.

Table 2.2 Basis for Accurate Forecasting

Data		Method		Forecast
Good	+	Wrong	⇒	Wrong
Wrong	+	Good	⇒	Wrong
Good	+	Good	⇒	Good

Source: The Author

2.5 Demand forecasting

Demand management facilitates the planning and use of business resources profitably and the role of demand forecasting within demand management has been clearly defined (Mentzer and Moon 2018). Demand management involves forecasting, order entry and determining warehouse and service parts requirements. Forecasting for demand is an integral part of an organisation's successful management of customer relations (Moon, 2018). When forecasting for demand, the aim is to match supply with demand. Oversupply of inventory will likely lead to undue costs caused by excess storage, stock deterioration and obsolescence. In contrast undersupply of inventory will invariably lead to lost sales. Ideally, there must be the least amount of inventory to satisfy customers' demands at the same time minimizing the cost of buying and holding the inventory. Reliable forecast is thereby critical to the survival and growth of any firm. Quality demand forecasts make it possible for an organization to provide customers with the products or services they want, when and where they want them. It is the starting point for most planning and organizational control activities (Mohammed et al 2015). In a manufacturing setting, demand forecast is necessary to inform the needed materials, labour, and capacity to fulfil customer demands.

Demand forecasting can be traced back to Brown (1959), Holt (1957) and Winters (1960) who all developed forecast models using exponential smoothing methods that requires only the demand from the most current time period.

R.G. Brown(1959) was the first to apply the forecasting method called exponential smoothing using single exponential smoothing which requires one coefficient (called the level) from the prior time period. The method generates forecasts for horizontal demand patterns combining the current demand entry with the past coefficient.

Charles C. Holt in 1957 however added a trend component to the exponential smoothing method. This method requires two coefficients (level and slope) from the prior time period and the demand from the most current time period. Furthermore, Winters and Holt (1960) introduced seasonal components to the exponential smoothing forecasts, and this required three coefficients, (level, slope, and seasonal). They introduced two models namely the multiplicative model and the additive model. As in the earlier exponential smoothing models, only the demand from the most current time period and three coefficients from the prior time period are needed to generate the forecast.

Accurate forecasts of demand for a new product or for an existing product in a new market are important given that large investments are involved, and uncertainty is high. Surprisingly, surveys of what consumers want and of how they make decisions are of little value. As shown in a meta-analysis of many studies from diverse areas of decision-making, customers are largely unaware of how they make decisions to purchase products (Nisbett and Wilson 1977). Rather than asking consumers what they want, it is better to provide them with product choices and ask about their intentions and expectations. A product description may involve prototypes, visual aids, product clinics, or brochures. A relatively simple description of the key features of the proposed product is suggested, as shown in a study of a proposed car-share system for Philadelphia (Armstrong and Overton 1971).

However, evidence collected by Polychronakis and Syntetos (2007) indicates “adversarial purchasing where contracts are short- term and decided exclusively on the basis of price (and availability) and where no sharing of forecast demand or process development exists; most of the suppliers realise that the buyer is not committed to long term business”. Identifying potential customers for a new product is

sometimes difficult. An inexpensive way around this is to create a role for subjects and ask them about their intentions to adopt the product when they are in that role.

2.5.1 Intermittent Demand

Intermittent demand patterns are characteristically sporadic demands which often vary in size and occur at irregular intervals (Syntetos, Boylan and Disney, 2009). The demand size is typically small and significantly influenced by external factors. Most of the literature on intermittent demand forecasting methods such as Syntetos and Boylan, (2001); the bootstrapping methods (Hasni et al., 2019a); the machine learning methods (Lolli et al., 2017), and the aggregation approach methods (Nikolopoulos, 2020) has developed from the notable publication by Croston (1972) cited in Syntetos and Boylan (2011). Intermittent demand patterns are very difficult to forecast and are commonly associated with spare parts' requirements (Syntetos and Boylan 2011), spare parts SKUs in the military and aerospace and automotive industries (Babai et al., 2019). They are difficult to forecast since they usually comprise a significant proportion of zero values and, are randomly mixed with non-zero values (Syntetos et al, 2015). The quantity of demand for intermittent demand may vary vastly when demand occurs (Cattani, Jacobs, & Schoenfelder, 2011). Nikolopoulos, (2020) similarly stated the two reasons for uncertainty in forecasting intermittent demand are because, actual demand volume is sporadic in nature and because of the unpredictability of demand timing. Another difficulty associated with intermittent demand forecasting is the assumption of intermittent data being independent and identically distributed (i.i.d.), with no evidence of time series characteristics (Petropoulos et al., 2014). This assumption has however been contested by Altay, Rudisill and Litteral (2008, 2012) who found seasonality in intermittent series and presence of patterns, driven by buyers and suppliers (Nikolopoulos, Babai and Bozos 2016). The erratic nature of the demand pattern poses a question as to how the demand should be forecasted whether to make point forecasts of the mean and variance of intermittent demand with a simple parametric method or employ some form of bootstrapping (Syntetos et al, 2015). Due to its erratic behaviour, it makes management of the relevant SKUs very challenging, and demand may be built only for modelling purposes.

Croston (1972) was the first to question the appropriateness of the traditional methods of forecasting such as MA for slow-moving irregular items. He proposed a method that captures the complex nature of the underlying demand demonstrating that using traditional methods for such demand can lead to sub-optimal stocking decisions proposing an alternative forecasting technique. Croston (1972) evidenced the inappropriateness of single exponential smoothing (SES) in an intermittent demand context; proposing a method that forecasts the inter-demand intervals and demand sizes separately when demand occurs. Croston (1972) method of forecasting intermittent demand is incorporated in statistical forecasting software packages; manufacturing solutions systems and demand planning modules of component-based enterprise (Fildes et al. 2008).

Variations of Croston ground-breaking method have since been proposed by a number of scholars, indicative, Syntetos and Boylan (2001) criticising Croston's method as biased. To correct the biasness identified by Syntetos and Boylan (2001) in Croston's original method, Levén and Segerstedt (2004) presented a method which updated the forecast for the demand per period directly using the ratio of demand size and interval, but their approach was found to be even more biased than Croston approach. Syntetos and Boylan (2005) indicated an avenue for improving the accuracy of Croston's method, they sought to correct the biasness by multiplying the forecast for the demand per period with 1-α /2, with 'α' being the smoothing constant. They acknowledged the existence of the bias and quantified its extent (Boylan and Syntetos, 2007). Snyder (2002) variation of the Croston method involved bootstrapping. Notwithstanding, Boylan & Babai, (2016); variation have been criticised for using time series data to forecast demand without considering exogenous factors. According to Jiang et al (2020), currently there are only a few research on intermittent demand forecasting method that utilizes time series data directly and takes external factors into account.

2.5.2 Demand Forecasting Impact on Supply Chain

Demand forecasting is vital to supply-chain management excellence since it is a critical element in planning future supply (Moon, 2018). In this ever-changing world of

supply chain management, forecasting helps businesses to cope with the constant shifts in demand for their products and services. Demand forecasting is also crucial in supply chains since a company's plans affect the plans of each company in the chain (Sanders, 2017). Impliedly, members of the supply chain should not make their forecasts independent of each other as it can result in a mismatch between supply and demand. Where there is collaboration between suppliers and manufacturers in generating forecasts, all units respond to the same level of demand. Independent forecasting by members of the supply chain gives rise to the bullwhip effect. The bullwhip effect occurs when each individual company in the supply chain forecast its own demand, plans its stocking levels, and makes its replenishment decisions independent of other companies in the chain (Sanders, 2017). This produces volatility in orders making forecasting more difficult. The effects are inefficiencies leading to excess investment in inventory throughout the supply chain, higher risk of stock-out, and unproductive use of working capital and manufacturing capacity (Davino, De Simone, & Schiraldi, 2014; Bhattacharya & Bandyopadhyay, 2011; Coppini et al. 2010). The supply chain is a complex network and assuming a simple chain comprising a single retailer and manufacturer is problematic. Some authors have proposed using managerial practices to mitigate the bullwhip effects. Others (Carlsson and Fullér, 2000; Dejonckheere et al, 2003) have suggested using forecasting methods such as fuzzy approach to lessen the consequences by centralizing demand information.

The bullwhip effect suggests that variability of orders increases as there is movement upstream in the supply chain from retailer to manufacturer (Lee et al, 1990). These increases in variability results in substantial increases in all elements of the supply chain from retailers to suppliers. It is argued that supply chains are not highly likely to be affected by disruption in consumer sales since they rarely change, although orders to the wholesaler from the retailer, the wholesaler to manufacturer and the manufacturer's orders to the supplier over time may have more variability.

Lee et al. (2004) categorized the major causes of bullwhip effect into four interdependent and connected factors as enumerated below:

(i) Updating demand forecasts,

This cause arises when the various companies in the supply chain base their forecasts on the historical demand behaviour of their direct customers. Each unit in the supply chain respond by adjusting their order entry to reflect the fluctuations. The fluctuations increase throughout the supply chain according to Lee (2004) if each participant respond to the fluctuations with smoothing techniques. Updating demand forecasts seem to be the major cause of the bullwhip effect.

(ii) Order batching,

This also amplifies order variability in the supply chain as an order policy.

(iii) Price fluctuation

When price fluctuates and offers such as quantity discounts or price discounts are attractive, customers tend to buy larger quantities.

(iv) Rationing and shortage gaming

This happens when demand exceeds supply. This can cause fear of shortage among customers and supply may not cover demand (Carlsson and Fullér, 2000).

2.5.3 Demand Driven Forecasting

Chase (2013) describes demand-driven forecasting as the set of business processes, analytics, and technologies that enable companies to analyse, choose, and execute against the precise mix of customer, product, channel, and geographic segments that achieves their customer focused business objectives. He submits that traditional demand forecasting systems focus on planning than on sensing demand signals, shaping and translating demand into an accurate demand response. Arguing that the systems were designed at an age when customer supply chains were less complicated and with shorter lead times therefore not the best fit for industries which are now global with a focus on lean management and efficient supply response.

Demand-driven forecasting uses market information and data from the companies' outlets (channel) to sense, shape, and translate demand requirements into an actionable demand response championed by an effective and efficient supply (Chase, 2013). This type of forecast is predominantly based on specific historic sales demand retrieved from Point of sale, shipment information and sales orders making it the best estimate of market demand. The approach makes use of supply networks closely linked together to ensure production is always matched to demand (Hadaya &

Cassivi, 2007). It senses demand signals, then using sophisticated data mining methods shape future customer demands, the technique use ‘big data’ analytics to measure the success of marketing strategies (Chase Jr, 2013). They may use price, new product launches, sales promotions, incentives, advertising and marketing programs to shape demand by influencing the amount customers buy (Zokaei & Hines, 2007).

Demand-driven forecasting methods involves five steps which are demand translation, demand sensing, demand shaping, demand shifting and demand orchestration.

Demand translation entails converting demand forecasts and actual demand into formats that can be used in supply planning. To achieve this, information such as sales, volume and revenues are made available to the supply and distribution planning databases (Lee and Ross, 2015). Demand sensing stage refers to perceiving the purchase behaviour of customers either by estimating the price a prospective customer would willingly pay for a new or existing product, set of new products they will be interested in or new product features that will appeal to them (Ravikumar et al, 2005). It utilises data from the value chain which includes seasonal products, and historical trends in buying patterns to create a more accurate demand forecast (Folinas & Rabi, 2012). The third step in demand driven forecasting is demand shaping, which basically is when all the accessible and available information are employed to develop a robust plan of demand and supply for achieving customer satisfaction the profitability targets (Chase Jr, 2013). Shifting demand according to Chase Jr (2020) is when a product is promoted as a substitute where the original product requested is unavailable. Finally, demand orchestration is the balance between sensing and shaping customer demand. Ross, (2015) explains it as developing demand plans that optimises the trade-offs between demand opportunity and risks.

2.5.3.1 Advantages of demand driven forecasting

- **Effective downstream planning:**

Chase (2013) postulates that, an effective downstream planning result in a reduction in customer back orders; out of stock products and a reduction in carrying costs. This can also result in high levels of customer service leading to high customer retention.

- **Improved collaboration:**

Improved collaboration according to Chase (2013) enables senior managers to better understand the drivers of profitability resulting in stricter budget control and an efficient allocation of marketing resources. There is thus a better appreciation of the market, product and customers, allowing for the creation of a more directed strategic allocation of resources across brands and products to drive growth and profitability.

- **Cohesion amongst internal stakeholders:**

Internal stakeholders develop trust for the process and become more firmly aligned, driving quality collaboration among sales, marketing, finance, and operations functions as well as external stakeholders. Quality relationships across the various stakeholders translate into stronger network integration.

Cost savings is it the only justification for a demand-driven forecasting process in an organisation; providing higher-quality demand forecasts can create a competitive advantage improve customer which will in turn increase market share for a company's products and services over its competitors.

2.6 Overview of Forecasting Methods

This section reviews the main types of forecasting methods. The focus of the study is the application of forecasting methods by manufacturing pharmaceuticals therefore no new methods will be suggested. It however gives a succinct description of the main forecasting methods as suggested by Armstrong and Green (2017).

Over the years, there has been many studies and proposals on how forecasts can be developed such as the different mathematical and statistical methods (Makridakis and Hyndmann 1998). These different methods are categorised based on suggested

frameworks. Makridakis & Wheelwright (1979) proposed two criteria for the classification of methods which are the type of information available (quantitative or qualitative), and the basic assumptions about the type of demand pattern (history repeats itself or external patters determine events). Mentzer & Moon (2005) also categorised forecasting methods into qualitative and quantitative methods. Quantitative methods may be separated based on different factors, one of such factors is demand history. Demand history may be the basis where enough data is available; but where no data exists, the use of judgemental methods is sufficient. Similarly, Martin et al, (2010) posit that, the choice of a forecasting approach is chiefly informed by the availability of data on explanatory variables and the availability of demand history data.

There has been significant improvement in forecasting particularly since 1960 as observed by Armstrong and Green (2017), with developments in both judgment methods and methods based on statistical data such as Delphi, intentions studies, opinions surveys, simulated interactions, bootstrapping as well as extrapolation, econometric and rule-based forecasting methods. It is a general perception that causal methods are more accurate than naïve methods. Nowadays, it is recognized that judgment is an indispensable component of forecasting (Lawrence et al. 2006). In recent years the integration of both statistical and judgmental forecasts has presented many gains.

The general Practise among forecasters is to apply the method most familiar to them or the method they adjudge to be the best for the situation. However, Armstrong and Green (2017) suggest that both approaches are not the best suggesting instead the use of all applicable forecasting methods and combining the forecasts. Armstrong and Green (2017) argue that combining methods is superior even when one could be certain that they know the best method for the demand forecasting problem being faced with. Combining methods has been found to reduce ex ante forecast error and help protect against bias.

Armstrong and Green (2017) noted that despite the superior accuracy of some methods, their adoption as methods that provide more accurate forecasts has been slow. Integrating forecasts as clearly articulated in the literature is reported to be beneficial; however, the method is rarely used. He identified some common reasons why scientific approach to forecasting is neglected citing the lack of priority by senior

managers; decision maker interested in supporting information only to back their already decided choice, forecasters not confident their evidence-based forecasts would support the clients' preferences. Fildes and Hastings (1994) add lack of specific training for forecasters. Forecasters typically have little training in forecasting methods according to surveys of forecasting practitioners. Subsequent sections will look at the arguments for combining methods.

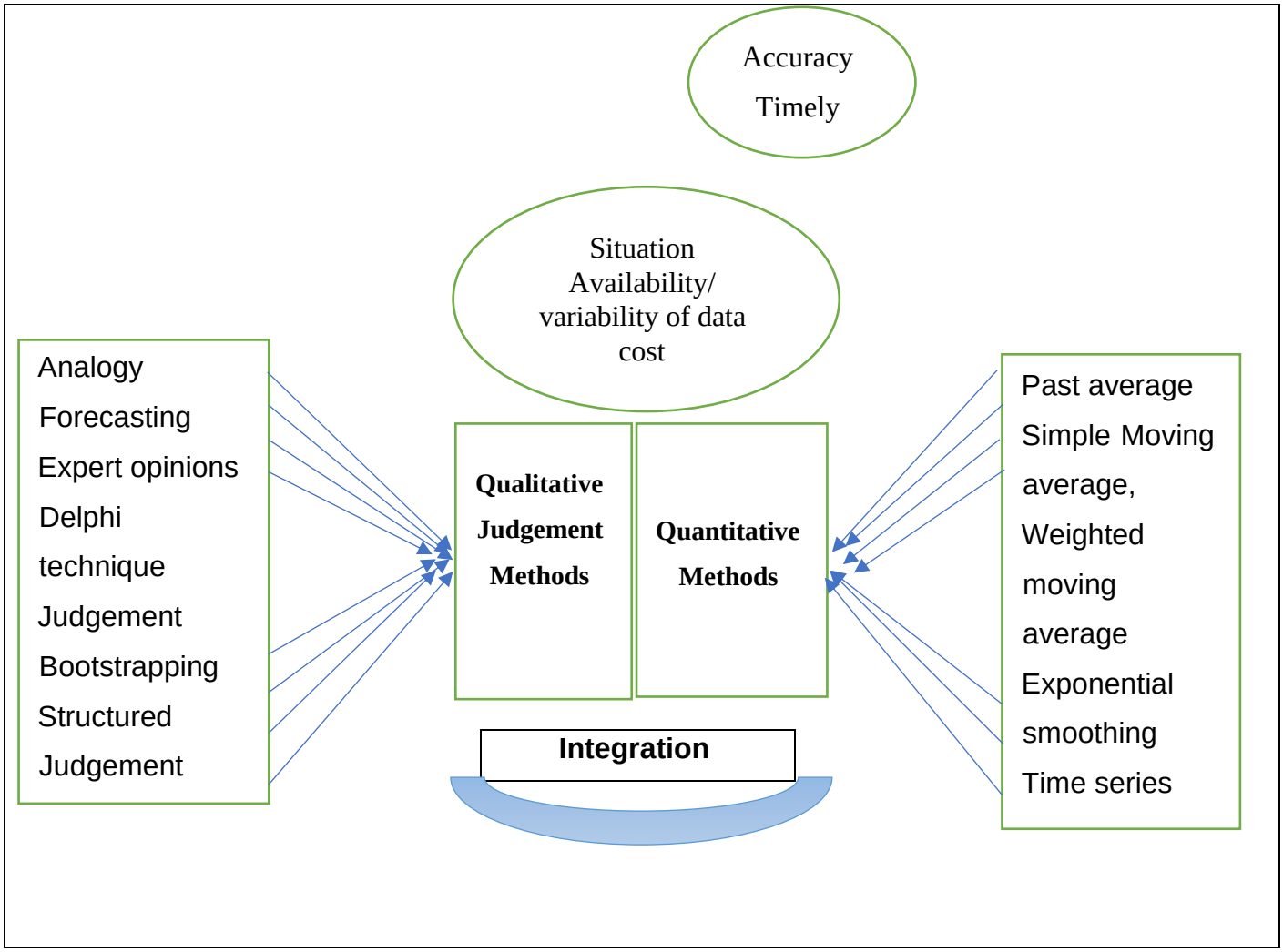
In order to apply the best forecasting method and to reduce errors as practicable as possible, certain general principles must be considered as defined by Armstrong and Green (2017). These principles suggest that when forecasting in highly volatile and uncertain situations, the forecaster must be conservative and the managers' domain knowledge should be combined with forecasting methods. They also stated there is no evidence to suggest that complex methods are relatively more accurate than simple methods and they present additional cost and are difficult to understand by the mass of its users, employing extremely complex process cannot be justified. As much as possible, forecasting methods should use data on actual behaviour, rather than judgments or intentions, to predict behaviour. More so, forecasting in highly uncertainty situations requires combining more than one method, combining forecasts, using simple averages (De Menezes et al 2000). Additionally, forecasting methods that integrate judgmental and statistical data and process are more likely to improve forecast accuracy in many situations.

Armstrong (2001b) defined six criteria to select forecasting method which are convenience, market popularity, structured judgment, statistical criteria, relative track records and principles from published research. This is briefly discussed in the next section.

In summary, the right forecasting method can be achieved by considering data pattern, forecast accuracy, and forecast error. Poor forecast method and neglecting high errors of forecast is a frequent cause of increasing inventory levels. Therefore, utilization of forecasting techniques in inventory demand is economically justified and rational. The below diagrams depict the forms of forecasting methods and the factors that impact the choice of method.

Forecasting Methods Summary

Fig 2:2 Overview of Forecasting methods



Source: The Author

2.6.1 Criteria for selecting forecasting Methods

As stated in the prior section, forecasting methods are generally divided into subjective (qualitative) and objective (quantitative) methods (Sanders, 2015). The Choice of the appropriate forecasting method may depend on the situation. Thus, is the forecast for the long-term or short-term; or are the forecasts for new or existing products? Econometric methods are predominately used for long-term forecasting of the environment or of the market, whereas extrapolation methods are useful for short-term forecasting of the market share (Armstrong, 2006). An essential criterion is for the chosen method to produce a forecast that is accurate, timely, and understood by management to facilitate the decision process.

The benefit that is accrued from the method should exceed the associated cost for its use (Hanke and Wichern 2008). Most surveys have shown that accuracy is the most important criterion when selecting forecasting methods. Mentzer and Kahn (1995), surveyed 207 forecasting executives, 92% of the respondents rated accuracy as most important. The importance ratings however varied for short versus long series, whether many or few forecasts were needed, and whether econometric or extrapolation methods were involved. Although forecasting literature prize accuracy when comparing methods (Yokum & Armstrong, 1995), practitioners see accuracy alone as insufficient criterion for selecting the forecasting method. They consider other factors such as cost, data availability, variability and consistency of data etc. (Georgoff and Murdick, 1986).

In his book principles of forecasting, Armstrong (2001b) outlined six criteria to consider when selecting a forecasting method.

(1) Convenience - "what's easy," is inexpensive, but risky.
(2) Market popularity - "what others do," sounds appealing but is unlikely to be of value because popularity and success may not be related and because it overlooks some methods.
(3) Structured judgment - "what experts advise," which is to rate methods against pre-specified criteria, is promising.
(4) Statistical criteria - "what should work," are widely used and valuable, but risky if applied narrowly.
(5) Relative track records - "what has worked in this situation," are expensive because they depend on conducting evaluation studies.
(6) Guidelines from prior research - "what works in this type of situation," relies on published research and offers a low-cost, effective approach to selection.

Armstrong (2017) developed specific guidelines for selecting methods based on the situation (selection tree). The author grouped forecasting methods into categories together with the conditions under which they are most likely to be useful.

In the selection checklist the writer bases the whole process of forecasting on "Sufficient objective data, this has however been criticized by other authors that what is objective might be subjective to others and suggest that the selection process could be based on the Sufficient robust data.

2.7 Qualitative/Judgemental forecasting

Qualitative forecasting is also referred to as judgemental forecasting. This method makes prediction based on judgment, intuition, and informed opinions, and are subjective (Sanders, 2015). It is argued that all forecasting involves judgment in choosing the applicable forecasting method and or formulating forecasting model, but, "judgemental forecasting" means the forecasts were wholly based on judgment, or with judgemental adjustments to statistical forecasts (Wright & Goodwin 1998). Sanders (2017) submits that qualitative and statistical forecasting methods are not mutually exclusive. In fact, identifying the sources of variability in practice is rare which makes quantitative models almost certainly incomplete (Arvan et al. 2019). Due to this, human judgement and 'gut feeling' when utilised enhances quantitative/statistical forecasts, making human expertise a vital element in forecasting.

In spite of the essence of judgement in operations and supply chain management, scanty research has been conducted on judgemental demand forecasting in behavioural operations management.

Qualitative techniques may be applied especially in situations where there is no or little demand history, for example in the case of forecasting the demand for a new product (Sanders, 2017). In such circumstances, demand history may be considered irrelevant or insufficient for forecasting future demand. Market forecasts for new or particularly rapidly changing markets are often based on judgment.

The selection of participants/forecasters with the appropriate level of expertise is very important in judgmental forecasting. Different types of knowledge that are beneficial to forecasters for example technical knowledge and contextual knowledge. Technical knowledge is described as understanding both statistical methods and the inherent biases in human judgment (Webby, et al 2001). Where no time series is available, for instance when a new product is introduced, human judgment is more priced since forecasters do not have access to historical data to use in a statistical model or inform their decisions (Siemsen, Moritz, & Goodwin, 2018). Differing and conflicting views have been presented in the literature; in some instances, it is suggested that novice forecasters do better than experts or compare equally with experts; whilst others stress the utility of expert opinion in judgmental forecasting methods (for example Önkal & Muradoglu, 1994). With yet others (example Edmundson 1990 and Sanders & Ritzman 1992) contending that technical knowledge do not improve the accuracy of

forecasts. Additionally, Lawrence et al. (2006) opined that technical knowledge is advantageous when the data is presented numerically. In Armstrong, (1985) view, expertise beyond a certain minimal level has limited value implying little to no evidence of a correlation between experience and forecasting performances.

There are a wide range of qualitative methods available to the forecaster; it ranges from a very simplistic method where forecasts are based wholly on intuition, to teamwork methods to special forms of market research. Altay and Narayanan, (2020) mentions structured management judgement such as Delphi method, surveys, forecasting by analogy and scenario forecasting.

Other approaches of judgement have also been identified. Petropoulos et al (2010) in their study highlighted two approaches of judgement as Unaided Judgment (UJ) and Interaction Groups approach (IG). They described unaided Judgment (UJ) as when forecasts are submitted by participants without employing any structured method or guidance. The individual forecasts collected from UJ are typically averaged to produce a group forecast. This approach is the most popular and simplest approach to forecasting (Petropoulos et al 2010).

Averaging has however been found to reduces the variance in forecasting errors which makes individual methods riskier than combination methods (Hibon & Evgeniou, 2005).

The Interaction Groups approach (IG) emphasises consensus building by a group of experts through debate and discussion to produce a forecast (Petropoulos). Through this process each member of the group has access to a wider range of information. This approach is deemed more accurate than unaided judgement forecasts (averaged individual forecasts) in most of the literature available example (Ang & O'Connor, 1991).

One main disadvantage of judgmental forecasting approaches is the effect of anchoring, which can be interpreted as cognitive bias, describing the human tendency to rely on one piece of information when making judgments. Judgmental forecasting may be modelled as an anchor and adjustment (Tversky & Kahneman, 1974; Lawrence & O'Connor, 1992, 1995), where a first approximation is produced (anchor) and then adjustments are made based on additional information. Judgmental adjustment to statistically produced forecasts though a very common practice in

industry (Fildes & Goodwin, 2007), it is an under researched area with relatively little attention given to it in the academic space. A few empirical studies analyse the effectiveness of judgmentally adjusted forecasts and their performance in comparison with the base-case, the unadjusted statistical forecasts (Syntetos, Babai, Boylan, Kolassa and Nikolopoulos 2015). The available studies have evidenced that judgemental adjusted statistical forecasting models tend to perform better when the adjustments are based on reliable contextual knowledge.

The next section discusses a few Judgemental forecasting methods.

2.7.1 Judgmental forecasting with domain knowledge

Sanders (2017) describe domain knowledge as the knowledge gained by practitioners from experience through the course of their jobs (contextual information). Through their interaction with their environment, practitioners become familiar with various environmental signals and cause-effect relationships which helps them determine which signals will have no significant consequence and which will be significant (Sanders 2017). Domain knowledge is also described as any information (non-time series information) other than time series which is relevant to the forecasting task (Webby and O'Connor 1996). It could be an understanding or awareness of the nature of the time series and its associated context. Lawrence, Goodwin O'Connor and Önkald (2006) submit that people generally have knowledge of time series, and it is very unusual practically for forecasters to have time series they have no knowledge about, although recognising that people may suffer from some cognitive traps and illusions. People may also be aware of information useful for explaining previous behaviour of the time series or likely impact in the future. Knowledge of the time series is especially important when producing a judgmental forecast (Perera, Hurley, Bahimnia and Reisi, 2018). The value of domain knowledge in judgmental forecasting as submitted by Sanders (2017) has been confirmed repeatedly by many studies; contextual or domain knowledge can improve forecast accuracy (Webby and O'Connor (1996). Lawrence et al., (2006) postulates that the value of domain knowledge is the information people possess which is not reflected in the forecasting models. Webby and O'Connor (1996) describe it as "the prime determinant of judgmental superiority over statistical models." Contextual information is also helpful where there is high data variability in a time series (Webby and O'Connor, 1996;

Sanders and Ritzman, 1992). Conversely, statistical forecasts are found to require less domain knowledge from forecasters compared to Judgmental forecasts (Sanders 2005).

Chase (2013) defines domain knowledge as the act of defining and uncovering market opportunities based on knowledge and not a forecast based on gut-feeling. He stresses the relevancy of access to data and conducting analytics to validate or invalidate assumptions. The result from the analysis is then used to make adjustments to the statistical baseline forecast or to build assumptions into the statistical baseline forecast by inculcating the new data and revising forecast. Chase (2013) opines that gut feeling judgement rather than informed judgment using domain knowledge may produce accurate forecast with well-behaved and easy-to-forecast demand but will not work in more challenging forecasting situations and will produce highly inaccurate forecasts.

Many researchers have acknowledged the difficulty in accurately incorporating contextual information into forecasts at the same time recognising the value it generates (Lawrence et al., 2006, O'Connor et al., 2000, Lawrence and O'Connor, 1996, Goodwin and Wright, 1994). Franses and Legerstee (2013) submit that the quality of domain knowledge will depend on time range the forecast is required for whether for the short, medium or long term. The power, influence or internal reputation of a forecaster due to their expert knowledge can affect the forecasting process (Olivia and Watson, 2009).

2.7.2 Expert opinions

Expert opinions are one of the widely used/ qualitative methods and this may be internal or *external* experts (Armstrong, 2001). The forecaster may start by seeking the opinion of an expert in the area to make an informed guess which may be subjective and not based on a quantitative model. Written questionnaire may be used to ensure each expert is questioned in the same way to avoid interviewers' biases. Questions may be worded in different ways to compensate for possible biases in wording and average across the answers. Essentially, the questions must be properly posed, and adjustments made for biases in experts' forecasts, and aggregate their responses. Experts if the problem is decomposing the problem for experts may enable them to make better forecasts. (Arkes, 2001) however noted that experts typically are overoptimistic/ confident.

2.7.3 Delphi technique

The Delphi technique provides an avenue for obtaining forecasts from different experts without the disadvantages of traditional group meetings, which could be time-wasting and biased responses. With this method, anonymous panellists autonomously produce a forecast through a single or multiple iteration (Arvan et al. 2019). After each iteration, a member of the panellist who also serves as a facilitator anonymously declares the forecasts of the experts' stating the reasons for the forecast (Arvan et al. 2019). Further iterations occur after this until eventually, after the final iteration, the average of the individual forecasts is declared as the final forecast. The Delphi method is commonly used in tourism forecasting (Lin, Goodwin and Song, 2014; 2015). The Delphi method as an interactive group method indicates that group forecast in judgemental forecasting can produce excellent results in comparison to staticised group forecast which averages individuals' judgement (Sniezek, 1989). Similarly, Ang and O'Connor (Ang and O'Connor, 1991) examining groups ability in forecasting for time series judgemental confidence intervals found that Armstrong (1985) assertions on the ineffectiveness of Delphi and generally group forecasting was in doubt. Nonetheless Sanders in a later study concluded that combining quantitative and judgemental forecasts results in more accurate forecasts than group forecasts (Sanders, 2017).

Delphi is most effective in situations where opinions are solicited from different and dispersed experts. For instance, in deciding where to locate a retail outlet would require forecasts from real estate, traffic, retailing, consumers, and the local area experts. Studies conducted which compares Delphi method to other traditional methods found that Delphi forecasts were more accurate than forecasts developed in traditional meetings in five studies, Delphi produced forecast were less accurate in one, and equivocal in two. Out of 16 studies, Delphi was more accurate than survey of expert opinions in 12 of the studies, with two ties and two cases in which Delphi was less accurate. Among 24 comparisons, Delphi improved accuracy in 71% and harmed it in 12% (Rowe and Wright 2001). For managers Delphi method is attractive because it is easily understood and comparatively cheaper because the experts do not need to meet. Since experts give reasons for the forecasts, Delphi has an advantage over prediction markets (Green, Armstrong, and Graefe 2007).

A key disadvantage of Delphi is when several forecasts need to be generated within a short period of time as commonly is the case in Fast-moving Consumer Goods industry (Arvan et al. 2019). The number of forecasters needed on the panel is also an issue making it an unappealing choice when forecasting for the short term particularly in product demand forecasting. It is however feasible forecasting option for new product forecasting in the context of product demand forecasting.

2.7.4 Market Research

Another judgmental forecasting technique is market research. Market research is a technique that uses surveys and interviews to determine customer likes, dislikes, and preferences, and to identify new product ideas. It uses this information to forecast what the customers want (Sanders, 2013). It can be an important tool to understand customers. Conducting market research, however, requires understanding of how to conduct reliable surveys. Therefore, companies usually hire an outside marketing firm to conduct a market research study. Market research can be a good determinant of customer preferences. However, it has a number of shortcomings. A common one is the potential inadequacy of the survey questionnaire design. For example, a market research firm may ask participants to identify a favorite hobby providing them with the following choices: gardening, fishing, cooking, or sports. The problem in this example is that the list is not exhaustive, as a participant may prefer music—an option not included. This questionnaire forces participants to select a category. As a result, the findings will incorrectly portray customer preferences and lead to misinterpretation of the market. Open-ended questions, on the other hand, are hard to score as there can be too much variation in responses. Even in today's digital age, companies continue to rely on online surveys to gather data about customer preferences and opinions. One key issue is getting a large response rate. In fact, surveys are so important that many companies offer various incentives for participation. The second key issue is the formulation of questions, which makes a large difference in the results and interpretation. A good survey instrument coupled with a large customer response rate can provide invaluable information.

2.7.5 Analogy Forecasting

Another judgmental approach to forecasting which is often useful in practice is forecasting by analogy. Analogies essentially are information about how people have

behaved in similar situations in the past. As noted by Goldfarb, Stekler, & David, (2005), the use of analogies is not a recent phenomenon since textbooks in the 1930s suggest its use then commonly for economic and business forecasting. Armstrong (2017) has also observed that, analogies in recent years has been applied to software development projects to overcome the problem of predicting the cost of such projects. Similarly, analogies have been found to provide useful information for situations that are relatively difficult to forecast such as forecasting decisions in conflict situations.

A typical example of analogy is the use of a property evaluation process to determine the price of a house particularly in the UK. A surveyor approximates the current market value of a house by benchmarking it against similar properties (in terms of land size, dwelling size, number of bedrooms and bathrooms, and garage space) sold in the area.

Inherently, forecasting by analogy presents challenges which make it expedient to base forecasts on multiple analogies which considers multiple attributes rather than on a single analogy. Effectively a systematic approach to forecasting by analogies such as the use of a detailed scoring system to rank the features is recommended.

2.7.6 Judgemental Bootstrapping

Judgemental bootstrapping is usually used to average the inconsistency that occurs when forecasters apply their knowledge. Simply put, judgemental bootstrapping attempts to work out and understand the how behind forecasts or adjustments (Arvan et al. 2019). This method regresses the forecasts of experts' which is referred to as dependent variable, against a variety of independent variables using the regression model. The independent variables generally are the cues that inform the judgement of forecasters (Goodwin, 2002). Franses (2011), established that when the outcome of the bootstrap model is combined with the Blattberg Hoch model it produces a forecast with better accuracy compared to combining with non-bootstrapped judgement. The bootstrap model works better when forecasting in predictable environments, however in a less predictable environment, it produces less consistent forecasts due to the complexity of series and excessive contextual information (Harvey, 2007; Seifert, Siemsen, Hadida, Eisingerich, 2015). In situations in which it is easy to forecast, more accurate and consistent forecasts are made by forecasters which improves the performance of the bootstrap model. Like other models, judgemental bootstrapping is also saddled with several limitations raising doubts on its efficiency (Lawrence and

O'Connor 1996). This method has been found to rely on large number of possible cues which may be unavailable in the model. It is also criticised for the assumption that the cues are independent whereas time series forecasting cues can be considerably auto-correlated (Lawrence and O'Connor 1996). Although initial studies concluded that bootstrapping method could outdo experts' forecasts, ideally since there will always be inconsistency in time series, forecast from experts rather outperform bootstrapping models (Bunn and Wright, 2003). Lastly, practitioners do not trust the bootstrapping method. More studies need to focus on the efficiency and effectiveness of bootstrapping especially in the demand forecasting context which needs more contextual information. Armstrong (2006) suggests that to overcome these limitations software can be produced to help people through this process. This means judgemental bootstrapping can be a function of an FSS which will produce significant guidance and support to the forecasters according to their performance.

The following section succinctly discusses structured judgement in forecasting.

2.7.7 Structured Judgement

As previously hinted, using expertise in forecasting is subject to limitation since it is usually elicited in an unstructured way (Fildes et al 2009). Green & Armstrong (2007) proposed however an alternative structured approach which comprises a panel of experts similar to the Delphi concept however forecasting is done by studying analogies. A structured approach to analogy forecasting may well aid experts to consider more information from the analogies, and to process it effectively.

Green & Armstrong, (2007) hypothesized that forecasts derived from an expert's structured analysis of analogies is likely to be more accurate than forecasts by experts who used unaided judgment. Armstrong (1985) contended that experts using unaided judgment make forecasts first, then seek out analogies to authenticate the forecast. They argued from evidence (research on judgmental decision making and forecasting) that, structured judgmental processes make more effective use of information possessed by people. Additional, Armstrong (1985) maintained that analogies will only increase accuracy of forecasts where an unbiassed process is used for their identification and analysis.

In a study by McIntyre, Achabal, and Shepperd and Schofield (1997) which compared forecasts from analogies with forecasts from models estimated using stepwise

regression they found the analogies forecasts were more accurate for all nine data sets they used on the basis of mean absolute percentage errors (MAPEs). Angelis and Stamelos (2000) employing similar processes to Shepperd and Schofield (1997), observed that analogies forecasts were fairly more accurate for one data set but significantly less accurate for a second data set; concluding that where there are sufficient data and strong relationships, regression models are likely to surpass analogy methods.

2.7.8 Structured Analogies process

To increase accuracy of forecasts, structured analogies may be employed as explained by prior studies. Structured analogies may also be used to complement forecasts produced using econometric models. Armstrong (2009) shows how analogies might be structured effectively and the conditions under which their use will be most beneficial. Owing to the unavailability of prior evidence in the literature on the process of structured analogy forecasting, Green and Armstrong (2007) propounded their own simple procedure. This process involves experts identifying analogies and the implication of the outcomes for the target, then assess how the analogies are similar to the target in a structured way. Below list Green and Armstrong (2007) five step structured analogies procedure

The administrator

(1) Describes the target situation, and

(2) Selects experts; the experts each

(3) Identify and describe analogies, and

(4) Rate similarity; the administrator

(5) Derives forecasts.

2.7.9 Judgmental (point) forecasting without domain knowledge

Certainly, judgement without domain knowledge is a useful basis to compare judgemental forecasting with statistical methods. To fairly compare the two methods according to (Sanders and Ritzman 2001), it is prudent to restrict both methods to the same data set restricting the judgmental forecaster from domain knowledge. This is, an unlikely situation in practice as a judgmental forecaster will almost always have some information about the value to be forecasted in addition to the time series values (Lawerence et al, 2006).

2.7.10 Super Forecasting

Judgmental forecasting approaches have been criticised for being prone to the forecaster's inherent biases (Makridakis et al, 1998) among other weakness even though other studies clearly highlight the relative effectiveness of judgement (Lawerence et al 2006). Intuitive predictions (probabilistic and nonprobabilistic) have been shown from previous studies to be worse than statistical predictions and even chance sometimes (Dawes, Faust, & Meehl, 1989). Super-forecasting one of the recent concepts of judgmental forecasting research approaches is the seminal work of Mellers et al (2015), through a rigorous forecasting experiment (the Good Judgment Project) they trained and tracked the forecasting performance of volunteers providing evidence of the features of better forecasting behaviours. For the experiment, forecasters were stratified into groups based on performance. It was concluded from the multiple years experiment that some class of forecasters due to their superior ability to accurately forecast can be referred as super forecasters however rare, regardless of this ability of some forecasters, training can make people better predictors of the future. Super forecasters due to their knowledge and level of sensitivity are superior in translating complex qualitative causal judgments into probability judgments (Meller et al 2015). Katsagounos et al (2021) observed that identifying super forecasters requires a rather big initial pool of experts and takes considerable time making it expensive if companies were to rely on super forecasters since there are only a handful globally. These limitations according to Katsagounos et al (2021) makes the application of this approach impracticable however exciting it may seem. Others also believe labelling high performing forecasters super can make them overconfident or egotistical.

Mellers et al (2015) trying to explain that factors influencing super forecasters performance highlights motivation and commitment, task-specific skills, cognitive abilities and enriched environments. Teamwork and an engaging environment as well as superior statistical methods used bolster super forecasting (Tetlock et al., 2014).

Super forecasters according to Tetlock and Gardiner (2015) have the ability to admit when mistakes occur or when new information is available and amend forecast accordingly, claiming that normal forecasters hardly admit mistakes especially when they are adjudged expert forecasters. Those they classify as hedgehogs are forecasters who are unwilling to shift their beliefs upon which their forecasts are based, in contrast to the foxes (super forecasters), they endeavour to be open to a variety of

possible explanations until one provides tremendous evidence. Super forecasters frequently update their beliefs than all others treating their belief as “testable propositions and not sacred possessions to be defended at all times (Fiske & Tetlock, 1997, Meller et al 2015). This view informed Telock and Gardiner (2015) definition of forecasts as “evolving judgments based on available information and that should be updated in light of changing information.”

The super forecasting experiment revealed that short training can help identify super forecasters (Tetlock & Gardner, 2015). This was tested when the first-year forecasters working collaboratively received cognitive-debiasing training and they performed better (Mellers & Tetlock, 2015). Training generally is intended for learning. Some are of the view skills are learned and not inborn (Dweck 2006). Mellers & Tetlock, (2015) confirmed that super forecasters pattern of behaviour indicates that forecasting skill can be developed through deliberate preparation, though others are of the opinion that saying this simply put super forecasters into a category of diligent workers and that anyone who is diligent, and practice carefully as super forecasters can be one. Meller and Tetlock (2015) experiment however provides that super forecasters are different from other forecasters in many other ways. Some other trainings are given on basic statistics and probabilistic reasoning and introductory Bayesian analysis (Chang et al., 2016; Dhami et al, 2015).

A recent study by Katsagounos et al (2021) using a relatively smaller sample to identify some attributes and skills of top forecasters found that men consistently receive higher scores than women, consistent with Frederick (2005) findings on cognitive abilities. Cognitive ability has been found correlate positively with forecasting (Mellers et al 2015).

In a nutshell, super forecasting involves thinking probabilistically since as (Muller et al 2015) suggest people generally are poor in probabilistic predictions of future events. super forecasters are partly discovered and partly created. They have an aptitude for judging future events. Also, super forecasters can be created through specialized training.

2.7.11 Challenges in applying Judgemental Forecasting Methods

Makridakis and Wheelwright (1989) identified three major problems with judgemental forecasting namely the quest for supporting evidence: overconfidence in result and

overconfirmity among group members. The quest for supporting evidence implies that decision makers collect information not to disprove their stance but to support their views. As information increases, predictive ability does not improve in a judgemental setting rather the additional information provides overconfidence. High cohesiveness, strong leadership and insulation of the group can influence the quality of decision making. This may be a non-deliberate suppression of opposing opinions and an unconscious attempt to avoid scrutiny. Salespeople by their proximity to customers are presumed to have first-hand access to customer information and a crucial part of the forecasting process. Nevertheless, as indicated by Byrne, Moon and Mentzer (2011) judgemental forecasts provided by salespeople, are prone to bias and inefficiency. This is explained by the conflict between the roles of selling and forecasting; salesperson may underestimate future sales since sales quotas are typically defined by forecasts (Davis & Mentzer, 2007).

2.7.12 Summary of Judgemental Forecasting Methods

Armstrong and Green (2005) suggest that the stage at which a product has reached in its life cycle is crucial for determining the choice of a forecasting method to estimate customer demand for the product. As a product progresses from the phase of conception through to modelling, market testing, introduction, growth, maturity, and decline stages, the comparative value of the alternative forecasting methods changes (Armstrong and Green 2005). Generally new product forecasts are based on surveys of consumers' intentions and expectations albeit complicated since potential customers may not be sufficiently familiar with the new product. However, a good product description with prototypes and or visual aids, may improve forecasts (Armstrong, Morwitz, & Kumar 2000). Errors in the description however unintended can be fatal and affect demand considerably where forecast proceeded based on the error description. Typically, at the conception phase expert opinions are extensively utilised; for example, the opinions of sales department can provide forecasts based on their expertise. The Delphi method like expert opinions is also useful for conducting intention surveys for short-term forecasts. Rather than ask potential customers about their purchasing intentions, experts may be asked to predict the responses of consumers. Distributors or marketing executives could also be asked to make forecasts. In spite of the advantages of these methods, there are also inherent problems; experts may be subject to biases when forecasting for new

products (Tyebjee 1987) therefore efforts must be made to avoid experts with obvious biases. Sales force may under forecast especially where the forecasts will be the source for setting quotas. On the contrary, marketing executives may forecast high to motivate salespersons or base on the assumptions that high forecast are more likely to gain approval for the project. It is important to have a heterogeneous expert group to offset the differing biases. Conjoint analysis is also a widely used method for forecasting new product demand. It can however be expensive since it large samples of prospective customers are required, who may be difficult to locate. Usually, the survey questions are difficult for respondents to complete.

Armstrong and Green (2005) conclude that it is better to use structured processes such as Delphi, conjoint analysis, structured analogies, and simulated interaction when using judgment.

2.8 Quantitative Forecasting

According to Moon (2018), the general idea of quantitative or statistical forecasting is to review or examine demand history, to identify and document patterns of demand for insights (periods of spike or dip in demand). Although both quantitative and qualitative methods operate based on the principles of identifying existing patterns and relationships, the actual difference between them rests on the how information is detained, prepared, and processed, the real test of any forecasting method or process (Sanders, 2017). For quantitative methods, the difficulty lies with forecasting changes to specific pattern or relationship, the timing of the change and the magnitude of the change; and not predicting or forecasting the continuation of established pattern or relationship (Chase Jr 2013). Quantitative methods depend on systems to retrieve, store, and coordinate information (data). Mathematical equations are then used to identify and model the patterns and relationships. Judgmental methods rely on human memory to identify and store information (Chase Jr 2013) and apply intuitive feelings to predict changes in the patterns and relationships. There various Quantitative Methods and the next session discuss a few of them.

2.8.1 Extrapolative methods

Extrapolative methods look at a series of past values without considering external factors to predict the future. This is commonly used when there is little information about causal relationships or when causal variables cannot be controlled. It is also utilised when several forecasts are needed for shorter time horizons such as for

production and inventory planning for hundreds and thousands of product lines due to it cost effectiveness (Armstrong and Green, 2017). Extrapolations are cost effective when many forecasts are needed, such as the demand for each of hundreds of inventory items.

There are many kinds of extrapolative methods, and these include:

- Past average,
- Simple Moving average,
- Weighted moving average and
- Exponential smoothing.

The most widely used extrapolation method is exponential smoothing.

Exponential smoothing

Exponential smoothing according to Arenas (2021) is one of the pillars in business forecasting. It is also known as Exponentially Weighted Moving Average (Harvey, 1990). this refers to methods that provide forecasts using weighted averages of the past values of a data set and forecast error. Simple exponential smoothing (SES) has been found to be more suited for none-trend or seasonal patterns. This category of methods generates forecasts with a simple formula which takes into consideration the trend and seasonality of data. The suitability of the method largely depends on the components that appear in the time series. The concept of exponential smoothing depends on the weighted average of past observations, where that weight decreases exponential as one moves away from the present observations (Arenas 2021). Exponential smoothing is popularly used in inventory management and sales forecasting. Exponential smoothing is also described as a moving average of time-series data in which recent data are weighted more heavily (Armstrong and Green, 2017). They are generally considered to produce consistent post-sample forecasts (Ferbar Tratar 2015). This method is easy to understand, inexpensive, and relatively accurate. Where the data to be extrapolated is less than annual frequency, it is recommended to remove the effects of seasonal influences. Seasonal adjustments of the data lead to substantial gains in accuracy in a study of time series forecasting (Makridakis, et al. 1984).

Zhao and Lee (1993) studies of HW method and the double exponential smoothing method; found the HW method to have higher total cost compared the exponential

smoothing method though it produces lower bias and standard deviation of forecasting error. The high total cost involved as necessitated research on new forecasting approaches dealing with demand aggregation and the 'how' of using combined forecasts, especially where there is intermittent demand, seasonal demand (Chen and Boylan, 2007; Viswanathan et al., 2008).

2.8.2 Causal Methods

Causal methods (extrinsic or explanatory) another quantitative method makes predictions based on external indicators (Armstrong and Green, 2017). This method is underpinned by the assumption that demand for a product group is directly linked to activity in another field (Arnold et al., 2008). The forecast produced using this method will depend on another forecast. The test however is to find an indicator that compares with demand and one that perfectly leads demand i.e., occurs before demand. Causal methods are most useful in forecasting the total demand for an organisation's products or the demand for families of products. As such, it is used most often in business and production planning rather than the forecasting of individual end items (Arnold et al., 2008).

According to Graefe, Armstrong and Green (2014) causal models are valuable for forecasting as they can assist policies and decisions; it is also used to forecast the effects of different policies. Causal models are most useful when:

(1) Strong causal relationships exist,
(2) The directions of the relationships are known,
(3) Large changes in the causal variables are expected over the forecast horizon, and
(4) The causal variables can be accurately forecast or controlled, especially with respect to their direction.

Where large changes are expected, causal model forecasts are more accurate than forecasts resulting from extrapolating the dependent variable (Armstrong 1985; Allen and Fildes, 2001). Some of the causal models include regression analysis, segmentation, and the Index method.

2.8.3 Time series method

Time series methods, also known as intrinsic or extrapolation methods/techniques, use historical data to forecast. Thus, what happened in the past will happen in the

future. This model assumes that some pattern or combination of patterns is recurring over time. Two factors are important in a time series model thus the data series to be forecast and the period of time to be used (Makridakis and wheelwright, 1989). Data is readily available since they are usually recorded in the company. This technique makes no attempt to discover the factors affecting the behaviour of the system. The system is viewed as an unknown generating process. Time-series techniques vary from simple to complex. The simple techniques include moving averages and simple exponential smoothing. The simplest technique uses sales history as a basis for forecast. This technique is typically named the *naïve* forecast. Other More complex techniques use more complicated formulas with more variables, concerning trend and seasonality in demand. There are at least 70 different time-series techniques available (Mentzer & Moon, 2005). Demand prediction and forecasting using time series entails using historical data of the previous events to achieve an estimation of the future demand (Marmier and Cheikhrouhou 2010).

2.9 Statistical Forecasting Verses Judgemental Forecasts

This section compares statistical forecasting with judgemental forecasting. Early comparisons of judgmental forecasting with statistical methods utilised predominately artificial data resulting in varied conclusions about the relative accuracy of both statistical forecasting and judgemental forecasting (Adam & Ebert, 1976; Eggleton, 1982; Lawrence, 1983) cited in Lawerence et al (2006). Lawrence, Edmundson and O'Connor (1985) were arguably the first authors to compare the accuracy of judgmental forecasting and quantitative model forecasting on a large-scale using real life data. They compared the accuracy of a majority of the available forecasting models on a set of 1001 real-life time series. They concluded by demonstrating that judgmental extrapolative forecasting is less accurate compared to statistical techniques.

According to Makridakis (1981), statistical forecasting is based on a misleading assumption of constancy where "patterns and/or relationships, or structural stability in the data, is either ignored outright, brushed aside as unimportant, overlooked as useless, or at least is not made explicit" leading to unfulfilled expectations. Alluding to the assumption of constancy may sufficiently define data from physical, natural, and most engineering related applications, but fails to capture business and economic data

which is intrinsically unstable and continuously changing. Consequently, successful hard sciences approaches cannot be automatically transferred to social sciences. Where changes occur, statistical forecasting cannot deal with this situation because the assumption of constancy will be defeated. The errors that may result due to the changes will not follow previous patterns as is necessary for statistical forecasting.

The existing literature suggests that in practice, quantitative methods mostly deliver better forecast accuracy than judgemental methods (Sanders & Manrodt, 2003, Mentzer & Moon, 2005). Makridakis and wheelwright (1989) stated that “unaided, subjective judgements clearly are not as accurate and effective as more systematic, explicit approaches to forecasting”. This conclusion can be supported by the fact that quantitative forecasting methods are more commonly applied to predictable demand. There are quite a few empirical evidence which suggest that where predictive accuracy is the issue, statistical models are superior to human Judgement. Petropoulos et al (2010) in their study examining the comparative forecasting performance of alternative statistical and judgmental approaches for Apple iPhone concluded that statistical extrapolations are more accurate and less biased than judgment. They reported that on average, statistical approaches were more accurate and less biased than judgmental methods and produce greater forecasts. Hogarth and Makridakis (1981), also warns against judgemental forecasting concluding after a review of over 175 papers concerned with forecasting and planning that quantitative model outperform judgmental forecasts.

Irrespective of the reported superiority of quantitative models, it is suggested that for statistical forecasting to be relevant and applicable for business and economic benefits some vital changes need to be made and central to these changes is the fact that data should not be structurally stable. Also, forecasting accuracy should mainly concern future predictions, thus the model should fit current data instead of past occurrence. Additionally, simple accuracy criterion should not be the only judge of forecasting but its ability to improve decision making within organizations. Makridakis and wheelwright (1989) conceded that quantitative technique has no simple and reliable way to predict the future when established patterns or relationships change since quantitative methods base forecasts on extrapolation.

In spite of the emphasis placed on quantitative methods in the existing literature, qualitative forecasting methods have been found to be the preference of practitioners. In the words of Lawrence et al (2006) “The forecasting practitioner has never shared the scepticism of the researcher towards judgement”. Chase Jr (2013) suggested that when quantitative methods fail to produce adequate accurate forecast, structured judgment methods are the next best alternative methods to predict changes in patterns and/or interrelationships. Using judgmental methods however requires the observation and knowledge of market dynamics or trends and an understanding of the magnitude of marketplace changes. It is generally agreed amongst commentators that the choice of method- either qualitative or quantitative methods depend on the circumstances, alluding to a combination of judgemental and quantitative methods when necessary. Judgemental methods can be applied by individuals or group of persons in a consensus process to gain agreement. Larger organisation which typically use quantitative methods in the majority of case conduct adjustments (overrides) using judgment (Chase Jr 2013). To make a fair evaluation, comparison of different methods should be in specific contexts. The comparison must reflect all the relevant dimensions of performance.

A survey by Sanders and Manrodt (2003) concluded that preference for judgemental methods by companies is due to certain organisational characteristics such as lack of relevant quantitative data, environmental uncertainty, and variability of associated data. Also, qualitative information is judged to be more valuable than the available demand history. Judgemental methods are relatively low in cost to develop, they do not need expensive computer hardware/software. Executives usually have a strong understanding of the factors that affect sales demand and how; also, demand forecasts can be produced reasonably quickly (Chase Jr 2013).

On the other hand, Lawrence et al., (2000) in their study showed that judgemental forecasts are not uniformly better than naïve forecasts. Arkes (2001) submitted that literature on forecasting typically communicate overconfidence in judgemental forecasting suggesting that overconfidence should be consciously reduced. Conversely, Chase Jr (2013) argues that judgmental methods unlike quantitative

methods are not robust in sensing and predicting trend, cyclical elements and seasonality, especially across thousands of products in an organisation even when there is sufficient data exist and there is established patterns.

Judgmental methods tend to be biased toward the developers of the forecast. Their consistent accuracy weans over time due to the amount subjectivity in their development. In situations where executives decide, their knowledge may be limited with no understanding of the organisation's sales situation since they are too far removed from the actual marketplace. Finally, judgmental methods are generally not well suited for firms with a large number of products or stock-keeping units. In these situations, the scope of the forecasting task is simply too large. Judgement has also been characterised as relating to large errors and systematic biases; with the tendency to see patterns where none exist and unfounded confidence in its correctness (Lawerence et al, 2006). However, as pointed out by Lawerence et al (2006) none of the cited studies included judgement applied to time series forecasting with serially correlated cues. Majority as indicated by Lawerence et al, 2006) were psychological laboratory experiments which used general knowledge or serially uncorrelated cues.

2.10 Integrating forecasting methods

The available literature provides strong empirical evidence of the superiority of combining statistical and/or judgmental methods relative to forecasting performance (Makridakis et al., 1982; Makridakis & Winkler, 1983; Clement, 1989; Surowiecki, 2005). The empirical studies advocating for integration of methods can be categorised into three, firstly the modifying historical data series to account for knowledge of the contextual information. Next, forecast which may be based on the outcomes of mathematical approaches and finally adjusting forecasts in anticipation of the impact of likely events (Webby et al. 2005).

Integrating statistical and judgemental forecasts generally improves the accuracy of forecasts when the experts have domain knowledge and when significant trends are involved (Webby & O'Connor, 1996). One of the highly suggested methods for reaping the benefits of both judgemental and quantitative methods is the combination of

system forecasts and expert opinion Arvan et al. (2019). It has been argued that for forecasters to benefit from the strengths of both time series and judgemental methods, these methods should be blended. Bunn and Wright (1991) suggested a methodology known as the model building approach which values judgment in the selection and development of the quantitative forecast. According to (Fildes and Goodwin 2007), this approach is pragmatic as it integrates the personal analysis of domain information that may influence the forecasts.

Likewise (Arvan et al. 2019) uses the term combination of forecasts to describe combining judgemental with quantitative forecasts as opposed to combining two quantitative methods or combining forecasts of different persons as widely implied in the existing literature.

A number of methods have been suggested for such combination. The initial method known as Blattberg-Hoch which basically allocates equal weights to the model and judgement was established by Blattberg and Hoch, (Blattberg and Hoch, 1990). This method is more likely to result in a more accurate forecast (Webby R, O'Connor, 1996; Lim and O'Connor, 1995). To examine how effective Blattberg-Hoch method was, Franses (2011) using the bootstrapping technique concluded that the replicable part is more accurate when Blattberg-Hoch method is used compared to other approaches such as quantitative method, an expert's forecast, or a combination with uneven weights. Nevertheless, Alvarado-Valencia et al (2017) recently found when forecasters with higher expertise apply adjustments to forecasts, they tend to be more accurate than Blattberg-Hoch approach confirming what previous studies concluded upon thus, an individual's characteristics and the context influence judgement (Moritz, Siemsen, and Kremer 2014).

There are other methods that use human judgement to determine the weights allocated to each model and judgement (Harvey and Harries, 2004; Lawrence and Edmundson, 1986). Goodwin (2000) comparing three dissimilar combination methods from a laboratory experiment concluded that when the biases of judgements have been rectified, combining forecasts will not add any value to the forecasting process. Based on this finding, Sanders and Ritzman (2004) proposed the following criteria to justify integrating two forecasts. Firstly, the two forecasts should not be dependent; secondly, the correlation of forecasts errors for the pair must be low.

Combination forecasts like judgemental adjustments will not improve forecasts if experts do not have any information advantage over the model (Gupta, 1994). Contextual knowledge is more significant than technical knowledge when combining forecasts. Additionally, contextual information is more relevant when the time series are unstable (Sanders and Ritzman, 1995). Some examples of contextual information are weather and seasonality; purchasing challenges, labour issues; competitors' actions; marketing plans; strikes; impending promotional activities; this information can dramatically change an experts' judgement (Arvan et al. 2019). The advantages of as reported by Sanders and Ritzmann (2004) includes allowing the judgment to rapidly incorporate the latest updated information and time reduction.

Another approach of integration submitted in the existing literature is the judgemental decomposition (Marmier and Cheikhrouhou 2010). This approach entails identifying and evaluating the effects of past contextual information in time series then establish statistical forecasts (Marmier and Cheikhrouhou 2010). The approach is considered is more complex than combination or adjustment methods but useful for bringing structure when integrating judgement into forecasting unlike judgemental adjustment which is criticised due its informal nature (Bunn and Wright 1991).

2.11 Software in Demand Forecasting

Forecasting software has revolutionised forecasting; the use of these computer software programmes has extended in practice especially free open-source software which are accessible at no installation or usage cost to users; and has a community of maintainers and users ready to provide support (Rostami-Tabar and Boylan 2021). New development in information technology permits forecasters to utilise existing software in carrying out their forecasting processes, with computer forecasting programs which enables users to make use of complex algorithms (Tashman and Leach, 1991; Sanders and Manrodt, 2003). The use of these computer software programmes has also extended in practice, thus, motivating researchers to test the level of satisfaction (Hoover, 1999; Tashman and Gros, 2001). According to (Hyndman et al., 2020) the R package is a commonly used open-source forecasting software, and Python is the programming language used in creating open-source forecasting

software which for statistical forecasting (Seabold and Perktold, 2010). Forecasting software aims to increase accuracy of the forecasts and support the users' confidence of the produced forecasts.

In spite of the recent advancement in technology and the accessibility of a wide variety of computer software programmes offering several technical innovations, most businesses still depend on judgmental forecasts (Lawrence et al., 2006). It could be as mentioned earlier in the literature review, in practice, (people within industry) judgemental methods are preferred over quantitative forecasting techniques. Software routinely classifies demand patterns randomly, selecting the process for estimation and the method for controlling stock in order to forecast for requirements for the future and manage stock cost-effectively. For example, certain arbitrary cut off values may be given to the number of demands occurring periods in a year, average demand per unit time period and standard deviation of the demand sizes in order to define demand patterns as slow, intermittent, lumpy and fast. According to Muscatello (2009), an experienced forecaster in a major chemical company, he mentions categorically that the expectations using computer forecasting programs is to provide more security in terms of forecasting accuracy, however, these programs failed to improve the accuracy of the forecasts for certain product lines when compared to judgmental models. In practice, judgmental forecasting involves the use of historical data and contextual or domain knowledge that would include promotion plans, competitor intelligence and macro-economic situation. In their research, Sanders and Manrodt (2003) surveyed 240 US firms regarding the use of the forecasting software and the level of satisfaction, where they found that "many corporate analysts continue to use spreadsheets as their primary analysis tool and avoid forecasting software because they fear it would take too long to master".
The under-developed Management Information System (MIS) will result in a gradual adoption of quantitative forecasting techniques, which will lead forecasters or decision makers to depend more on informal information, invariably increasing the occurrence of forecasting errors (Fildes and Hasting, 1994).

Sanders (2015) submits that, a forecaster need access to at least one forecasting package but admits that with the many packages available- packages offering an array of capabilities to specialized, industry specific, in-depth packages- choosing a suitable

package can be a daunting task. The choice will however depend on the needs of the user, the quality of the output, the forecasting other factors the user may deem fit. Excel is widely used in organisations due to it forecasting functions, but they are not designed for exploratory data analysis or statistical analysis (Sanders, 2015). Sanders (2015) suggests that when choosing any software package, it is important to consider the below

Capability – consider available methods in the package, find out if allows managerial overrides and can be in automated mode.

Relevance to the Industry - the popularity of the package in the industry. How it interfaces with existing IT systems and Enterprise Resource Planning systems (ERP) (Rostami-Tabar and Boylan 2021).

Cost - the relative cost of the package compared to similar packages.

Scalability if it allows “add-ons” as the business expands and if it allows connectivity to other regions and different businesses.

Customer support – after sale support and training with forecasters and demand Planners.

The next section looks at forecasting and the Ghana manufacturing pharmaceutical industry. It starts with overview of the industry and continues with the application of forecasting.

2.12 Summary of Forecasting Techniques

Many discussions have centred on the superiority of qualitative and quantitative forecasting methods (e.g., Armstrong 2001, Makridakis, 1981), however the conclusion reached in these arguments is that the performance of a method depends on the circumstances (e.g., Lawrence et al., 2006). Armstrong and Green (2005) submit that structured methods should generally be used to avoid data mining, intuition, focus groups and unstructured meetings. They opine that where enough data is available, quantitative methods such as extrapolation, causal methods quantitative analogies or rule-based forecasting should be used. Where there is insufficient data, they advocate for the use of structured judgement including surveys of intentions and expectations, judgmental bootstrapping, structured analogies, and simulated interaction. When using statistical forecasts, managers' domain knowledge should be incorporated into them. Methods which combine forecasts such as Delphi are known

to improve accuracy. Before producing forecasts, it is important to decide their use through scenarios. An argument put forward is that theory should be the basis for developing methods and not data. Finally, forecasts must be free from organisational politics but rather an emphasis on achieving agreement on the forecasting methods.

2.13 Barriers to Forecasting

Forecasting can be very beneficial to an organisation but there are potential barriers to these benefits. A plethora of studies have explored the challenges to implementing forecasting methods/process. Makridakis (2021) advises acknowledging the benefits and limitations of any systematic forecasting method to avoid the hyperbole of what it can achieve, arguing that forecasting methods are only an extrapolation of established patterns and relationships to make future prediction. The barriers to forecasting according to Boylan and Syntetos (2017), are typically associated with cultural issues and suggested the presence of an effective change agent as the most significant element in breaking down such barriers. Davis and Mentzer (2007), in their study highlighted the importance of the "forecasting climate" which is also linked to the organisations forecasting capability. The "forecasting climate" according to Davis and Mentzer (2007), includes leadership support, credibility of sales forecasting and reward alignment. They further posit that negative forecasting is detrimental to forecasting capability. Despite all the efforts, research has shown that evidence indicates that lack of resources, expertise, and high costs hinder the widespread implementation of such methods and support systems in practice (Hughes, 2001).

Hughes, (2001) investigating the reasons the manufacturing sector and financial services sector in Scotland do not use forecasting techniques cited insufficient time due to other work; insufficient resources; limited historical database; insufficient training and lack of computer resources/skills as the reasons. These challenges are highlighted in the table 2.3 below.

Table 2.3 Forecasting Challenges

Barrier	% of respondents
Insufficient time due to other work	**41%**
Insufficient resources	**28%**
Limited historical database	**24%**
Insufficient training	**23%**
Lack of computer resources/skills	**20%**

Source: *Adapted from Hughes, (2001)*

Byrne et al (2011) also found a lack of feedback to forecasters and resistance from the salespeople concerning their forecasting responsibilities in almost all the 33 companies studied as the barriers to forecasting.

Moon (2018) in a publication hinted that in researching for over two decades in dozens of companies, the three major barriers to forecast process are: wrong culture, perception of system as the solution and Management. These are further elucidated below:

Wrong Culture

In most organisations forecasting is perceived to be bound to one functional area, with the sales function worlds apart from the operations function. The corporate attitudes exhibited clearly shows misplaced strategies and a lack of understanding about how demand forecasting drives the supply chain, Mello (2005). The culture is devoid of teamwork and consensus resulting in ineffective forecasting. To this barrier to effective forecasting process Moon (2006) suggested training for both the demand and supply sides of the organization to overcome cultural differences. He further suggested the use of performance measurement and reward strategies to mitigate the wrong organisational culture. Forecast-accuracy metrics may be inculcated into performance evaluation. The “wrong culture” barrier can be overcome by setting the forecast function within an integrated demand-supply process. Communication should be formalised to enable “demand side” to communicate its demand forecast and the “supply side” its capacity constraints.

The perception of system as the solution.

Moon (2018) notes that there is a wrong perception that technology investment will automatically make forecast accurate. He observed that many organizations invest in technology solutions without first trying to understand the forecasting process. To overcome the “system is the solution” barrier, Moon (2018) proposed an audit to comprehend the strengths and weaknesses of the overall forecasting process, tackling issues such as functional integration, culture, and performance measurement and narrow focus on technology.

Management

Lack of understanding by management and executives in some organizations on the importance of demand forecasting is a barrier to the forecasting process. Senior managers may not embrace the notions that the organisation requires effective prediction of future customer demand. To mitigate this problem (Byrne, Moon and Mentzer 2011.) concluded in their study the need for an effective forecasting champion who can appreciate the importance of gaining support from senior management. Mentzer (1999) proposed showing management how forecasting can influence the businesses return on shareholder investment, reduce inventory, carrying costs and reduce shipping costs.

In conclusion, when forecasting is bound to one functional area in an organisation its acceptance as the blueprint for the whole organisation becomes an issue and may further affect the accuracy of the forecast. Forecasts need the necessary organisational clout and adequate resources to achieve the desired result. Forecasting barriers are normally associated with cultural issues. These barriers can be overcome by a forecasting champion as proposed by Canitz (2016) is the most important element in breaking down such barriers. This champion must be someone who can engage senior executives, provide the needed resources, and has the ability to integrate and gain acceptance from the various functional areas.

The next section looks at Ghana Pharmaceutical industry and forecasting in the pharmaceutical industry in general

2.14 Ghana Pharmaceutical industry

The Ghana pharmaceutical industry dates back to the late fifties during the industrialization period as the basis for its economic development. The industry consists of pharmaceutical manufacturing, packaging and dispensing companies and various consumer benefit schemes including insurance products (Rentmeester & Garis, 2008). The industry is made up of drug producers, wholesalers, distributors, retailers and consumers. In 2019 the size of Ghana's Pharmaceutical market was estimated to be $586million and was expected to grow to $616 in 2020 at a growth rate of 5.3% though the economic disruptions due to Covid19 may make this but a dream (Ghana Pharma Market & regulatory report, 2020). The current market size confirms a consistent growth in the industry since in 2008 it was estimated at US$300 million (Seiter and Gyansa-Lutterodt 2019). This growth can be attributed to the rollout of the national health insurance which provides universal healthcare system which has since an increase in spending on pharmaceuticals and healthcare (Ghana Pharma Market & regulatory report, 2020). Scarcity of medicines has the potential to inflate the already high prices of medicines in Ghana.

The government of Ghana serves as a regulator of the pharmaceutical sector and is also a buyer directly involved in the wholesale and supply of drugs and healthcare services. As of 2019, there were 30 registered members of the Pharmaceutical Manufacturers Association including those engaged in importation and wholesale. These are all owned by Ghanaian entrepreneurs and are all classified as SMEs according to the Pharmaceutical Manufacturing Association of Ghana (PMAG 2019). Some of these manufacturers are classified as manufacturing wholesalers as they have both backward and forward linkages in the pharmaceutical manufacturing industry. The domestic drug manufacturers mostly produce generic antiretroviral, malarial and OTC medicines.

Seiter and Gyansa-Lutterodt (2009) report that the total number of businesses involved in active drug import and distribution is between 200 and 300. The sector has become increasingly attractive for both wholesale and retail suppliers owing to the reasonably high economic growth over the last two decades. Local producers account for about 30% of market share with the remaining 70% share supplied mainly by Indian and Chinese pharmaceutical firms (Buabeng, 2010; Seiter and Gyansa-Lutterodt, 2009).

In practice a retail pharmacy in a small-local area can act as a wholesaler for the other local chemical sellers or local clinics and hospitals (Seiter and Gyansa-Lutterodt, 2009).

From an economic diagnostic perspective, the pharmaceutical wholesale market in Ghana has a monopolistic competitive market structure on the supply side; thus, the market is characterised by many sellers who distinguish themselves from each other through branding and selective advertising.

Concerns about pharmaceutical businesses providing relatively cheap and effective drugs to the mass population led to several government and/or private sector interventions and initiatives in the pharmaceutical sector of Ghana. A recent initiative by the Government of the United Kingdom was the Medicine Transparency Alliance (MeTA); a multi-stakeholder organization focused on increasing transparency in terms of the selection, regulation, procurement, distribution and sale of medicines in the developing world. MeTA, was launched as a pilot project in seven countries including Ghana. The Ghana pilot programme ran from September 2008 to October 2010. To sustain the industry, all raw materials and packaging materials for the local production of pharmaceuticals are exempted from payment of customs duty and environmental tax on all plastic packaging materials. Locally produced pharmaceuticals are zero rated under the Value Added Tax (VAT) taxation system (PMAG, 2019)

Economic Community of West African States (Ecowas) cited Ghana as currently having the best quality of locally produced pharmaceuticals due to the stringent criteria, inspection and enforcement procedures of the Ghana food and drugs board (PMAG, 2019).

2.14.1 The strengths of the industry

The pharmaceutical industry in Ghana is adjudged as one of the most attractive markets in West Africa. The significance of the industry to the economic policy of the government means it receives support from government through initiatives of the NBSSI the institution set up by government to oversee the promotion and development of SMEs in Ghana. It also supports through government policies and interventions such as making funding available to selected domestic pharmaceutical

companies to invest in infrastructure to upgrade their production standards towards international standards. The NHI scheme makes the ministry of health the major customer of the industry and through price containment policies encourages procuring local generic drugs as a substitute to foreign, branded alternatives, this put the ministry at an advantageous position to drive price.
The market is however very dependent on imports and is mainly produces branded Generics

Domestic manufacturers seem to be moving towards attaining certification from GMP and WHO qualification. It is projected that; the evolving demography of the populace will potentially increase the revenue generating opportunities for pharmaceutical companies.

As with most emerging African countries, Ghana has a negative trade balance. According to the Ghanaian health service, only 30% of the national requirements of pharmaceutical products are produced in Ghana, while the remaining 70% are imported. However, the Ghanaian government has emphasized the need to manufacture more locally produced medicines over the next decade, an ambition it shares with many African governments. Ghana's pharmaceutical trade performance is relatively erratic. Although it's few key local drug makers are known to produce essential medicines for local demand and exports.

2.15 Forecasting in the Pharmaceutical industry

Johnson (2005) opined that "*forecasting in the pharmaceutical industry could be done much better"* implying that the pharmaceutical industry is awash with forecasting challenges.

Generally, forecasts may be produced at a global, regional, country, or business unit level and the supply chain to ensure availability of medical supplies, avoid excessive inventory. Accurate demand forecasting in any health supply chain is crucial to prevent the loss of lives (Baicker et al., 2012). Within the pharmaceutical industry, it the practice to produce a single 10-year forecast when the product is being introduced to the global market, then as market conditions evolve, 1–5-year-ahead forecasts are continuously produced. Judy Cooke the head of Business Intelligence at Janssen has

shown that in the UK local level, forecasts are generally produced 3–5 years ahead. Some of the common forecasting methods for clinical decision making comprise time series, regression, classification tree, neural networks, Markov models and Bayesian networks (Rostami-Tabar, 2021). For drug utilisation and expenditures methods such Neural Network models, classical exponential smoothing, regression and ARIMA have been applied to estimate the (Dolgin, 2010; Linn´er et al., 2020). Forecasting in the pharmaceutical industry and the wider health care system is also useful for predicting policy and management.

Typically, two classifications of drugs tend to be available in any given markets which are namely branded drugs (prescription) and generic (over the counter) drugs. Although these different types are normally owned by competing companies, it is not uncommon for both types to be owned by the same pharmaceutical company.
A branded drug is commonly protected by a patent that averts the introduction of cheaper alternatives until the patent has expired (Nikolopoulos et al 2016). A patent is granted at the initial stage of a molecule being developed lasting approximately 20 years. This means that the drug is protected through the preclinical and clinical trials, the approval process, and finally the introduction to the market. The introduction may ensue 10–15 years after the initial development; thus, the drug is protected in the marketplace for only a limited amount of time.

Generic drugs are however able to enter the market swiftly upon the expiry of the patent, as they are not subject to the same extensive development and approval process as the branded drug. Though equivalent to the branded drugs in terms of their bioactivity, generics can differ from the brands in their colour, shape, and packaging, as well as price and may even be better (Nikolopoulos et al 2016). Kanavos *et al.* (2008) described generic drugs as the drugs that are chemically equivalent and bioequivalent to originator brands are allowed unto the market after the patent of the originator brand have expired. They are characteristically low-priced drugs, because their manufacturing does not incur R&D costs. Medical practitioners may switch to cheaper generic alternatives as they become available (Frank & Salkever, 1997; Kvesic, 2008), and may even occur before the patent's expiry.

2.16 Forecasting for New Drugs

In the pharmaceutical market, new products are constantly introduced either as branded or generic products. When new products are introduced into an industry, the industry will change, and it must adapt to include the new products (Darroch & Miles, 2011) this in turn affects the performance of forecasting managers.

Forecasting new products may be challenging since little to no historical data is available and may be costly to sales forecasting through inaccurate forecasts and may reduce morale. There are many models used to predict sales of new product however the existing studies do not address predicting pharmaceuticals products and previous studies have been limited to consumer products (Wind, Mahajan, & Cardozo, 1981). Parenthetically, forecasting models for consumer goods may not be necessarily suitable for pharmaceutical products (Nikolopoulos et al 2016).

New pharmaceutical products are introduced into the market either as branded or generic. They come on the market first as branded and later or on the expiry of branded patents alternative products are introduced which become generic products. Forecast of the number of unit of medicines expected to be dispensed helps managers to implement strategies and may alter the product life cycle based on the predicted units to be sold in order to increase sales and profitability.

2.17 Forecasting in Project (New Drug)

Before every new drug is manufactured it must go through series of clinical trials to ensure that the medicine is safe, efficacious, and meet all the food and drugs (FDA) board's rigid requirements before they are licensed and made available for patients.

Though there is no standard length of time for a drug to be tested and approved, it can take up 5 to 20 years or even more to complete all the research and the clinical trial before the licensing is issued (Hansel, et al.2010).

In other to ascertain how the new product will perform in the market in terms of sales after it has been produced, drug manufacturers rely heavily on demand forecasts to augment their decisions about their Research and Development(R&D).

This type of forecast covers the beginning of the R&D process to the licencing and launch stage of the product.

Forecasting the new product development project can be complex, therefore it is very crucial to accurately predict the actual length of the project in progress as well as the cost of the project in progress. As Batselier and Vanhoucke (2015) established, earned value management (EVM) is the most utilised and greatest performing methodology for determining actual length of a project and it cost forecasts. Other EVM forecasting techniques have in recent years been developed and as Barraza et al., (2004) report, they may be grouped into deterministic and probabilistic approaches. Deterministic techniques provide point estimates of the eventual duration of the project, whereas probabilistic techniques provide confidence intervals and/or distributions of possible durations (Batselier and Vanhoucke 2015).

Even though EVM methodology is widely acclaimed as useful and reliable for evaluating the current cost performance of a project; and forecasting its actual cost, the time dimension EVM, only got the requisite boost after Lipke (2003) introduced an extension concept known as earned schedule (ES). There has been other emergent forecasting approaches but these have generally been extensions to EVM (Chen et al., 2016; Baqerin et al., 2015; Mortaji et al., 2014; Lipke, 2011; Elshaer, 2013; Kim and Reinschmidt, 2010). For instance, Anbari (2003) proposed the planned value method (PVM), Jacob and Kane (2004) created the Earned Duration Method (EDM) the Elshaer (2013) creating a similar approach to Lipke (2011) both an extension of ESM. Elshaer (2013) approach calculate project duration forecasts by integrating activity sensitivity information in ESM time forecasting.

Conversely, Khamooshi and Golafshani (2014) created a technique which though sprung from ESM had a different definition of the key metrics. They proposed earned duration management (EDMt), which instead of using cost-based metrics calculates schedule performance from time-based. They opined that using ESM (Earned Schedule Method) for time forecasting has the potential to yield equivocal results since the method persistently utilises costs as an alternative to measure schedule performance. It uses EV and PV values to calculate ES. Both EV and PV are expressed in cost units. Khamooshi and Golafshani (2014) created the technique earned duration ED(t) to replace the ES metric. Inspite of these different variations to EVM, Batselier and Vanhoucke, (2015b) and Vanhoucke and Vandevoorde, have found ESM to dominate over PVM and EDM in terms of EVM forecasting accuracy.

Aimed at Improving project forecast accuracy, Batselier and Vanhoucke (2015) in a study combined exponential smoothing forecasting approach with the earned value management (EVM) methodology to create what they referred to as XSM (eXponential Smoothing-based Method). They opined that exponential smoothing technique is useful since the data collected during a project represent a time series therefore exponential smoothing can be used to forecast a project duration and cost. Their technique uses one smoothing parameter to calculate the enhanced EVM performance factor and in the course of the project development it can be adjusted based on data on previous performance and/or anticipated management actions (Batselier and Vanhoucke 2015).

2.18 Branded drugs

Nikolopoulos et al, (2016) states that, the expectation is for branded pharmaceutical products to follow the classical product lifecycle curve - introduction, growth, maturity and decline- until its patent expires and generic products become available.
Forecasting how many prescriptions a specific medicine will generate enables managers to decide if the product should follow its current rate on the life cycle or measures should be implemented to slow its decline or create a new variant of the existing product.

2.19 Generic drugs

Generic pharmaceuticals as indicated earlier enter the market swiftly as they don't go through the preclinical and clinical trials branded products are subjected to. The introduction to the market is expected to follow a different pattern growing rapidly immediately after the patent expiry of the branded alternative (Nikolopoulos et al 2016). When a generic drug come on the market, branded version of the drug begins to see a decline in the number of prescriptions written for it whiles the number of generic prescriptions increases at the same rate or faster.

Pharmaceutical Product life cycle forecast allows the companies to formulate and apply the appropriate marketing strategies where sales are forecast to decline or

increase at a given time period. The strategies may include patent extension, introducing over-the-counter varieties and diverse strengths of the drug, altering price, or implementing promotional strategies to meet the change in demand. These strategies can be applied at different stages of a product's life cycles (Nikolopoulos et al 2016).

The majority of Ghana's pharmaceutical sales are in generic drugs, paradoxically branded drugs are more popular as they are the most trusted and preferred option compared to unbranded generics which are perceived to be ineffective and even unsafe though they are comparatively more affordable. According to Ghana Pharma Market & regulatory report, (2020), the market size for Ghana's generic drugs in 2019 was USD376 million, representing 63.8% of the total market value. The unbranded generic drugs have a 5% market share of the total generic market. The United Nations Industrial Development Organization in a bid to promote the production of essential domestic generic drugs have created and funded projects in both Ghana and Kenya to boost domestic generic drug manufacturing capabilities.

The next section identifies barriers and enablers of forecasting within the pharmaceutical industry as identified in the literature.

2.20 Theoretical Framework

This section presents the theoretical framework developed from the literature review. The key literature themes discussed were categorised into barriers (how the key themes hinder forecasting) and enablers (how the key themes facilitate forecasting).

A plethora of studies have explored the challenges to implementing forecasting methods/process. These barriers according to Ali, Mohammad M., et al (2017), are typically associated with cultural issues and suggested that the presence of an effective change agent, as the most significant element in breaking down such barriers. The study even though adapted Ali, Mohammad M., et al (2017) assertion in generally finding out the barrier's forecasters in the pharmaceutical SMEs face and how it can be mitigated, this section specifically proposes that most of the theories, concepts and themes raised in the literature review can either impede or facilitate the forecasting process. The next section identifies the barriers and enablers deduced from the literature review.

2.20.1 Identification of Barriers and Enablers

The researcher identified 22 barriers and 28 enablers by assessing each idea under the forecasting process and practice to determine whether it helps in achieving the outcome of accurate forecast or not. Below are the various barriers identified from the literature review.

Barrier No 1: Right data but wrong choice of method may produce bad forecast and vice versa

The forecasting process involves gathering of repeated events or historical data and superimposing a method (*Quantitative or judgemental*) to predict future events. The process can be inferred from Armstrong (2017) publication of the *Principles of Forecasting* which outlines the process as formulating a problem, obtaining information about it (data), selecting and applying methods, evaluating methods and using forecasts encapsulate the forecasting process.

Impliedly, there are two pervasive components in the forecasting process, which are Data and Method. These two elements (Method/ Data) must be in sync for accurate forecast to occur. Where the data is good, but the choice of method is wrong the tendency of producing a good forecast is low, likewise, if the data is wrong but the method is right, forecasting accuracy is marginalized.

Barrier No 2: External factors affect choice of method

Mentzer & Moon (2005) also categorised forecasting methods into qualitative and quantitative methods. In addition, quantitative methods may be separated into those that are based on external factors and those based on demand history. Quantitative methods can be used, if there is enough data. If no data exists, then the use of judgemental methods is sufficient.

Barrier No 3: Forecaster's assumption and practices influence the choice of method either judgement or quantitative

Forecasting methods are categorised based on suggested frameworks. Makridakis & Wheelwright (1979) proposed two criteria for the classification of methods which are the type of information available (quantitative or qualitative), and the basic assumptions about the type of demand pattern (history repeats itself or external patterns determine events).

Barrier No 4: Statistical forecasting assumes stable business patterns without considering economic data which is intrinsically unstable and continuously changing

Makridakis (1981), states that statistical forecasting is based on a misleading assumption of constancy where “patterns and/or relationships, or structural stability in the data, is either ignored outright, brushed aside as unimportant, overlooked as useless, or at least is not made explicit” leading to unfulfilled expectations. The statistical forecasting assumes constancy; alluding to the assumption of constancy may sufficiently define data from physical, natural, and also engineering related applications, but fails to capture business and economic data which is intrinsically unstable and continuously changing. Consequently, successful hard sciences approaches cannot be automatically transferred to social sciences. Where changes occur, statistical forecasting cannot deal with this situation because the assumption of constancy will be defeated. The errors that may result due to the changes will not follow previous patterns as is necessary for statistical forecasting.

Barrier No 5: Additional information in Judgemental forecasting provides overconfidence

Lawrence et al., (2000) in their study showed that judgemental forecasts are not uniformly better than naïve forecasts. Arkes (2001) submitted that literature on forecasting typically communicate overconfidence in judgemental forecasting suggesting that overconfidence should be consciously reduced. Makridakis and Wheelwright (1989) also identified overconfidence in result as a major problem with judgemental forecasting. The quest for supporting evidence implies that decision makers collect information not to disprove their stance but to support their views. As information increases predictive ability does not improve in a judgemental setting rather the additional information provides overconfidence.

Barrier No 6: Judgement is also characterised with large errors and systematic biases

Judgement has also been characterised as relating to large errors and systematic biases; with the tendency to see patterns where none exist and unfounded confidence in its correctness (Lawerence et al, 2006).

Barrier No 7: Turbulence in the environment such as high inflation rates and or recession likely result in forecasting errors due to their unpredictive nature.

Organizations need accurate forecasts to plan to meet demand for their goods and services (Armstrong and Green, 2017). Accurate forecasts can increase the efficiency in all sectors of the economy including the pharmaceutical industry. It is argued that where there is stability in the external environment, forecasting is an extension and continuations of established patterns/relationships and therefore accurate; however, where there is turbulence in the environment, forecasting errors are likely to be high since such occurrence as high inflation rates and or recession cannot be predicted.

Barrier No 8: Cost of inaccurate forecasts- loss of sales, loss of profit, loss of customers or potential customers.

Inaccurate forecasting may be very costly and may include trade promotions but also the costs of ineffective advertising, new products development without adequate demand, pricing at the level that does not maximize profit contribution and inappropriate sales quotas (Nikolopoulos et al 2014). Low service levels caused by inaccurate forecasts may cause loss of sales, loss of customers, or even loss of potential customers. Wacker and Lummus (2002), note that there is a lack of error measures that rate the forecast accuracy with the actual use of the forecasts.

Barrier No 9: Mistakenly sensing demand signals or predicting false pattern /relationship

Armstrong (2006) and Chase Jr (2013) opined that mistakenly sensing demand signals can occur in both statistical and judgmental forecasting. It occurs when a false pattern or relationship is predicted between a causal factor and the product being forecasted to indicate a strong relationship with the product being forecasted, rendering all other causal factors insignificant.

Barrier No 10: Insufficient information or inability to identify wrong information can also result in errors

Insufficient information or the identification of wrong information according to Chase Jr (2013) can also result in identifying incorrectly existing patterns. Such situations may be too complex to forecast resulting in errors. It is therefore imperative to

integrate domain knowledge-which will assist in identifying and interpreting patterns and relationships to make sense without relying entirely on pure judgment in making decisions with little regard for the dynamics of the marketplace.

Barrier No 11: Sporadic changes in patterns and relationships overtime may cause continuous errors which may not be predicted- (examples: changes as stock price fluctuations, interest rates, exchange rates, and commodity price

Chase Jr (2013) indicate that Over a time period, patterns and relationships continuously change which make these patterns impossible to forecast. These changes may cause continuous errors which may not be predicted. Longer time horizon means less accurate forecast; and this may have a significant effect on forecast accuracy. Such changes as stock price fluctuations, interest rates, exchange rates, and commodity price cannot be accurately predicted due to unknown factors that may influence the price.

Barrier No 12: Availability and price as basis for buyer's decision

Polychronakis and Syntetos (2007) submitted that "adversarial purchasing where contracts are short- term and decided exclusively on the basis of price (and availability) and where no sharing of forecast demand or process development exists; Most of the suppliers realise that the buyer is not committed to long term business".

Barrier No 13: Customer Expectations

A plethora of reasons has been cited in the existing literature (Cook, 2015; Chase, 2013; Porasmaa and Ojala, 2011; Monczka et al., 2009; Handfield and Nichols, 2002) to underpin organisations need for accurate forecasting and this among others are increasing customer expectations, shortening lead times, scarcity of resources and avoid the 'bullwhip effect'. Makridakis et al (1993) mentions how crucial forecasting is for identifying potential opportunities and threats in the business environment and for predicting future uncertainties and its likely impact on the business.

Barrier No 14: Intermittent Demand patterns are difficult to forecast

Intermittent demand patterns are characteristically sporadic demands which often vary in size and occur at irregular intervals. Syntetos and Boyan (2011) stated that,

intermittent demand patterns are very difficult to forecast since they usually comprise a significant proportion of zero values and are randomly mixed with nonzero values (Syntetos et al, 2015). Demand quantities for intermittent demand may vary vastly when demand occurs (Cattani, Jacobs, & Schoenfelder, 2011).

Barrier No 15: Lack of understanding / support by Management

Lack of understanding by management and executives in some organizations on the importance of demand forecasting is a barrier to the forecasting process. Senior managers may not embrace the notions that the organisation requires effective prediction of future customer demand. To mitigate this problem (Mentzer, Moon, Kent, & Smith, 1997) concluded in their study the need for an effective forecasting champion who can appreciate the importance of gaining support from senior management.

Barrier No 16: Lack of specific training for forecasters

Fildes and Hastings (1994) indicate that lack of specific training for forecasters as a huge barrier. Forecasters typically have little training in forecasting methods according to surveys of forecasting practitioners, this then result in inaccurate forecast.

Barrier No 17: Collaboration or teamwork among the functional areas such as sales and operations

Cohesion amongst internal stakeholders: Internal stakeholders develop trust for the process and become more firmly aligned, driving quality collaboration among sales, marketing, finance, and operations functions as well as external stakeholders.

Barrier No 18: Lack of quality collaboration among sales, marketing, finance, and operations functions

Chase Jr (2013) Quality relationships across the various stakeholders translates into stronger network integration but the lack of it leads to inaccurate forecasting.

Barrier No 19: Industry and health policy -pharmaceuticals manufacture according to regulations

In the pharmaceutical market, new products are constantly introduced either as branded or generic products. When new products are introduced into an industry the

industry will change and it must adapt to include the new products (Darroch & Miles, 2011) this in turn affects the performance of forecasting managers.

Barrier No 20 Forecasting for new drugs challenging since little to no historical data is available

Forecasting new products may be challenging since little to no historical data is available and may be costly to sales forecasting through inaccurate forecasts and may reduce morale. There are many models used to predict sales of new product however the existing studies do not address predicting pharmaceuticals products; previous studies have been limited to consumer products (Wind, Mahajan, & Cardozo, 1981). Forecasting models for consumer goods may not be necessarily suitable for pharmaceutical products (Nikolopoulos et al 2016).

Barrier No 21: Expectations of stakeholders Patients, doctors and health insurance

Nikolopoulos et al (2016) states that, the expectation is for branded pharmaceutical products to follow the classical product lifecycle curve - introduction, growth, maturity and decline- until its patent expires and generic products becomes available.

Forecasting how many prescriptions a specific medicine will generate enables managers to decide if the product should follow its current rate on the life cycle or measures should be implemented to slow its decline or create a new variant of the existing product.

Barrier No 22 Forecasting software selected and purchased by the wrong people

Moon (2006) notes that, there is a wrong perception that technology investment will automatically make forecast accurate. He observed that many organizations invest in technology solutions without first trying to understand the forecasting process. To overcome this challenge Moon (2006) suggest that forecasters are consulted during the software acquisition.

2.21 Enablers/Facilitators for demand forecasting

This segment of the research focuses on enablers and facilitators for forecasting demand. A number of authors, many of whom already been introduced earlier in this work, have identified enablers and processes that can improve demand forecasting in general and in the pharmaceutical industry.

Enabler No 1: ***Data availability influence choice of forecasting method.***

Georgoff and Murdick, (1986) indicated that other factors such as data availability, variability and consistency of data etc. should be considered in selecting forecasting method to ensure an accurate forecast.

Enabler No 2: ***Studying data pattern is important for choosing the right forecasting method***

Armstrong (2001) defined six criteria to select forecasting method which are convenience, market popularity, structured judgment, statistical criteria, relative track records (data pattern) and principles from published research. The right forecasting method can be achieved by considering data pattern, forecast accuracy and forecast error.

Enabler No 3: ***Good forecast requires both right data and method***

The forecasting process involves gathering of repeated events or historical data and superimposing a method (*Quantitative or judgemental*) to predict future events. The process can be inferred from Armstrong (2017) publication of the *Principles of Forecasting* which outlines the process as formulating a problem, obtaining information about it (data), selecting and applying methods, evaluating methods and using forecasts encapsulate the forecasting process.

Impliedly, there are two pervasive components in the forecasting process, which are Data and Method. These two elements (Method/ Data) must be in sync for accurate forecast to occur. Where the data is good but the choice of method is wrong the tendency of producing a good forecast is low, likewise, if the data is wrong but the method is right, forecasting accuracy is marginalized.

Enabler No 4: ***Combining methods reduce ex ante forecast error and bias***

Armstrong and Green (2017) in their submission disagreed with the practice of choosing the most familiar method when forecasting, contending that both practices is erred suggesting instead the use of all applicable forecasting methods and combining their forecasts. Combining methods is deemed superior even when one could be certain that they know the best method for the demand forecasting problem being

faced with. This practice has been found to reduce ex ante forecast error and help protect against bias.

Enabler No 5: *Quantitative methods are more systematic accurate and effective than unaided, subjective judgements*

Sanders & Manrodt, (2003), Mentzer &Moon, (2005) and Makridakis and wheelwright (1989) stated that “unaided, subjective judgements clearly are not as accurate and effective as more systematic, explicit approaches to forecasting”. This conclusion can be supported by the fact that quantitative forecasting methods are more commonly applied to predictable demand. Petropoulos et al. (2010) in their study examining the comparative forecasting performance of alternative statistical and judgmental approaches for Apple iPhone concluded that statistical extrapolations are more accurate and less biased than judgment.

Enabler No 6: *Judgemental methods are preferred by companies due to environmental uncertainty, and variability of data*

A survey by Sanders and Manrodt (2003) concluded that preference for judgemental methods by companies is due to certain organisational characteristics such as lack of relevant quantitative data, environmental uncertainty, and variability of associated data. Also, qualitative information is judged to be more valuable than the available demand history.

Enabler No 7: *Qualitative techniques may be utilised especially in situations where there is no or little demand history*

Qualitative techniques may be utilised especially in situations where there is no or little demand history example as in the case of forecasting the demand for a new product. In such circumstances, demand history may be considered irrelevant or insufficient for forecasting future demand. Market forecasts for new or rapidly changing markets particularly are often based on judgment. It is argued that all forecasting involves judgment in choosing the applicable forecasting method and or formulating forecasting model, but, “judgemental forecasting” means the forecasts were wholly based on judgment, or with judgemental adjustments to statistical forecasts (Wright& Goodwin 1998).

Enabler No 8: ***Interaction Groups approach which builds consensus by a group of experts through debate and discussion to produce a more accurate forecast***

The Interaction Groups approach (IG) emphasises consensus building by a group of experts through debate and discussion to produce a forecast (Petropoulos et al 2010). Through this process each member of the group has access to a wider range of information. This approach is deemed more accurate than unaided judgement forecasts (average of individual forecasts) in most of the literature available example (Ang & O'Connor, 1991).

Enabler No 9: ***Accurate forecasts can increase efficiency***

Organizations need accurate forecasts to plan to meet demand for their goods and services (Armstrong and Green, 2017). Accurate forecasts can increase the efficiency in all sectors of the economy including the pharmaceutical industry

Enabler No 10: ***Stability in external environment means forecasting is continuations of established patterns and therefore accurate***

Armstrong (2017) argued that where there is stability in the external environment, forecasting is an extension and continuations of established patterns/relationships and therefore accurate however, where there is turbulence in the environment, forecasting errors are likely to be high since such occurrence as high inflation rates and or recession cannot be predicted.

Enabler No 11: ***Analysis of previous errors will determine systematic changes in past patterns Analysis of previous errors will determine systematic changes in past patterns***

Armstrong (2006) asserted that forecast errors provide invaluable information about the current state of the organization how the charted direction is changing. He further opined, that analysis of the errors will determine systematic changes in past patterns/relationships.

Enabler No 12: ***Domain knowledge with regard for marketplace dynamics essential for mitigating errors***

Chase Jr (2013) in their submission indicated that, insufficient information or the identification of wrong information can also result in identifying incorrectly existing

patterns. Such situations may be too complex to forecast resulting in errors. It is therefore imperative to integrate domain knowledge-which will assist in identifying and interpreting patterns and relationships to make sense without relying entirely on pure judgment in making decisions with little regard for the dynamics of the marketplace.

Enabler No 13: Advanced forecasting techniques- advanced forecasting techniques may also provide fewer forecasting errors, but an ill-developed Management Information System will lead forecasters to rely more on informal information. Chase Jr (2013)

Enabler No 14: ***Inventory Management***

Demand forecasting is also an integral part of an organisation's successful management of customer relations (Moon, 2006). Ideally there must be the least amount of inventory to satisfy customers' demands at the same time minimizing the cost of buying and holding the inventory. The main aim of demand forecasting is to match supply with demand. Over-supply of inventory will likely lead to undue costs, triggered by excess storage, stock deterioration and obsolescence. In contrast undersupply of inventory will invariably lead to lost sales

Enabler No 15: ***Identifying potential customers***

Identifying potential customers for a new product is sometimes difficult. An inexpensive way around this is to create a role for subjects and ask them about their intentions to adopt the product when they are in that role. Polychronakis and Syntetos 2007 indicates "adversarial purchasing where contracts are short- term and decided exclusively on the basis of price (and availability) and where no sharing of forecast demand or process development exists most suppliers, see a buyer who is not committed to long term business".

Enabler No 16: ***Capacity to fulfil customer demands***

Demand forecasting is the starting point for most planning and control organizational activities (Mohammed et al 2015). Mentzer and Moon (2005) have defined the role of demand forecasting within demand management. In a manufacturing setting, demand forecast is necessary to inform the needed materials, labour, and capacity to fulfil customer demands.

Enabler No 17: ***Efficient allocation of marketing resources***

Improved collaboration according to Chase Jr (2013) enables senior managers to better understand the drivers of profitability resulting in stricter budget control and an efficient allocation of marketing resources. There is thus a better appreciation of the market, product and customer allowing for the creation of a more directed strategic allocation of resources across brands and products to drive growth and profitability.

Enabler No 18: ***Increase market share***

Cost savings is it the only justification for a demand-driven forecasting process in an organisation; providing higher-quality demand forecasts can create a competitive advantage improve customer base which will in turn increase market share for a company's products and services over its competitors. (Chase Jr 2013)

Enabler No 19: *Tailored training for forecasters*

Fildes and Hastings (1994) add lack of specific training by forecasters. Forecasters typically have little training in forecasting methods according to surveys of forecasting practitioners.

Enabler No 20: *Reward alignment*

Davis and Mentzer (2007), in their study found that the nature of "forecasting climate" is connected to the forecasting capability. The "forecasting climate" according to them are leadership support, credibility of sales forecasting and reward alignment. They further posit that negative forecasting is detrimental to forecasting capability.

Enabler No 21: *Performance Measurement*

Moon (2006) suggested the use of performance measurement and reward strategies to mitigate the wrong organisational culture. Forecast-accuracy metrics may be inculcating into performance evaluation. The "wrong culture" barrier can be overcome by setting the forecast function within an integrated demand-supply process.

Enabler No 22: *Right Technology*

Moon (2006) notes that, there is a wrong perception that technology investment will automatically make forecast accurate. He observed that many organizations invest in technology solutions without first trying to understand the forecasting process. To overcome the “system is the solution” barrier, Moon (2006) proposed that different software’s should be tried before settling on the right technology for any particular organization.

Enabler No 23: *Formalised communication*

Communication should be formalised to enable demand side to communicate its demand forecast and the supply side its capacity constraints

Enabler No 24: *Management Support*

Lack of understanding by management and executives in some organizations on the importance of demand forecasting is a barrier to the forecasting process. Senior managers may not embrace the notions that the organisation requires effective prediction of future customer demand. To mitigate this problem (Mentzer, Moon, Kent, & Smith, 1997) concluded in their study the need for an effective forecasting champion who can appreciate the importance of gaining support from senior management. Mentzer (1999) proposed showing management how forecasting can influence the businesses return on shareholder investment, reduce inventory carrying costs and reduce shipping costs.

Enabler No 25: *Branding, loyalty*

Seiter and Gyansa-Lutterodt, (2009) opines that from an economic diagnostic perspective, the pharmaceutical wholesale market in Ghana has a monopolistic competitive market structure on the supply side; thus the market is characterised by many sellers who distinguish themselves from each other through branding and selective advertising.

Enabler No 26: *Pharmaceutical Product life cycle*

Pharmaceutical Product life cycle forecast allows the companies to formulate and apply the appropriate marketing strategies where sales are forecast to decline or increase at a given time period. The strategies may include patent extension, introducing over-the-counter varieties and diverse strengths of the drug, altering price, or implementing promotional strategies to meet the change in demand. These strategies can be applied at different stages in a products life cycle (Nikolopoulos et al 2016).

Enabler No 27: *Generic Drug- grows rapidly immediately after the patent expiry of the branded alternative*.

Generic drugs are able to enter the market swiftly upon the expiry of the patent, as they are not subject to the same extensive development and approval process as the branded drug. Though equivalent to the branded drugs in terms of their bio-activity, generics can differ from the brands in their colour, shape, and packaging, as well as price and may even be better (Nikolopoulos et al 2016). Kanavos *et al.* (2008) described generic drugs as the drugs that are chemically equivalent and bioequivalent to originator brands and allowed unto the market after the patent of the originator brand have expired. They are characteristically low-priced drugs, because their manufacturing does not incur R&D costs.

Enabler No 28: *Documenting all the assumptions made and all changes to the original forecast.*

The forecasting process involves gathering of repeated events or historical data and superimposing a method (*Quantitative or judgemental*) to predict future events. The process can be inferred from Armstrong (2017) publication of the *Principles of Forecasting* which outlines the process as formulating a problem, obtaining information about it (data), selecting and applying methods, evaluating methods and using forecasts encapsulate the forecasting process.

2.22 Summary of Barriers and Enablers

From the literature review phase of the research, 22 barriers and 28 enablers relating to forecasting in pharmaceutical industry were identified. In order to be able to answer the research questions, a theoretical framework have been developed and interview questions based on the framework.

Table 2.5 Theoretical Framework

Enablers/Facilitators	Barriers	Reference
Theme 1: General Overview Questions	*Reserved for the general overview interview questions*	
Theme 2 Process - Data and Method		
E1 The forecasting process is the selection of data and superimposition of method to predict the future. Good forecast requires both right data and method.	**B1** Right data but wrong choice of method may produce bad forecast and vice versa	**B1** Armstrong (2017) **E1** Georgoff and Murdick, (1986)
E2 Studying data pattern is important for choosing the right forecasting method	**B2** External factors affect choice of method	**B2** Mentzer & Moon (2005) **E2** Armstrong (2001)
E3 Data availability influence choice of forecasting method	**B3** Forecasters assumption and practices influence the choice of method either judgement or quantitative	**B3** Makridakis & Wheelwright (1979) **E3** Armstrong (2017)
E4 Combining methods reduce ex ante forecast error and bias	**B22** Forecasting software selected and purchased by the wrong people	**B22** Moon (2006) **E4** Armstrong and Green (2017)

E13 Advanced forecasting techniques-an ill-developed Management Information System will lead forecasters to rely more on informal information	**B23** Expertise or experience of the forecaster ignored when evaluating forecasting software for purchase	
Theme 3 Quantitative methods Verses Judgemental methods		
E5 Quantitative methods are more systematic accurate and effective than unaided, subjective judgements	**B4** Statistical forecasting assumes stable patterns business without considering economic data which is intrinsically unstable and continuously changing	**B4** Makridakis (1981) **E5** Sanders & Manrodt, (2003), Mentzer &Moon, (2005)
E6 Judgemental methods are preferred by companies due to environmental uncertainty, and variability of data	**B5** With Judgemental forecasting additional information provides overconfidence	**B5** Makridakis & Wainwright (1989) E6 Sanders and Manrodt (2003)
E7 Qualitative techniques may be utilised especially in situations where there is no or little demand history	**B6** Judgement is also characterised with large errors and systematic biases	**B6** Lawerence et al, (2006)
E8 Interaction Groups approach which builds consensus by a group of experts through debate and discussion to produce a forecast more accurate		**B6** Lawerence et al, (2006) Petropoulos et al (2010)
Theme 4 Forecast Accuracy		

E9 Accurate forecasts can increase efficiency	**B7** Turbulence in the environment such as high inflation rates and or recession likely result in forecasting errors due to their unpredictive nature	Armstrong (2017)
E10 Stability in external environment means forecasting is continuations of established patterns and therefore accurate	**B8** Cost of inaccurate forecasts- loss of sales, loss of profit, loss of customers or potential customers.	**B8** Nikolopoulos et al (2014) **E10** Armstrong (2017)
E28 Documenting all the assumptions made and all changes to the original forecast		**E28** Armstrong (2017)
Theme 5 Forecast Error		
E11 Analysis of previous errors will determine systematic changes in past patterns	**B9** Mistakenly sensing demand signals or predicting false pattern /relationship	Armstrong (2006) and Chase Jr (2013)
E12 Domain knowledge with regard for marketplace dynamics essential for mitigating errors	**B10** Insufficient information or inability to identify wrong information can also result in errors	Chase Jr (2013)
E13 Advanced forecasting techniques- advanced forecasting techniques may also provide fewer forecasting errors, but an ill-developed Management Information System will lead forecasters	**B11** Sporadic changes in patterns and relationships overtime may cause continuous errors which may not be predicted-Such changes as stock price fluctuations, interest rates,	Chase Jr (2013)

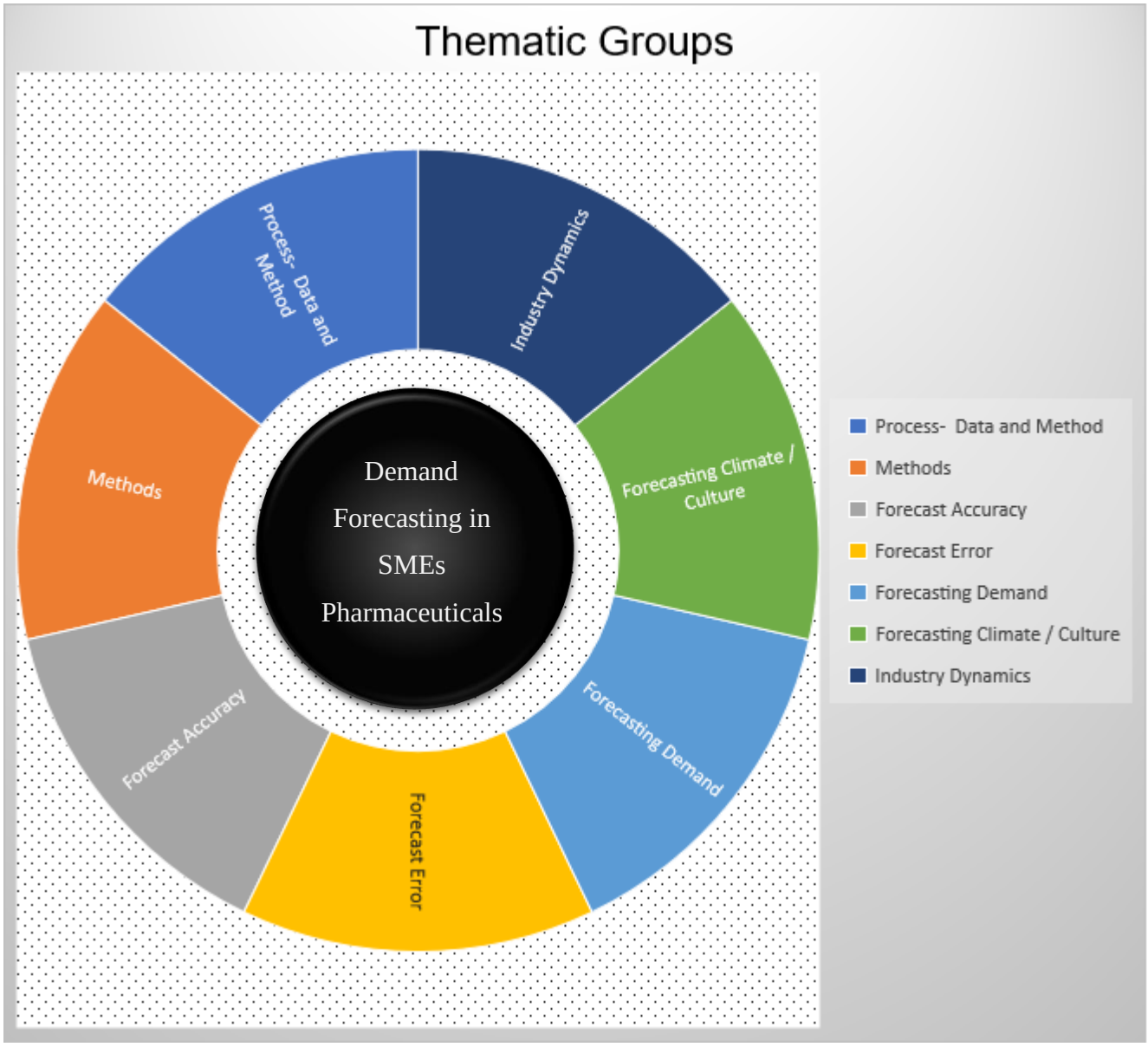
to rely more on informal information	exchange rates, and commodity price	
Theme 6 Forecasting Demand		
E14 Inventory Management	**B12** Availability and price basis for buyer's decision	**B12** Polychronakis and Syntetos (2007) **E14** Moon, (2006)
E15 Identifying potential customers		Polychronakis and Syntetos (2007)
E16 Capacity to fulfil customer demands	**B13** Customer Expectations	**B13** Porasmaa and Ojala, (2011) Monczka et al., (2009)
E17 Efficient allocation of marketing resources	**B14** Intermittent Demand patterns are difficult to forecast	**B14** Syntetos and Boyan (2011) Syntetos et (2015) **E17** Chase Jr (2013)
E18 Increase market share		Chase Jr (2013)
Theme 7 Forecasting Climate / Culture		
E19 Tailored training for forecasters	**B15** Lack of understanding by management	Mentzer, Moon, Kent, & Smith, (1997)
E20 Reward alignment	**B16** Lack of specific training for forecasters	**B16** Fildes and Hastings (1994) **E20** Davis and Mentzer (2007),
E21 Performance Measurement	**B17** Lack of Collaboration or teamwork among the	Moon (2006)
E22 Right Technology		Moon (2006)

	functional areas such as sales and operations	
E23 Formalised communication	**B18** Lack of quality collaboration among sales, marketing, finance, and operations functions	**B18** Chase Jr (2013)
E24 Management Support	**B22** Forecasting software selected and purchased by the wrong people	**B22** Moon (2006) **E24** Mentzer, Moon, Kent, & Smith, 1997)
Theme 8 Industry Dynamics		
E25 Branding, loyalty	‘	**B19** Darroch & Miles, (2011)
E26 Pharmaceutical Product life cycle forecast allows the companies to formulate and apply the appropriate marketing strategies	**B20** Forecasting for new drugs challenging since little to no historical data is available	Nikolopoulos et al (2016).
E27 Generic Drug- grows rapidly immediately after the patent expiry of the branded alternative	**B21** Expectations of stake holders Patients, doctors and health insurance	Nikolopoulos et al (2016). **E27** Kanavos *et al.* (2008)

Source: The Author

All the barriers and enablers have been grouped into seven thematic groups and presented in the figure below.

Figure 2. 3 Thematic Groups



Source: The Author

2.22 Literature Review Summary

Chapter two critically reviewed relevant literature on forecasting and forecasting in the pharmaceutical industry specifically through which a conceptual framework was developed for this study. It begins with a concise overview of forecasting, the forecasting process, the importance of accuracy in forecasting and forecasting errors.

Subsequently, forecasting methods was extensively discussed, next demand forecasting was discussed emphasising intermittent demand forecasting and software in forecasting. Demand forecasting in the pharmaceutical industry was also examined. From the extant literature reviewed, 22 barriers and 28 enablers of forecasting were identified which formed the basis of the interview questions.

Accurately Predicting trends and demand is a necessity and not a luxury if organisations are to stay on top of rapid changes in demand levels, competition, seasonal demands, changes in regulation and economic variations etc. Even those who theorise forecasting as an art still agrees that an in depth understanding of forecasting, its principles and process is essential for mitigating the issues listed. Researchers largely agree that there are two significant components in the forecasting process, which are Data and Method; these two are very important for accurate forecasts to happen. It is argued that where there is stability in the external environment, forecasting tends to be more accurate; however, where there is turbulence in the environment, forecasting errors are likely to be high.

Forecasting also helps in deciding which methods, techniques or models are suitable to the specific needs of an organisation. Many different forecasting techniques and methods have been developed over the years to manage the many different and complex forecasting challenges. Each model or method has its own advantages and special use, and care must be taken when selecting a method to ensure the correct method is applied in every different scenario. This requires domain knowledge, communication and participation of all functional heads, information sharing at all levels and executive buy in.

The forecasting method or technique adopted should be appropriate for the product's stage in the product's life cycle. The possibility of establishing patterns and sufficient available data directly depend on the maturity of a product, making the stage in the product life-cycle a paramount basis for selecting the forecasting method to be used. Selecting the best suited method depends among other things the context of the forecast, historical data relevance and availability, the degree of accuracy desirable, the time period to be forecast, the cost/ benefit (or *value*) of the forecast to the company, and the time available for making the analysis (Chambers, Mullick and Smith, 1971). It is important to constantly weigh these factors on a variety of levels

for a balance. Forecaster may choose a method which adequately use the available data or instead apply a method with an acceptable accuracy. Integrating methods have been found to also potentially increase accuracy.

In the pharmaceutical market, forecasting is usually challenging as new products are constantly being introduced either as branded or generic products. New products don't tend to have any historical data making forecasting a hit and miss adventure. Although many models have been designed to predict sales of new product; the extant literature fails to provide a model for predicting pharmaceuticals products.
From the review 22 barriers and 28 enablers were coined, these include right data but wrong choice of method, negative external factors, insufficient information or inability to identify wrong information and some enablers also included in the enablers were right data right method for accurate forecast, technological software aiding forecast as well as positive external factors.

The next chapter discusses the methodological consideration for this study.

Chapter Three
Research Methodology

3.1 Chapter Outline

This chapter introduces the methodological approach for the study. It discusses the research design and strategy as well as examining the data collection and analysis methods used in this thesis. The chapter is divided into sections as follow. Section 3.2 explains the meaning of research design. Section 3.3 discusses the philosophical considerations for research whiles Section 3.4 the approaches for developing theory. Section 3.5 and 3.6 explains the methodological choice, Section 3.6 looks at and research strategy respectively, Section 3.7 gives an overview of case study research. The section also outlines the differences between case study and survey research, it further discusses single case versus multiple cases. Section 3.8 highlights exploratory research.

The chapter then moves onto discussing the data collection methods employed in the current research highlighting three methods used which are interviews, observation and documents review in Section 3.9 to 3.11. Section 3.12 then focuses on the importance of triangulation with Section 3.13 discussing the reliability and validity of the data. Subsequently following on, Section 3.14 highlights the pilot study; Section 3.15 discusses the sample selection, whiles 3.16 looks at the unit of analysis, 3.17 provides a summary of how the research will be conducted and. 3.18 the data analysis Sections.

The penultimate section, 3.19 considers how the data collected for this thesis will be analysed. Finally, Section 3.22 provides the summary for the chapter.

3.2 Introduction

Research design is significant component of any research project as alluded to by all researchers however, Collis and Hussey (2013) stated that research means different things to different people, accordingly there is no conclusive definition of research in the literatures. On the contrary, there seems to be a consensus that research is a process of systematically enquiring and investigating in order to increase knowledge (Collis & Hussey, 2013; Hossain, 2011; Saunders, Lewis and Thornhill 2019). Ghauri and GrØnhaug (2010) reasoned that research is systematic since it is established on logical relationships and not just on beliefs. Likewise, Saunders et al, (2019) identified the three prerequisites to research as: “systematic data collection; systematic data

interpretation and a clear purpose to find things out". As stated by Hossain (2011) research may be carried out either to solve a specific problem or to generate a body of knowledge. The former is known as applied research and the latter as fundamental or pure research.

To achieve the research, aim and objectives and address the research questions a robust research design must be formulated to ensure that there is clear line of exposition between the literature, data gathered, and the conclusions drawn.

Research design as indicated by Saunders et al. (2019) shows the overall plan of the research and how the research questions will be answered. It encapsulates among other things the theory and philosophy behind the research, research strategy, the data collection method and the time frame within which the research project will be completed. Easterby-Smith, Thorpe and Jackson (2021) also defined research design as "the overall configuration of a piece of research: what kind of evidence is gathered from where, and how such evidence is interpreted in order to provide good answers to the basic research question[s]". On the other hand, Leedy and Ormrod (2013) described research design as the general strategy for answering a research question. Despite the differences in opinion, Myers, (2019) share a similar view with Saunders et al. (2019) that research design shows the comprehensive plan of the research, and therefore include the philosophical assumptions, research method, data collection technique, data analysis approach and the written record.

3.2.1 Methodological Framework

This research like other business management research evaluated the five major philosophies in business and management: positivism, critical realism, interpretivism, postmodernism and pragmatism Saunders et al. (2019) and adopted interpretivism which is also considered as phenomenology (Crotty 1998). Saunders et al. (2019) opines that interpretivist research seeks to create new, richer understandings and interpretations of social worlds and contexts from the perspectives of different groups of people (CEO, board directors, functional managers, shop assistants etc) within an organisation. Walsham, (2015) states that phenomenology focuses on participants' lived experience; that is, the participants' recollections and interpretations of those experiences. According to Saunders et al, (2019) qualitative methods of research are established on phenomenological perspectives.

This philosophy and approach fitted perfectly well with the aim of the research which was to explore the forecasting process in manufacturing Pharmaceutical SMEs in Ghana centring on how manufacturing Pharmaceutical SMEs in Ghana forecast demand, methods used in forecasting, the importance of forecasting accuracy and the challenges encountered in forecasting demand from the perspective of forecasting Practitioners like CEO, Operation Managers, Procurement, and Sales & Marketing Managers.

The phenomenological philosophy utilises inductive approach to theory, qualitative methods to collect and analyse the data as opposed to quantitative methods.

This research by coalescing inductive approach with the phenomenology philosophy enabled the researcher to interact with practitioners within the Ghanaian manufacturing pharmaceutical SMEs to explore and understand the forecasting practices and barriers of these organisations from.

The analysis of the qualitative data collected was done using computer-assisted qualitative data analysis software (CAQDAS) programme - NVivo. The NVivo programme allowed for textual/contextual information to be linked to text document and allows coding to emerge from the research (Hutchison, et al 2010). The coding enabled labels to be assigned to each piece of data or group of data with the ultimate aim of facilitating such data to be analysed in qualitative terms. The results did not follow statistical procedures as will be the case in quantitative approach.

Archetypically using a phenomenology philosophy and inductive methodological approach for qualitative research as is the case for this study does not allow for generalisation unlike combining an inductive approach with a positivist viewpoint (Saunders et al 2019), even though simple generalisation can be made. Carminati (2018) also adds that generalisation can be possible from a qualitative study where it is the main objective of the study. In the grand scheme, this research is not generalisable since the aim was to provide in-depth explanations and contextualised understandings rather than generalise findings (Macionis & Gerber, 2010). However, considering that firstly, the existing literature to a large extent is supported by the research findings of this study, it can be generalised to pharmaceutical SMEs in the Ghanaian context and Pharmaceuticals in the West Africa sub region since they tend to exhibit similar characteristics. The focus of this study which follows the

phenomenological philosophical tradition of analytical/theoretical generalisation (Hallberg, 2013).

The methodological pathway for this research is depicted in figure 3.1 below.

Figure 3.1 Methodological Framework

Adapted from Saunders et al., 2019 and Myers 2019

The following section looks at the philosophical considerations of the research and justification.

3.3.0 Philosophical Considerations

As mentioned from the beginning of this chapter, choosing the appropriate research method must be based on the underlying philosophical considerations. Inevitably, the overall methodology and the associated methodological decisions hinges on how the researcher instinctively and or intuitively approaches knowledge development. The research philosophy summaries the assumptions about the researcher's worldview (Saunders et al., 2019). Conversely, these assumptions underpin the choice of research strategy and the method adopted. The philosophical underpinning of a research explains what will work and what will not. In this regard Johnson and Clark, (2014) posited that the researcher must understand that the research strategy they choose invariably denotes certain philosophical commitments which substantially

impact not only how they understand what is being investigated but also what they do.

According, to Saunders et al. (2019) there are three ways of thinking about research philosophy. These are ontology, epistemology, and axiology. Ontological philosophy as they mention has to do with the nature of reality (Saunders et al., 2019). They further submitted that an ontological view expansively interrogates the research assumptions than epistemology. Ontology examines what kinds of things exist; whilst epistemology examines how one would know the kinds of things that exist. Epistemology can either be a positivist or interpretivist. It comprises what constitutes acceptable knowledge in a field of study (Saunders et al, 2019). Ontology on the other hand can be objectivism or subjectivism.

According to Easterby-Smith, Thorpe and Jackson (2021) traditionally, there are two philosophical views as which are social positivism and constructivism (phenomenology). Each philosophy is associated with its own assumptions and methodological implications however no philosopher endorses all facets of both positions. Social scientist who were pro natural scientists' approach to positivism argued that the physical sciences deal with only objects which are outside the human mind with the social sciences dealing with actions and behaviours which are generated from within the human mind (Collis & Hussey, 2013) coming up with a new phenomenon known as phenomenology.

3.3.1 Positivism Paradigm

The positivism paradigm has also been referred to as "the traditional", "the experimental", or the "empiricist paradigm" (Creswell, 2017). A positivist view is akin to the philosophical viewpoint of the natural scientist that works with an observable social reality (Gill and Johnson 2010). A positivist researcher may use existing theory to develop hypotheses. The Positivism philosophy collect data about observable reality and search for regularities and causal relationships in the data to create law-like generalisations; like those created by scientists (Gill and Johnson, 2010). It is an epistemological viewpoint that advocates applying natural sciences methods to the study of social reality (Bryman, 2016). The theoretical underpinning of this view is that the social world exists externally and must therefore be measured using certain objective methods rather than using observation to make subjective inferences either

by reflection or intuition. It pledges unambiguous and accurate knowledge. The positivism philosophy sees “reality” as external and objective, taking on ontological assumption in investigating a phenomenon (Easterby-Smith et al., 2021).

In management research, the positivistic philosophy is generally associated with “quantitative methods” and “quantitative data collection” (Saunders et. al., 2019; Johnson & Duberley, 2012). The researcher uses the available sufficient data to attempts to explain causal relationships between variables and to generate law-like generalizable conclusions. Large scale survey is the preferred data collection approach for the positivist researcher. The positivist researcher aims at being neutral and independent of the research and data to avoid influencing the findings (Gibbs, 2010).

Research undertaken is perceived to be value-free; human interests are viewed as irrelevant, and the overall approach becomes very structured by its very nature. According to Duberley, Johnson, and Cassell (2012) positivists are likely to adopt a structured methodology in order to facilitate replication.

3.3.2 Phenomenology

Phenomenology has also been cited as the “naturalistic”, “interpretive” or “constructivist” approach, and the “post-positivist” and “post-modern” perspective (Creswell, 2017). This philosophical stance is predicated on understanding human behaviours and actions (Collis and Hussey, 2013), and has been linked with a number of studies on organisations and people. Saunders et al. (2019) posit that the post-positivistic philosophies are well suited for business management research, particularly in areas of organisational behaviour, marketing and human resource management. It emphasises that humans are different from physical phenomena since they create meanings (Saunders et al., 2019). The phenomenological philosophy attempts to understand and interpret social reality based on people’s lived experiences. Thus, phenomenology largely attempts to understand specific phenomena by establishing the meanings that people assign to them (Walsham, 2015). This stance is very critical of the positivist attempt to discover definite, universal laws that apply to everybody (Saunders et al., 2019). The phenomenological approach tends to produce “qualitative data” that is usually very rich but can also be subjective. Based on the characteristics of both philosophies and the nature of this study it adopts the phenomenological philosophy. The study is qualitative employing

a case study approach and as highlighted earlier this philosophical view is well suited for such studies. This philosophical stance will enable the researcher to interact with the phenomenon being studied, in order for the researcher to explore and understand the forecasting practices in the pharmaceutical industry.

The table 3.0 below summarises the essential differences between the two the philosophies discussed above.

Table 3.0: Differences between Positivist and Phenomenology Paradigms

Positivistic Paradigm	Phenomenological Paradigm
• Tends to produce quantitative data • Uses large samples • Concerned with hypothesis testing • Data is highly specific and precise • The location is artificial • Reliability is high • Validity is low • Generalises from sample to Population	• Tends to produce qualitative data • Uses small samples • Concerned with generating theories • Data is rich and subjective • The location is natural • Reliability is low • Validity is high • Generalises from one setting to another

Source: Adapted from Collis and Hussey (2013)

As indicated earlier there is a contrasting Implications of Positivism and Phenomenology paradigms and this has been highlighted in the table below. It focuses on elements such as the observer, the human interest, the unit of analysis and sampling requirement just to mention a few.

Table 3.1 Contrasting Implications of Positivism and Phenomenology

Elements	Positivism	Phenomenological
The observer	Must be independent	Is part of what is being observed
Human interest	Should be irrelevant	Are the main drivers of science
Explanations	Must demonstrate	Causality Aim to increase general understanding of the situation
Concepts	Need to be operationalised so that they can be measured	Should incorporate stakeholder perspectives
Research	progresses through Hypotheses and deductions	Gathering rich data from what ideas are induced
Unit of analysis	Should be reduced to simplest terms	May include the complexity of "whole" situations
Generalisation Through	statistical probability	Theoretical abstraction
Sampling Requires	Large numbers selected randomly	Small numbers of cases chosen for specific reasons

Source: Adapted from Easterby et al. (2021)

3.4 Approaches to developing theory

Research approaches may be categorised into two contrasting approaches namely deduction and Induction. Deductive reasoning occurs when conclusion is logically derived from a set of premises, the conclusions being true when all the premises are true (Ketokivi and Mantere, 2010). As such it is the dominant approach in the natural sciences research (Saunders et al., 2019). The researcher thus develops a

hypothesis and theory when employing the deductive approach. Critics of this approach argue that there is a tendency to construct an inflexible methodology that does not give room for alternative justification of what is happening (Saunders et al., 2019). In contrast, inductive theory occurs where the theory is still unknown but develops based on the analysis of the data gathered (Saunders et al., 2019). Accordingly, theory follows data rather the opposite as is the case with deduction. According to Saunders et al. (2019) inductive reasoning lean towards interpretivist research philosophy in that it seeks to understand how humans interpret their social world by contextualising the research. Researcher utilising this approach are more likely to use qualitative data and varied methods to collect the data. As pointed out by Ketokivi and Mantere (2010) there is however a gap in the logic argument between the conclusion and the premises observed in inductive reasoning. Conclusions are judged to be supported by the observations made (Ketokivi and Mantere 2010).

The table below highlights the differences between deduction and induction.

Table 3.2 Major Differences between the Approaches to Research

Element	Deduction (Quantitative) Emphasis	Induction (Qualitative) Emphasis
Logic	**In a deductive inference, when the premises are true, the conclusion must also be true.**	**In an inductive inference, known premises are used to generate untested conclusions**
Generalisability	**Generalising from the general to specific.**	**Generalising from the interactions between the specific and the general.**

Use of data	**Data collection is used to evaluate propositions or hypotheses related to an existing theory.**	**Data collection is used to explore a phenomenon, identify themes and patterns and create a conceptual framework.**
Theory	**Theory falsification or verification.**	**Theory generation and building**

Source: Adapted from Saunders et al (2019)

Considering the difference in approach, induction seems to emphasise understanding the research context and collecting qualitative data. It adopts a flexible approach making room for alterations in the research emphasis as the study develops.

This research assumes an inductive reasoning approach to aptly answer the research question to achieve the research objectives. The inductive approach is employed since it is flexible and makes room for changes in the research as it develops. The researcher as an actor in the research process implies that the perceptions of the researcher may influence the findings and conclusion. The next section looks at the methodological choice otherwise referred to as research design.

3.5 Methodological Choice

Saunders et al., (2019 p 175) reasoned that choosing to use either quantitative, qualitative, or mixed methods is very vital to every business research design. There is therefore the need for the researcher to have a clear and coherent design with strong reasons for selecting any of the research designs. According to (Saunders et al 2019) justification for methodological choice otherwise referred to as research design should be based on the research question(s) and objectives and must be consistent with the research philosophy. It is very important for the researcher to highlight that there is a difference between research design and research tactics (Teddlie, C. and Tashakkori, A., 2011). Whereas research design focus on the overall plan for the research project; tactics looks at the finer details of data collection and analysis which is at the centre of the research onion (Saunders et al 2019). Reasoning

regarding research tactics requires the researcher to be clear when it comes to differentiating between quantitative and qualitative data collection techniques for example questionnaires, interviews, focus groups and secondary data) and consequent qualitative and quantitative data analysis procedures.

The distinction between quantitative research and qualitative research is mostly based on data i.e either numeric data (numbers) or non-numeric data which may include words, images, audio recordings, video clips etc. Hair et al. (2015)

Often quantitative is referred to as being synonymous to data collection technique like questionnaire which in the end adopts data analysis procedure such as graphs or statistics to produce numerical data. Qualitative on the other hand is mostly used as a synonym for any data collection technique such as interview and data analysis procedure like categorising data that produces or utilizes non-numerical data.

This way of differentiating the methodological choice is important albeit challenging and narrow. It is challenging in the sense that in real life many research designs are most likely to adopt both quantitative and qualitative elements. Reasons being that a researcher may use a research design that utilizes questionnaire to gather data but may be essential to ask participants to answer some 'open' questions using their own words instead of just answering yes or no. In some instances, it may be very vital to perform a follow-up interviews in order to obtain further meaning and clarification from the findings from the questionnaire. Similarly, there are occasions where qualitative research data may also be analysed quantitatively or may form the basis of developing ensuing questionnaire. To this end quantitative and qualitative research can be seen as two ends of a continuum, which in reality are often mixed (Saunders et al 2019).

The dichotomy drawn initially regarding both quantitative research and qualitative research can also be said to be narrow in the sense that it does not factor in how philosophical assumptions inform methodological choice, it only centred on numeric and non- numeric data which is unsatisfactory for selecting either quantitative or qualitative research.

As stated, earlier research philosophy plays an important role by providing coherent way in the selection of appropriate research design**.**

Normally quantitative research designs are linked with positivism, particularly when it combines with data collection techniques which are predetermined and highly

structured (Saunders et al 2019). However, according to (Bryman 2015, Walsh et al 2015a) it is philosophically improper to propose that there is an exclusive link amid positivism, deduction and a quantitative research design. Instead, there should be a clear difference between data relating to the attributes or traits of people, organisations or other things and opinion-based data.

Alternatively, qualitative research is mostly connected with an interpretive philosophy (Denzin and Lincoln 2018). It is interpretive in the sense that the persons carrying out the enquires need to understand the subjective and socially constructed connotations expressed about the phenomenon being studied. This type of research is every so often discussed as naturalistic since researchers need to work within a natural setting, or research context, so as to establish trust, participation, access to meanings and in-depth understanding (Saunders et al 2019). Bryman (2015), however suggest that both qualitative and quantitative research designs can be done within the realist and pragmatist philosophies.

This study adopts the qualitative research designs based on the research questions of this study that address the “what, how, and why”- questions; the data collection technique - semi-interviews and data analysis done on the basis of thematic categorization. Furthermore, on the philosophical stance of the research is the phenomenology paradigm which is also referred to as interpretive stance; hence the qualitative methodological choice does not only follow the research onion by (Sunders et all 2019) but also appropriate in positioning the research on a coherent and clear path. The next section looks at the research strategy.

3.6 Research Strategy

As previously stated, a research design is a plan of how a researcher will go about answering his or her research question (Saunders et al., 2019). The design typically covers the research strategy. The strategies may be used for exploratory, descriptive or explanatory studies (Yin, 2018). The research strategy adopted essentially depends on the research question(s), the set objectives, the extent of existing knowledge, time constraints as well as access to potential participants (Saunders et al., 2019) and not because one strategy is inherently superior.

Yin (2018) identified three conditions for selecting a research strategy. These are as follows:

- Type of research questions.

This is echoed by Neuman and Robson (2012) who also posit that the research strategy and the methods or techniques utilised in a research must be appropriate for the questions to be answered.

- The extent of control the researcher has over actual behavioural events.
- The degree of focus on contemporary, as opposed to historical, events.

As indicated previously, the research question is significantly useful in defining the most appropriate strategy. “What” questions are mainly for asking how many or how much; “What” research questions may suggest a more flexible strategy and can be exploratory (Yin, 2018). “Who and “where” research questions indicate the use of survey strategies. On the reverse “how” and “why” research questions seem more exploratory hence more suited for case study research. The reason according to Yin (2018) is because “how” and “why” questions focus mostly on operational links, instead of simple frequencies or incidence.

According to Saunders et al. (2019) experiments and survey are exclusively linked to quantitative research design whereas narrative inquiry, action research and grounded theory research are primarily linked to qualitative research. Archival research or case study may involve both qualitative and quantitative research.

Below depicts is a basic categorisation of the types of questions into the series who, what, where how and why.

Table 3.3 Relevant Situations for Different Research Strategies

Strategy	Form of research questions	Requires control over behavioural events	Focuses on contemporary events
Experiment	How, Why	Yes	Yes
Survey	Who, What, Where, How many, How much	No	Yes
Archival analysis	Who, What, Where How many, how?	No	Yes/No

	much		
History	How, Why	No	No
Case study	**How, why**	**No**	**Yes**

Source: Adapted from Yin, (2018)

Saunders et al. (2019) mentions that research strategies are not mutually exclusive since for example, a case study research can use survey. They outlined eight (8) research strategies (Saunders et al., 2019) namely:

- Experiment
- Survey
- Case study
- Action research
- Grounded theory
- Ethnography
- Archival research
- Narrative inquiry

3.6.1 Choice of Strategy

The importance of research questions in choosing the appropriate strategy cannot be overemphasised. Below lists the research question this study seeks to answer and states the strategy by which the questions will be answered.

Research Questions

- What forecasting methods are used by manufacturing Pharmaceutical SMEs in Ghana?
- How important is accuracy in demand forecasting to manufacturing Pharmaceutical SMEs in Ghana?
- What barriers manufacturing Pharmaceutical SMEs in Ghana encounters in forecasting,
    - *why do they exist and*
    - *How are these barriers managed?*

- What forecasting GAP exist in practices i.e manufacturing Pharmaceutical SMEs in Ghana?

Considering the model proposed by Yin (2018) in the table 3.4 above, and the aims, objectives and research questions of this study, a case study approach seem more appropriate.

The study focuses on forecasting in the context of the pharmaceutical industry, it tries to understand the dynamics of the phenomenon in the context of pharmaceutical industry and this point is supported by (Yin 2018) who indicate that understanding context is fundamental to case study research. Eisenhardt and Graebner (2007); Ridder et al. (2014) and Yin (2018) further argue that:

"A case study strategy has the capacity to generate insights from intensive and in-depth research into the study of a phenomenon in its real-life context, leading to rich, empirical descriptions and the development of theory".

Dubois and Gadde (2002) also make the point that, 'the interaction between a phenomenon and its context is best understood through in-depth case studies', since the data required for analysis needs to be sufficient (breadth) and thorough (depth) so as to have an in-depth understanding and for theory generation, multiple sources of evidence are employed.

Having justified the use of the case study method, it is also important to set out more definitively the relevance of the use of an exploratory case study related to this research.

3.7 Overview of Case Study

Case study is a research method which is used in several settings to advance knowledge of an individual, group or organisation and related phenomena (Yin, 2018). It is a widespread research strategy utilised in several disciplines such as psychology, anthropology, sociology, political science, business, social work etc. and may be studies of organizations and institutions covering a myriad of issues such as best practice, policy implementation and evaluation, industrial relations, management and organizational issues, organizational cultures, processes of change and adaptation and more.

Yin (2018) describe case study as an in-depth inquiry into a topic or phenomenon within its real-life setting especially when the boundaries between phenomenon and context is not clearly evident. Similarly, Neuman and Robson (2012) defined case study research as

"a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real-life context using multiple sources of evidence".

Further to this Yin (2018) suggested that "The case study allows an investigation to retain the holistic and meaningful characteristics of real life events such as individual life cycles, organizational and managerial processes, neighbourhood change, international relations, and the maturation of industries".

He continues to outline the conditions under which a case study method may be used explaining that when the research poses "why" and "how" questions about a contemporary set of events over which the researcher has little or no control, then a case study method may be used.

Case study research may use quantitative or qualitative methods and many case study designs use a mix of these methods to collect and analyse data (Yin, 2018). Göttfert (2015) add that qualitative data predominates in case studies. The methods that may be used in case studies include interviews, observations, questionnaires and documentary analysis.

This method is criticized for its lack of generalization and replication and usually frowned on by social science researchers (Yin, 2018). It is also criticised for the presence of bias on the part of the researcher. Dawson (2014) argued that, the theory of validity which is typical of quantitative research is not for qualitative research since qualitative researchers admit that their own personal preference and experience influence the research. Triangulation (multiple methods of collecting data) however is a way of increasing the validity and reliability of case study research (Yin, 2018). Yin (2018) in combating criticism raised on the issue of generalizing case studies argued that the goal of a researcher should be analytical generalization and not statistical generalization

3.7.1 Typical features of a case study:

- Selection of a single case of a situation, individual or group;

- Study of the case in its context;
- Collection of information via a range of data collection techniques such as observation, interviews or documentary analyses; and
- Systematic but flexible research strategy which provides detailed prescriptions for data analyses and theory generation.

3.7.2 Case study verses the Survey Research Approach

Although Case study is widely used in many fields of interest, it is however not the only research method available to the researcher. Saunders et al. (2019) identified seven (7) other methods namely experiment, survey, action research, grounded theory, ethnography, archival research and narrative inquiry

Survey is described by Neuman and Robson (2012) as, mainly, to do with the collection of a small amount of data in standardized form from a large number of individuals, organizations, department's etc. On the other hand, Case studies are very effective when they are used to study organizations and institutions. They are very good for exploratory work and as such do not need tight pre-structuring. In a sense, they are more "forgiving" in their design as they allow the space for modifications and change of focus at every stage (Yin, 2018).

Essentially, the survey studies the sample not in its own right but as a means of understanding the population from which it is drawn. Case studies have a prime concern for understanding that particular case in its own right. In reality however, a case study of an organization may incorporate a survey of employees at all levels.

This is an important point for some of the publications presented here; interviews are held within organizations and therefore some of the elements of the survey approach are incorporated in certain outputs. Arguably, the overlapping of more than one research method is indeed a very common scenario and very much an acceptable method as both Yin (2018), Neuman and Robson (2012) and others identify.

3.7.3 Types of Case Study

Yin (2018) distinguishes between four case study strategies based upon two discrete dimensions which are holistic case versus embedded case and single case versus multiple cases.

There are various types of case studies and the ‘case’ can be anything. it case can be an individual person: that is a simple, single case which may just focus on that particular person, an organisation or group in its context. Multiple case studies, on the other hand, tend to be more complex in nature and would involve the study of several individual ‘cases’, being people, organisations or groups, again within their context (Neuman and Robson (2012).

Table 3.4 Case Study Types

Individual case study	Detailed account of one person tends to focus on antecedents, contextual factors, perceptions and attitudes preceding a known outcome. Used to explore possible causes, determinants, processes, experiences, etc. contributing to the outcome.
Set of individual case studies	As above, but a small number of individuals with some features in common are studied. 3.
Community study	Study of one or more local communities. Describes and analyses the pattern of, and relations between, main aspects of community life. Commonly descriptive, but may explore specific issues or be used in theory testing.
Social Group study	Covers studies of both small direct contact groups for example families and larger more diffuse ones such as organisational groups. Describes and analyses relationships and activities.

Studies of events and relationships	Focus on a specific event. Very varied; includes studies of police – citizen encounters, doctor – patient interaction, specific crimes or incidents, studies of role conflicts, stereo types, adaptations
Studies of organisations and institutions	Studies of firms, workplaces, schools, trade unions, departments. Many possible foci, e.g. best practice, policy and organisational issues, cultures, processes of change and adaptation.

Source: Adapted from Yin (2018)

3.7.4 Distinguishing between single and multiple case designs

Saunders et al. (2019) indicated that a single case is often used to represent a critical or unique case and it's easily managed. In contrast, multiple cases focus on whether findings can be replicated across cases. Yin (2018) suggests that both the single and multiple cases should be seen within the same methodological framework, stressing that the main point of differences lay on their specific attributes and therefore their use is dependent on the aims, objectives, and the general design of the specific study. Multiple case studies are seen to be more robust since the evidence gathered tends to be usually more compelling. Single case study approach on the other hand is more appropriate when an unusual or unique situation is to be studied. A single case study research cannot be generalised (Saunders et al., 2016). In effects this research utilises multiple cases studies.

3.8 Exploratory Research

An exploratory research as stipulated by Saunders et al. (2019) is a means of asking open ended questions to discover what is happening to gain insights about a topic of interest. As noted in table 3.4, exploratory research questions are likely to begin with "What" and "How". It is advantageous due to its flexibility and adaptability and it's particularly useful for clarifying understanding of a problem or phenomenon (Saunders et al., 2019). Accordingly, it may begin with a broad focus but becomes narrower as the research evolves.

Creswell and Poth (2018) concisely and judiciously explains that a researcher by carrying out exploratory work attempts to understand a phenomenon in a novel situation where there is little guide to what to expect. Additionally, the approach at the end could be embedded in a wider study which may illuminate on relationships, or even recommend alternative interpretations.

This study is an exploratory research which uses a case study research strategy to explore how Ghanaian Pharmaceutical manufacturing SMEs forecast. The study recognises the uniqueness of the Ghana market and an exploratory research will help identify how the relevant issues identified in the literatures play out in the Ghanaian setting.

As suggested by Yin (2018) case study research uses diverse data collection methods such as interviews, documents, observations and archival records. In this study, a survey approach is not considered. Sending questionnaires to the pharmaceutical manufacturing SMEs is not a practicable exercise firstly because questionnaires are archetypal attribute of a survey research strategy. Even though Göttfert (2015) reiterated by Saunders et al. (2019) suggest that survey type questionnaires can be used both in case study and experimental researches it can only collect small quantities of data and would therefore require a large sample size which may be time consuming. Furthermore, standardized questions work best where there is confidence that the questions mean the same thing to different respondents, a requirement which may be difficult to satisfy.

This study limited the sample to the Forecaster, CEO's, Operations Managers and Sales & Marketing Managers of all 38 pharmaceutical manufacturing SMEs and aimed at interviewing as many as possible until saturation is reached.

3.9 Research Design Summary

This study is reminiscent of most mainstream management research adopts a subjective ontological and phenomenological/ interpretivist epistemological position. According to Saunders et al. (2019) qualitative methods of research are established on interpretivist perspectives. It is based on the assumption that social phenomena are created from the perception and consequent actions of social actors. The actors in this particular case are the CEO's, Operation Managers, Forecasters as well as Sales and Marketing Managers of the 14 manufacturing SMEs in Ghana. Based on

this assumption the researcher interacted with the managers to explore and understand the forecasting process. The purpose of this research requires a deep understanding of the social context within which it is set as the concept of forecasting, its importance and practice may be different from each manufacturer. This study relies on qualitative data gathered through qualitative methods from which ideas can be induced. In an attempt to answer the question of whether manufacturing pharmaceutical SMEs forecast, it is imperative to examine firstly what motivates their decisions. As the focus of this study is to explore the concept of forecasting in Ghanaian manufacturing pharmaceutical SMEs and to explore why and how they forecast, it lends itself to qualitative paradigms since qualitative paradigms considers human attitudes and feelings.

Additionally, the study is an exploratory research which utilises a case study research strategy. As suggested by Yin (2018) case study research uses diverse data collection methods such as interviews, documents, observations and archival records. The researcher employs semi- structured face to face interviews, participant observation and document review to collect data. Although surveys may be used in case study research it was not feasible as a data collection method for this study.

The subsequent section highlights the data collection methods.

3.10 Data Collection Methods

Data is defined by Collis & Hussey, (2013) as:

“Known facts or things used as a basis for interference of reckoning”

Saunders et al. (2019) classified data into two major categories as primary and secondary. Primary data is collected at source and may include survey data, or experimental data, interviews or focus groups, whilst secondary data is data which exists already. It may be in the form of reports, archives, annual reports, etc., and can be either quantitative or qualitative in nature (Collis and Hussey, 2013).

There are numerous ways of collecting data for research. Yin (2018) suggested that case study usually uses six sources of data which are namely documentation, archival records, interviews, direct observation, participant- observation and physical artefacts. However, none of these sources of data is absolutely advantageous over the other therefore the need for triangulation. A case study should make use of many sources of data that are pertinent to the study.

Table 3.5 Data Collection methods

Source of Evidence	Strengths	Weaknesses
Documentation	Stable - can be reviewed repeatedly Unobtrusive - not created as a result of the case study Exact - contains exact names, references, and details of an event Broad coverage - long span of time, many events, and many settings	Retrievability - can be low Biased selectivity, if collection is incomplete Reporting bias - reflects (unknown) bias of author Access - may be deliberately blocked
Archival Records	[Same as above for documentation] precise and quantitative	[Same as above for documentation] accessibility due to privacy reasons
Interviews	Targeted - focuses directly on case study topic Insightful - provides perceived causal inferences	Bias due to poorly constructed questions Response bias Inaccuracies due to poor recall Reflexivity - interviewee gives what interviewer wants to hear
Direct Observations	Reality - covers events in real time Contextual - covers context of event	Time consuming Selectivity - unless broad coverage Reflexivity - event may proceed differently because it is being observed Cost - hours needed by human observers
Participant Observation	[Same as above for direct observations] Insightful into interpersonal behaviour and motives	[same as above for direct observations] Bias due to investigator's manipulation of events

Source: Adapted from Yin (2018)

This research used two data sources to obtain the needed information from the subjects. It employed semi-structured interviews and observations. The pros and cons which informed the choice of methods are discussed in the next sub-sections. The two data sources were used to allow for triangulation. The concept of triangulation is also discussed in subsequent sections.

3.11.0 Interviews

Saunders et al, (2019) explains interviews as essentially asking purposeful questions and carefully listening to the answers for further exploration; and may be highly formalised and structured or informal, conversational and unstructured. They are useful for gathering valid and reliable data relevant to the research objectives and aim. It helps in understanding the motivation for people's attitudes and decisions and potentially records a higher response rate than questionnaire (Saunders et al., 2019). This method can however be flawed by value judgements and arguably a highly subjective process with the presence of bias.

The study employed semi-structured interviews to collect primary data.

3.11.1 Semi-Structured Interviews

Semi-structured interviews also referred to as qualitative research (Brown and Danaher, 2019), are non-standardised unlike structured interviews (Saunders et al., 2019). The researcher may list key questions or themes to be covered but the approach may differ from each interview (Saunders et al., 2019) depending probably on the organisational context or the flow of the conversation.

Some commentators (Easterby-Smith et al 2021; Mikecz, R., 2012) have expressed concern about semi-structured interviews obtaining different data by different researchers due to the non-standardised nature of questions. Consequently, findings and conclusions reached from this method cannot be generalised. One proponents of Semi-structured interviews as a data collection method however argues that the findings are not intended to be replicated since it reflects reality at the time of the study (Rossman, G.B., 2014, Walby, K., 2015). Similarly, there is the issue of interviewer bias since the interviewer is part of the process; and it may be time consuming (Neuman and Robson 2012).

Irrespective of the criticisms, semi-structured telephone interview may be easily accessible and cost effective. For instance, it is easier to contact participants whom it might be unfeasible to interview face to face. Although this method is also saddled with the issue of reliability due to lack of contact; mistrust can be lessened where there has been a prior contact with participants (Saunders et al., 2019). Abbot and Mckinney (2013) sums it all up by indicating that the success of the process relies mostly on the skill of the researcher, thus good interviewers subordinate their own feelings and opinions about the topic.

3.11.2 Observation

Observation entails the systematic viewing, recording, description, analysis and interpretation of people's behaviour (Saunders et al., 2019). Typically, observation is either participant observation and or structured observation. Neuman Robson, (2012) suggest that a significant attribute of participant observation is that the observer become a member of the people or process being observed. The researcher observes the events and attaches a meaning to them. Observational evidence can be useful for providing additional information about the research topic; and can be sidewalk activities, observation of meetings factory work etc (Yin, 2018). This provides access to events or groups that would otherwise be inaccessible. The interpretation given to the observed events is an important element of direct observation. It has been suggested that the observer should follow the interpretations given by the respondents, and not the observer's own interpretation. Saunders et al. (2016) also suggest that the high level of immersion achieved by the researcher makes participant observation a strong technique compared to other data collection techniques. It must be noted however that participant observation does not imply complete participation, where the observed is ignorant of the researcher's real purpose. In participant observation, the observed knows the observer is there for a reason (Neuman & Robson, 2012).

3.11.3 Review of documents

Documents have an explicit role in collecting data for case study research; even though it is not seen as a substantial technique for carrying out case study research, it is a very effective tool when used for the triangulation of the findings of the other methods (Maxwell, J.A.2013). Documents review is usually seen as a supplementary method to observation, participant observation and interviewing in case study research (Marshall and Rossman 2014) For case study research, documents review is important for corroborating and augmenting the evidence from the other sources (Yin, 2018). It has been criticised for potential overreliance on documents in case study research (Yin, 2018).

3.12 Triangulation

Triangulation (multiple methods of collecting data) is a way of increasing the validity and reliability of case study research (Yin, 2018). Neuman & Robson, (2012) explains: "..the use of evidence from different sources, of different methods of collecting data

and of different investigators, where feasible, are all triangulation techniques which enhance credibility".

Collis & Hussey (2013) Suggests in case study research, using multiple sources of data is essential to the study. In a case study, any findings or conclusions are likely to be more convincing and accurate when multiples sources of evidence are used (Yin, 2018). When multiple approaches of data collecting are used within the case study, then the researcher is more likely to clarify or nullify some inessential influences, thus adding value to interpretations and therefore to the conclusions derived from that.

Schwandt (2015) outlines four categories of triangulation as

1. Data triangulation, where there is a look to see if the phenomenon or case remains the same at other times, in other spaces, or as persons interact differently.

2. Investigator triangulation, where there is more than one researcher that take a look at the same phenomenon.

3. Theory triangulation, where co-observers, panellists, or reviewers are chosen based on their alternative theoretical viewpoints of the same phenomena so as to offer some triangulation.

4. Methodological triangulation is the fourth protocol; this is the one most recognised and predominantly used in this study.

In this study, to help answer the research questions, semi -structured interviews was the main primary data collection source. Participant observation is also used.

3.13 Validity and Reliability

Yin (2018) invented four tests for measuring the quality of a case study. See Table 3.7 below. Generally, validity is the extent to which the research findings accurately represent what it appears to be about. Conversely, reliability is concerned with the actual research findings and the general credibility of these findings. Merriam and Tisdell (2016) in explaining reliability talks about the stability and consistency of measurements whiles in the case of validity the measure of the right concept.

Saunders et al. (2019) defines reliability as the extent to which data collection techniques or analysis methods yield consistent findings. Additionally, Neuman & Robson (2012) highlighted four threats to reliability as participant error and bias; and observer error and bias.

As rightly stated by Easterby et al. (2021), the terms reliability and validity may mean different things within different research traditions. The positivist researcher views validity in the light of whether the design makes it possible to eliminate plausible alternative explanation whereas to the phenomenologist it is whether a sufficient number of perceptive have been covered (Easterby et al., 2021). Likewise, reliability to the positivist focuses on the measures used to provide a good approximation to the underlying concepts of interest whereas reliability to phenomenologist is whether similar conclusions or observations will be reached by other observers (Easterby et al., 2021).

In qualitative research however, the focus seems to be on validity rather than reliability. Yin (2018) proposes four tests to establish the quality of empirical research:

1. Construct validity: establishing correct operational measures for the concepts being studied. To increase construct validity, three tactics are available:

    i. Use multiple sources of evidence: this tactic is relevant during data collection.

    To increase the construct validity, the researcher used many sources of evidence, such as semi-structured face-to-face interviews as the main source of data, plus participant observation, as in the case of this research.

    ii. Establish a chain of evidence: this tactic again is relevant during data collection.

    iii. To have the draft case study report reviewed by key informants.

2. Internal validity (for explanatory or causal studies only, and not for descriptive or exploratory studies): establishing a causal relationship, whereby certain conditions are shown to lead to other conditions, as distinguished from spurious relationships.

Table 3.6 Reliability and Validity Test

Tests	Case study Tactic	Phase of Research Tactic occurs
Construct Validity	Use multiple sources of evidence Establish chain of evidence Have key informants review draft case report	Data collection Data collection Composition
Internal Validity	Do pattern matching Do explanation building Address rival explanations Use logic	Data analysis Data analysis Data analysis Data analysis
External Validity	Use theory in single-case studies Use replication logic in multiple-case studies	Research design Research design
Reliability	**Use case study protocol** **Develop Case study database**	**Data collection** **Data collection**

Source: Adapted from (Yin 2018)

3.14 The Pilot Study

Saunders et al. (2019) defines a pilot study as:
'A small-scale study to test a questionnaire, interview checklist or direct observation schedule, to minimise the likelihood of respondents having problems in answering the questions and of data recording problems as well as to allow some assessment of the questions' validity and the reliability of the data that will be collected'

Saunders et al. (2019) emphasises the need to pilot test to refine the questions respondents will be asked to avoid respondents having problems answering the questions. Furthermore, it helps the researcher evaluate the validity of the questions and the likely reliability of the data collected.

To determine the suitability and relevance of the interview questions, four pilot interviews were conducted. Two academics as well as two business practitioners from

different manufacturing pharmaceutical companies were selected to partake in the pilot.

The interview questions were developed based on the 22 barriers and 28 enablers relating to SMEs forecasting process in the pharmaceutical industry identified from the literature review phase built on the research questions, aim and objectives.

Both barriers and enablers were originally classified into eight themes, upon which the conceptual frameworks as well as the 58 interview questions, (27 being main questions and 31 supporting questions) were developed

Feedback from the pilot was very vital as it highlighted potential challenging areas in the interview process. The attention of the researcher was also drawn to other issues such as overlapping of some questions, questions requesting similar information at different stages of the process. Comments and suggestions received helped rephrased and, in some instances, moved questions between groups of questions to help bring clarity for the final interview questions.

In the end the themes were regrouped into seven and a general classification theme introduced. The interview questions reduced to 53, with 24 leading questions, and 29 supporting questions. The supporting questions were added to deepen the understanding of certain areas of interest as required and encouraging further discussion therefore not all were always asked during the interview process.

3.15 Sample Selection

According to Saunders et al (2019), choosing a sample technique is reliant on the feasibility and sensibility of collecting data to answer the research question and address objective from the entire population. Furthermore, they suggested that if the population size is under 50 it is ideal to collect data from the entire population. Based on Saunders et al (2019) submission and for representativeness the researcher adopted census sampling technique to collect data from all 38 SMEs in the manufacturing pharmaceutical industry in Ghana, however after several attempt to gain access to all the 38 organization failed the researcher then adopted snowball sampling technique.

Snowball sampling also described as chain referral sampling Bryman and Bell (2015) It is a non-probability sampling technique where participants or interviewees whom the researcher has already contacted refer the researcher to other potential

participants using their social network Anderson (2009). Snowball sampling is often used to find and recruit “hidden populations,” that is, groups not easily accessible to researchers through other sampling strategies.

As indicated earlier the researcher made several attempt to contact almost all 38 SMEs but failed to gain access, however upon referral to CEO1 by the researcher’s colleague who work in the pharmaceutical industry in Ghana, the researcher gained access to the first organization coded as SME1, the participant happens to be the CEO then later referred the researcher to a couple of participants, who also in the end referred others. In total 14 SMEs granted access to the researcher, below is a table 3.8 that shows the number of participants who partook in the research all of whom were contacted as a result of snowball sampling.

Table 3.7 Participant & Organization

Organization's Code	Interviewee's Code	Interviewee's Position
SME1	CEO1	CEO
SME2	PM1	Procurement Manager
SME3	PM2	Procurement Manager
SME4	OP1	Operations Manager
SME4	OP2	Operations Manager
SME5	OP3	Operations Manager
SME6	CEO2	CEO
SME7	MM1	Marketing Manager
SME8	MM2	Marketing Manager
SME9	MM3	Marketing Manager
SME10	MM4	Marketing Manager
SME11	SMM1	Sales & Marketing Manager
SME12	SMM2	Sales & Marketing Manager
SME13	MM7	Marketing Manager
SME14	SMM3	Sales & Marketing Manager

Source: The Author

3.16 Unit of Analysis

Identifying the unit of analysis is the initial phase in analyzing the data Merriam and Tisdell, (2016). The unit of analysis according to Yin (2018) is the person or entity whom the researcher collects data, and it helps clarify the question of 'what' and 'who' is being studied in the research. It consists of persons, groups of people, organizations, countries, and other objects that are at the centre of the research. The unit of analysis for this particular research is defined as both persons who are involved in forecasting the demand of finished pharmaceutical products and their respective organizations (SMEs)

It is essential to state from the onset that whereas the persons or individuals participating in the research are classified as the primary unit of analysis, it is fitting to look at their organisations in the same level. Although the research questions are connected and form part of the study outputs, they are not mutually exclusive, in the sense that, there are some questions put to the participants, which are interrelated to their understanding and knowledge of the forecasting processes and practices in pharmaceutical organisation they represent

Yin (2018) postulate that where there is no clarity regarding the unit of analysis in any case study research from the onset the researcher runs the risk of mix-up between the unit of data collection and the unit of analysis which in the end can cause a muddle for the reader. Notwithstanding, in clarifies that this challenge can be allayed by producing a clear and robust case study protocol.

Hence in regard to this study, the research questions in the protocol are outlined in a way that there is a clear differentiation between questions asked at the individual level and the organization level.

3.17 Conducting the Case Study

The case study was conducted in Ghana over a two month period. The target was to interview all the 38-manufacturing pharmaceutical SMEs currently operating in Ghana; however, during the data collection stage, the researcher was able to interview 14 out of the 38 SMEs due to lack of access and time constraint.

The priority group for the interview were Forecaster, CEO's, operation Managers and procurement managers not excluding Sales & Marketing Managers in each manufacturing SME.

Each interviewee was given a description of the research purpose. Easterby-Smith (2021) emphasise the importance of developing trust between the researcher and the targeted interviewees as an important factor in conducting qualitative interviews.

The researcher travelled to Ghana to meet all 14 participants and conduct the interviews. The language used for the interviews was the English language. Although the interview was conducted in English, there were a few times that some of interviewee used the local diction to emphasise a point being made. Granting that the interviews were conducted in Ghana, not all the 14 participants were Ghanaians, their background were quite diverse. Two interviewees were Indian citizens but domiciled in Ghana, heading subsidiaries of their Indian based pharmaceutical companies in Ghana. Their perspective due to their exposure to two very distinct world views enriched the interview. Though the travelling presented additional cost to the study, it wasn't any surprise as from the beginning it was clear the interviews will be conducted abroad.

The entire 14 interviews were audio recorded using a high-quality audio recorder which also transcribes the voice. Consent for interviews was sought in advance before the actual day of the interview however, before any recording actually begun, each study participant was asked to give consent for the interview session to be recorded, having been informed beforehand of the purpose of the recording. For the avoidance of doubt and to reassure participants, an informal discussion which was not recorded was held to help participants understand the purpose and aims of the study and to clarify any misgivings they may harbour by giving them an opportunity to ask questions or comment. The opportunity was taken to also address confidential issues regarding the interviews, and the interviewees were guaranteed that their personal details would not be disclosed and that the recordings would be irreversibly destroyed as soon as transcriptions of the interviews had been completed. As mentioned initially, recording help keep the interview sessions short since the information being relayed is captured in the first instance without asking participants to unnecessarily repeat so you can catch up with transcribing. Interview transcriptions can be done later after recording. Before each interview began the researcher explained that the interview was intended to be confidential and not invasive and that interviewees can stop the

voice recorder at any time or withdraws. Interviewees were also given the opportunity to listen to the recording after the interview although all declined.

3.18 Data Analysis

Analysis of qualitative data requires a prior preparation and organisation of the data to facilitate a smooth analytical process. Analysis may begin right from the data collection stage in other to shape the data collection (Easterby et al. (2021). Qualitative data unlike quantitative data derive meanings from spoken or textual words and not numbers; they are non-standardised and therefore normally analysed through conceptualisation (Saunders et al., 2019). This type of data is linked with the interpretivist /phenomenological philosophy which maintains that reality is socially construed and depends on people's interpretation. Due to the non-numeric nature of qualitative data, they tend to be elastic and complex therefore the need to process them by summarising the data to condense them, code and categorise into meaningful thematic groups (Saunders et al., 2019). After coding and categorising the qualitative data, it is now possible to apply statistics on diagrams for analysis.

3.19.1 Data Analysis Approach

There seems to be no hard and fast rules as how qualitative analysis should be approached, with different commentators suggesting different approaches. Evidently, Easterby et al. (2021), identified seven main approaches to qualitative data analysis as content, grounded, visual, discourse, conversation, argument and narrative analysis. Neuman and Robson (2012), also proposed various typologies linked to the methods of analysis and these are quasi-statistical methods, template approach, editing approach and immersion approach (table below shows the different approaches). Yin (2018) commenting, proposed that the overall goal in data analysis should be to treat the evidence fairly, produce compelling, analytic conclusions and rule out alternative interpretations.

In spite of the lack of a homogeneous approach to qualitative analysis in the existing literature, Miles, Huberman and Saldaña (2014), cited in Neuman and Robson, (2017)

identified some common characteristics that runs through all the suggested approaches.

These are listed in table 3.8 below giving codes to the initial set of materials obtained from observation, interviews, and documentary analyses.

Adding comments, reflections or keeping memos.

Going through the materials to identify similar phrases, patterns, themes, relationships, sequences, differences between sub–groups, etc.

Gradually elaborating a small set of generalisations that cover the consistencies one discerns in the data.

Linking these generalisations to a formalised body of knowledge in the form of constructs or theories.

Table 3.8 Data Analysis Approaches

Quasi–statistical approach	Use word or phrase frequencies and inter-correlations as key methods of determining the relative importance of terms and concepts. Typified by content analysis.
Template approach	Key codes are determined either on an *a priori* basis (i.e., derived from theory or research questions) or from initial read of the data. These codes then serve as a template or bins for data analysis, the template in this case could be changed as analysis continues. Typified by matrix analysis, where descriptive summaries of the text segments are supplemented by matrices, network maps, flow charts and diagrams.
Editing Approach	More interpretive and flexible than the above. No or very few *a priori* codes used. Codes are based on the researcher's

	interpretation of the meanings or patterns in the texts. Typified by grounded theory approaches
Immersion Approaches	Least structured and most interpretive, emphasising researcher insight, intuition and creativity. Methods are fluid and not systemised. Close to literary/artistic interpretation and connoisseurship (i.e., calling for expert knowledge and targeted at a similarly skilled audience). Difficult to reconcile with the scientific approach.

Source: Adapted from Neuman and Robson (2012)

3.19.2 YIN'S (2018) Analytical Techniques

Yin (2018) devised five analytic techniques for case study analysis namely pattern matching, explanation building, time-series, logic model and cross-case. He proposed the use of any of these techniques within the analytic strategy adopted.

1. Pattern Matching: pattern matching logic compares an empirically based pattern with a predicted pattern made before the data for the case study was collected. If the case matches the predicted patterns, then the case supports the theory in the same way as successful experiments support a theory; if the patterns are comparable, the results can help a case study to strengthen its internal validity.

2. Explanation Building: this technique aims to analyse the case study data by building explanations about the case. This technique according to Yin (2018) is relevant to explanatory case studies. With the explanation technique, the findings are compared to any statement or proposition created.

3. Time-Series: Yin (2018) argues that if the events have been traced in detail and with precision over time, the time-series analysis technique may be possible.

4. Logic Model: The logic model deliberately stipulates a chain of events over an extended period of time. The events are phased in with a repeated cause-effect-

cause-effect pattern, whereby a dependent variable (event) at an earlier phase becomes the independent variable for the next phase. This process can help define the sequence of programmatic actions will accomplish the goals (Yin, 2018).

5. Cross-Case Synthesis**:** cross-case synthesis is a technique especially relevant to research consisting of at least two cases. This technique treats each individual case study as a separate case (Yin, 2018).

3.20 Criteria for evaluating quality of an analysis

The following factors may be used for evaluating the quality of data analysis.

Credibility: this demonstrates that the research was conducted in such a manner that the subject of the enquiry was correctly identified and described. Credibility can be improved by the researcher's immersion in the study for a prolonged period of time, by persistent observation of the subject to obtain deep understanding.

Transferability: this is concerned whether the findings can be generalised to another situation.

Dependability: illustrates that the research process is systematic, rigorous and well-documented.

Conformability: if the study has described the research process fully, allowing assessment on whether the findings flow from the data.

3.21 Data Analysis Process

After completing the process, the researcher will continue to explore key themes and patterns or relationships among the data units. In addition, the researcher will consult other sources of data collected during the fieldwork, such as reports, notes taken during participant observation and any other relevant archival resources. This will be for the purpose of triangulation and to enhance clarification of the issues and themes under investigation.

3.22 Summary of Methodology

This chapter extensively discussed the research methodology employed in this study. The discussion centred on research philosophy, research approach, research strategy and the data collection and analysis methods and techniques.

The phenomenological research philosophy is preferred as the most appropriate philosophical basis of this study because of the nature of the research, the aim, objectives and research questions. Likewise, the two approaches to research theory development were discussed and the researcher adopted the inductive approach with no predetermined hypothesis. Subsequently, the various research strategies were discussed, this study however is an exploratory case study research which uses face-to-face semi-structured interviews, observation and documents review as the main sources of data collection. The chapter also highlighted topics such as triangulation and piloting. The final sections of the chapter focused on data analysis.

The next chapter presents and discusses the findings of the study.

Chapter Four
Findings

4.1 Introduction

This chapter presents the primary findings of the face-to-face semi-structured interviews carried out for this research as stated in the methodology chapter.

Collins and Hussey (2016), states that the data collection, analysis and the discussion of every research work should be governed by the overarching research questions, it is therefore important to restate these questions at this stage to keep the purpose of the research in focus.

The research questions that this thesis seek to answer are as follows:

- What forecasting methods are used by manufacturing Pharmaceutical SMEs in Ghana?
- How important is accuracy in demand forecasting to manufacturing Pharmaceutical SMEs in Ghana?
- What barriers manufacturing Pharmaceutical SMEs in Ghana encounters in forecasting,
    - *why do they exist and*
    - *how these barriers are managed?*
- What forecasting GAP exist in practices i.e manufacturing Pharmaceutical SMEs in Ghana?

The researcher in attempt to answer the above questions developed a theoretical framework from the literature review findings, and based on the framework, designed the interview questions to procure the data.

The theoretical framework is presented in detail below.

4.2 Theoretical Framework

From the literature review phase of the research taking into account the research questions, aim and objectives of the research, 22 barriers and 28 enablers relating to SMEs forecasting in the pharmaceutical industry were identified.

Both barriers and enablers were originally classified into eight themes, upon which the theoretical framework and the interview questions were developed, however after conducting the pilot interview on both academicians and forecasting practitioners the

classification were reduced to seven and the interview questions reduced to reflect same.

Nonetheless, a further general class of questions were introduced to the thematic groups, which looked at background information about the interviewees, the organization they represented, their length of experience, roles within the organisation as well as their involvement in the forecasting process. This is referred to as the general class of questions and formed the initial part of the interview questions.

The result of the above discussed exercise is a theoretical framework, a theoretical contribution to knowledge, outlined in Table 4.0 below.

Table 4.0 Theoretical Framework

Enablers/Facilitators	**Barriers**	**Reference**
Theme 1 General Overview Questions	*Reserved for the general overview interview questions*	
Theme 2 Process - Data and Method		
E1 The forecasting process is the selection of data and superimposition of method to predict the future. Good forecast requires both right data and method.	**B1** Right data but wrong choice of method may produce bad forecast and vice versa	**B1** Armstrong (2017) **E1** Georgoff and Murdick, (1986)
E2 Studying data pattern is important for choosing the right forecasting method	**B2** External factors affect choice of method	**B2** Mentzer & Moon (2005) **E2** Armstrong (2001)
E3 Data availability influence choice of forecasting method	**B3** Forecasters assumption and practices influence the choice of method either judgement or quantitative	**B3** Makridakis & Wheelwright (1979) **E3** Armstrong (2017)

E4 Combining methods reduce ex ante forecast error and bias	**B22** Forecasting software selected and purchased by the wrong people	**B22** Moon (2006) **E4** Armstrong and Green (2017)
E13 Advanced forecasting techniques-an ill-developed Management Information System will lead forecasters to rely more on informal information	**B23** Expertise or experience of the forecaster ignored when evaluating forecasting software for purchase	
Theme 3 Quantitative methods Verses Judgemental methods		
E5 Quantitative methods are more systematic accurate and effective than unaided, subjective judgements	**B4** Statistical forecasting assumes stable patterns business without considering economic data which is intrinsically unstable and continuously changing	**B4** Makridakis (1981) **E5** Sanders & Manrodt, (2003), Mentzer &Moon, (2005)
E6 Judgemental methods are preferred by companies due to environmental uncertainty, and variability of data	**B5** With Judgemental forecasting additional information provides overconfidence	**B5** Makridakis & Wainwright (1989) E6 Sanders and Manrodt (2003)
E7 Qualitative techniques may be utilised especially in situations where there is no or little demand history	**B6** Judgement is also characterised with large errors and systematic biases	**B6** Lawerence et al, (2006)
E8 Interaction Groups approach which builds consensus by a group of experts through debate and		**B6** Lawerence et al, (2006) Petropoulos et al (2010)

discussion to produce a forecast more accurate		
Theme 4 Forecast Accuracy		
E9 Accurate forecasts can increase efficiency	**B7** Turbulence in the environment such as high inflation rates and or recession likely result in forecasting errors due to their unpredictive nature	Armstrong (2017)
E10 Stability in external environment means forecasting is continuations of established patterns and therefore accurate	**B8** Cost of inaccurate forecasts- loss of sales, loss of profit, loss of customers or potential customers.	**B8** Nikolopoulos et al (2014) **E10** Armstrong (2017)
E28 Documenting all the assumptions made and all changes to the original forecast		**E28** Armstrong (2017)
Theme 5 Forecast Error		
E11 Analysis of previous errors will determine systematic changes in past patterns	**B9** Mistakenly sensing demand signals or predicting false pattern /relationship	Armstrong (2006) and Chase Jr (2013)
E12 Domain knowledge with regard for marketplace dynamics essential for mitigating errors	**B10** Insufficient information or inability to identify wrong information can also result in errors	Chase Jr (2013)
E13 Advanced forecasting techniques- advanced forecasting techniques may	**B11** Sporadic changes in patterns and relationships overtime may cause	Chase Jr (2013)

also provide fewer forecasting errors, but an ill-developed Management Information System will lead forecasters to rely more on informal information	continuous errors which may not be predicted-Such changes as stock price fluctuations, interest rates, exchange rates, and commodity price	
Theme 6 Forecasting Demand		
E14 Inventory Management	**B12** Availability and price basis for buyer's decision	**B12** Polychronakis and Syntetos (2007) **E14** Moon, (2006)
E15 Identifying potential customers		Polychronakis and Syntetos (2007)
E16 Capacity to fulfil customer demands	**B13** Customer Expectations	**B13** Porasmaa and Ojala, (2011) Monczka et al., (2009)
E17 Efficient allocation of marketing resources	**B14** Intermittent Demand patterns are difficult to forecast	**B14** Syntetos and Boyan (2011) Syntetos et (2015) **E17** Chase Jr (2013)
E18 Increase market share		Chase Jr (2013)
Theme 7 Forecasting Climate / Culture		
E19 Tailored training for forecasters	**B15** Lack of understanding by management	Mentzer, Moon, Kent, & Smith, (1997)
E20 Reward alignment	**B16** Lack of specific training for forecasters	**B16** Fildes and Hastings (1994)

		E20 Davis and Mentzer (2007),
E21 Performance Measurement	**B17** Lack of Collaboration or teamwork among the functional areas such as sales and operations	Moon (2006)
E22 Right Technology		Moon (2006)
E23 Formalised communication	**B18** Lack of quality collaboration among sales, marketing, finance, and operations functions	**B18** Chase Jr (2013)
E24 Management Support	**B22** Forecasting software selected and purchased by the wrong people	**B22** Moon (2006) **E24** Mentzer, Moon, Kent, & Smith, 1997)
Theme 8 Industry Dynamics		
E25 Branding, loyalty	**B19** Industry and health policy -pharmaceuticals manufacture according to regulations	**B19** Darroch & Miles, (2011)
E26 Pharmaceutical Product life cycle forecast allows the companies to formulate and apply the appropriate marketing strategies	**B20** Forecasting for new drugs challenging since little to no historical data is available	Nikolopoulos et al (2016).
E27 Generic Drug- grows rapidly immediately after the patent expiry of the branded alternative	**B21** Expectations of stake holders Patients, doctors and health insurance	Nikolopoulos et al (2016). **E27** Kanavos *et al.* (2008)

The subsequent section presents the interview questions used in gathering the data.

4.3 Interview Questions

The researcher developed the interview questions to answer the research questions and to also address the research aim and objectives. These were designed based on the theoretical framework outlined in section 4.2. above. The process required a thorough and even coverage of the subject matter, minimising over-coverage of one aspect of forecasting. The interview questions reflect the order of the thematic groups in the theoretical framework on issues surrounding the forecasting process, data, methods, forecasting demand, forecast accuracy, forecast errors, climate and culture without precluding industry dynamics.

Altogether, 53 interview questions were formulated, with 24 leading questions, and 29 supporting questions. The supporting questions were added to deepen the understanding of certain areas of interest as required and encouraging further discussion therefore not all were always asked during the interview process. The leading and complimentary interview questions are presented below;

Class 1 Questions: General Overview Questions

1. Can you tell me about your organisation? (Overview, ie number of employees, turnover etc)
2. What is your role in the organisation and how long have you worked for the organisation?
3. Does your organization forecast demand for finished products?
4. Are you involved (at any stage) in producing the company's forecast? How long have you been involved?

Class 2 Questions: Forecasting Process- Data and Method

5. What does your company's forecasting process entail?
    - ✓ What Data or information is usually needed before a drug is manufactured?
    - ✓ How does the availability of data influence the choice of method?
    - ✓ Who is responsible for selecting the forecast method?

- ✓ To what extent is the choice of method driven by the business strategy or forecasters assumption/experience.

6. In your opinion do any external factors (competition, prices of raw materials, new legislations etc) affect the choice of method?
    - ✓ If yes what are these factors
    - ✓ In which ways does factors mentioned above affect forecasting process?
7. Do you use any information technology system /software to forecast? *(if **NO** what process/platform do you use)*
    - ✓ If yes, how effective is the IT system, is it suitable for the purpose?
    - ✓ Who is responsible for purchasing the IT system or software?
    - ✓ Are the expertise or experience of the forecaster sort when evaluating forecasting software for purchase?
    - ✓ Do you think generally there is a trend of overreliance on technology because of the believe that technology will automatically make forecast accurate?

Class 3 Questions: Forecasting Demand

8. When forecasting demand what steps does your company take to ensure supply matches demand to avoid excess storage or lost sales, especially forecasting for new drug?
    - ✓ When a new drug is introduced to the market how is the Product life cycle (**development**, **introduction**, **growth**, **maturity**, and **decline**) forecasted in order to apply the appropriate marketing strategies to the stage?
9. How do you forecast for products with erratic (irregular) demand patterns?
10. From your experience and observation, what do you perceive are the obstacles to demand forecasting?
    - ✓ In your opinion why do these barriers exit and what can be done to eradicate the obstacles mentioned?

Class 4 Questions: Quantitative methods Verses Judgemental methods

11. Which form of forecasting is favoured in your organisation (quantitative or judgemental)?

- ✓ Why this type?
- ✓ In your opinion which form is more accurate and why.
- ✓ From your experience which form is prone to errors; and does additional information makes any difference?

12. Does uncertainty in the external environment determine which method is adopted?
13. Do you combine both forms when forecasting? Do you obtain superior forecast by this process?

Class 5 Questions: Forecast Accuracy

14. In your opinion, is forecast accuracy important to your department and organisation?

15. How does accurate forecast affect:
    (a) sales,
    (b) profit,
    (c) Customers or potential customers?

Class 6 Questions: Forecast Errors

16. How do you identify errors in previous forecast in order to avoid in subsequent forecast?
    - ✓ In your opinion, how does turbulence in the environment (stock price fluctuations, interest rates, exchange rates, high inflation rates and commodity price, sickness or disease outbreak) affect accuracy?
    - ✓ Which processes are used to test the validity of information available?
    - ✓ Do you document all the assumptions and changes to the original forecast?
    - ✓ Does domain knowledge (***any information relevant to the forecasting task other than the time series***) help mitigate errors?
17. In your opinion how is forecasting errors minimised in your company.

Class 7 Questions: Forecasting Climate / Culture

18. In your opinion how supportive and committed is management to the process of forecasting.

- ✓ Do you think management understand the importance of demand forecasting for example to influence return on investment?
- ✓ Generally, do you think management are willing to provide the needed resources for effective forecasting?

19. Is there any collaboration among the various department in your organisation i.e. sales, marketing, finance, and operations functions etc? (***It is believed that there is lack of teamwork and consensus among the demand and supply side resulting in separate forecast for the different functional areas and not a blueprint forecast for the organisation.)***
    - ✓ Is there formalised communication between the demand and supply side during the forecasting process?
    - ✓ Which employees from both sides participate in the collaboration or integration
20. In your opinion, has your company been successful with the integration of forecast from the various functional areas?
21. Have you at any time received any training (formal or otherwise) in forecasting?
    - ✓ How does the training or lack of it impact your ability to forecast?
    - ✓ Is Forecast-accuracy metrics inculcated into performance evaluation?
    - ✓ Is there any reward regime in place to celebrate performance regarding accurate forecasting?

Class 8 Questions: Industry dynamics- stakeholders' interaction

22. Could you tell me which classification of drug you manufacture- branded or generic or both?
    - ✓ If branded what forecasting method do you use?
    - ✓ If Generic what forecasting method do you use?
    - ✓ If both what forecasting method do you use?
    - ✓ If generic, how do you forecast to take advantage of the branded alternatives?
23. How important is brand loyalty to forecasting demand especially for new drug?
24. In your opinion does the Industry regulations and the government health policy impact your demand forecast? In what ways does it impact it?

4.4 Interview Organisation and Participant Encryption

As indicated above in section 4.3, the interview questions were grouped into eight categories consistent with the theoretical framework of the thematic groups. This approach provided ease of comparison between the interview questions and the theoretical framework and maintained a high level of clarity, affecting the way the interviews were completed.

The interview process started with general questions which looked at background information about the interviewees, the organization they represented, their length of experience, roles within the organisation as well as their involvement to the forecasting process before progressing into the subject matter of forecasting. These sets of questions were added to ensure that personnel interviewed had the relevant experience and know how in the issues of forecasting in the Ghanaian pharmaceutical manufacturing industry.

Altogether 14 interviews were conducted. The study participants held various position ranging from CEO's, Operation managers, Sales, marketing & procurement managers within the case study organisations.

The procurement managers were added to get the perspective of how internal demand of materials was conducted and how that affected or contributed towards forecasting for demand of finished goods.

The approach worked to perfection, as most of the candidates naturally flowed and without any difficulty moved on to answer the interview questions on demand forecasting in the SMEs pharmaceutical industry.

The table 4.1 below shows the composition of the participants.

Table 4.1 Composition of the Participants

Positions	Total Number
CEO's	2
Procurement Managers	2
Operations Managers	3
Sales & Marketing Managers	3
Marketing Managers	4

Source: The Author

To meet the ethical conditions established from the onset of this study, and for the purpose of the research, as well as honouring the promise made to the participants of this study, the interviewees names are encrypted to maintain anonymity. The interviewee names and the matching participant codes are locked away as well as the consent forms of participant and the interview transcripts. The above-mentioned documents will be permanently destroyed three years after the completion of the study.

The assigned codes for participants and their corresponding position in the organisation, as well as the date and length of the interview are depicted in Table 4.2 below.

Table 4.2 Interview Schedule

Organization's Code	Interviewee's Code	Interviewee's Position	Interview Date	Interview Duration
SME1	CEO1	CEO	22.04.2019	64
SME2	PM1	Procurement Manager	22.04.2019	36
SME3	PM2	Procurement Manager	23.04.2019	40
SME4	OP1	Operations Manager	24.04.2019	57
SME5	OP2	Operations Manager	24.04.2019	40
SME6	OP3	Operations Manager	25.04.2019	51
SME7	CEO2	CEO	26.04.2019	70
SME8	MM1	Marketing Manager	29.04.2019	63
SME9	MM2	Marketing Manager	30.04.2019	48
SME10	MM3	Marketing Manager	01.05.2019	49
SME11	SMM1	Sales & Marketing Manager	03.05.2019	64
SME12	SMM2	Sales & Marketing Manager	04.05.2019	43
SME13	MM4	Marketing Manager	05.05.2019	57
SME14	SMM3	Sales & Marketing Manager	05.05.2019	60

Source: Author 2019

To make the participant codes representative and informative, they were generated from the characteristics of the participants. Each letter and digit of every code is significant. Basically, the codes were coined out of the respective job titles of participants. Chief Executive Officer- CEO, Procurement Manager - PM, operations Manager – OP, Sales and Marketing Manager - SMM, Marketing Manager - MM.

Similarly, a digit within the participant code, represent the number of interviewees within the group.

All 14 interviews were held in Ghana in English language and the researcher travelled to Ghana to meet the participants. Granting that the interview was conducted in English, there were a few times that some of the interviewee used the local diction to emphasise a point being made.

Despite the fact that the interviews were conducted in Ghana, not all the 14 participants were Ghanaians, their background were quite diverse. Two interviewees were Indian citizens but domiciled in Ghana, as expatriates their perspective due to their exposure to two very distinct world views enriched the interview. Though the travelling presented additional cost to the study, it wasn't any surprise as from the beginning it was clear the interviews will be conducted abroad.

The entire 14 interviews were audio recorded using a high-quality audio recorder which had the capability to auto generate transcript from the audio recordings. Consent for interviews was sought in advance before the actual day of the interview however, before any recording actually begun, each study participant was asked to give consent for the interview session to be recorded, having been informed beforehand of the purpose of the recording. For the avoidance of doubt and to reassure participants, an informal discussion was held to help participants understand the purpose and aims of the study and to clarify any misgivings they may harbour by giving them an opportunity to ask questions or comment and all these conversations were not recorded. The opportunity was taken to also address confidentiality issues regarding the interviews, and the interviewees were guaranteed that their personal details would not be disclosed and that the recordings would be irreversibly destroyed as soon as transcriptions of the interviews had been completed. As mentioned initially, recording help keep the interview sessions short since the information being relayed is captured in the first instance without asking participants to unnecessarily repeat so you can catch up with transcribing. Before each interview began the researcher explained that the interview was intended to be confidential and not invasive and that interviewees can stop the voice recorder at any time or withdraws. Interviewees were also given the opportunity to listen to the recording after the interview although all declined. Even though audio recording the interviews ensured all the information

verbally given were encapsulated apart from the nuances, it was important to generate the transcript just after the interviews for proper examination and analysis and correct the natural limitations of human memory.

The nature of this research required individuals with a specialist knowledge of the subject area which in the Ghanaian context were the CEO's and operations and marketing managers, consent had to come from them directly, although the human resources departments of the case study companies were contacted and had no objections to the researcher interviewing employees, the actual consent came from the individuals who were interviewed since HR could not control or even support the researcher in accessing them due to their positions in the companies. Human resources departments however scrutinised the interview questions and verified the validity and authenticity of the researcher by reviewing the researcher's passport and student ID, they cautioned against revealing the company's name within the study. These terms were accepted and therefore the researcher refers to the organisations as SME1, SME2, SME3 etc or 'the companies or 'the organisation' accordingly.

4.5 Qualitative Data Coding

The interviews produced a sizeable amount of qualitative data and NVivo 11 for Windows package, was used for the analysis. Each interview was transcribed and afterward loaded into the software. Where the recordings were not clear the researcher approached the participant again for clarification. The interviewees were only re-contacted by the researcher where thoughts which had a significant meaning and a bearing on the interview were unclear. This approach ensured that the results were as accurate as possible. At the same time limiting the number of interactions made post data collection stage with the interviewees. After transcribing, verifying, and, where appropriate translating, interviews were manually coded to ensure that every word and valuable phrase, or thought was captured and categorised accordingly for further analysis.

Below is a map of the categorisation

Figure 4.1 Visual Map of Categories

Source: The Author

4.6 Thematic Categories and Themes

This segment reports all the findings from the data collection phase of the study. It is imperative to state that the reporting follows the sequence of the theoretical framework and the interview questions with the initial section looking at the general overview questions followed by forecasting process, demand forecasting, methods accuracy and errors as well as climate and culture of forecasting in the SME pharmaceutical industry. Where appropriate, diagrams, tables, figures and charts are used to present the data. Section 4.6.1 below presents the general overview questions.

Since this study was qualitative research, it does exhibit the characteristics and in some cases the criticism of qualitative research in terms of using thematic analysis and the lack of structure it provides (Braun and Clarke, 2006) since there is no universally accepted or standard approach for analysing interviews. However, the thematic analysis provides a structure to the data.

4.6.1 General Overview Questions

The purpose of the general overview questions was to determine the category of the various organizations selected for the study, thus to identify these companies as either micro, small, medium or large enterprise; and to ascertain their performance in terms of turnover as well as their contribution (in the form of employment) towards the Ghanaian economy. Moreover, the questions sought to delve more about the interviewee's roles, responsibilities, and length of service / experience within the organization. The interviewees were also asked whether their organizations forecast demand for their finished goods (drugs), their involvement in the forecasting process and for how long they have been forecasting through their entire professional careers. Details are shown in Table 4.3 below.

Table 4.3 Organization & Interviews Statistics

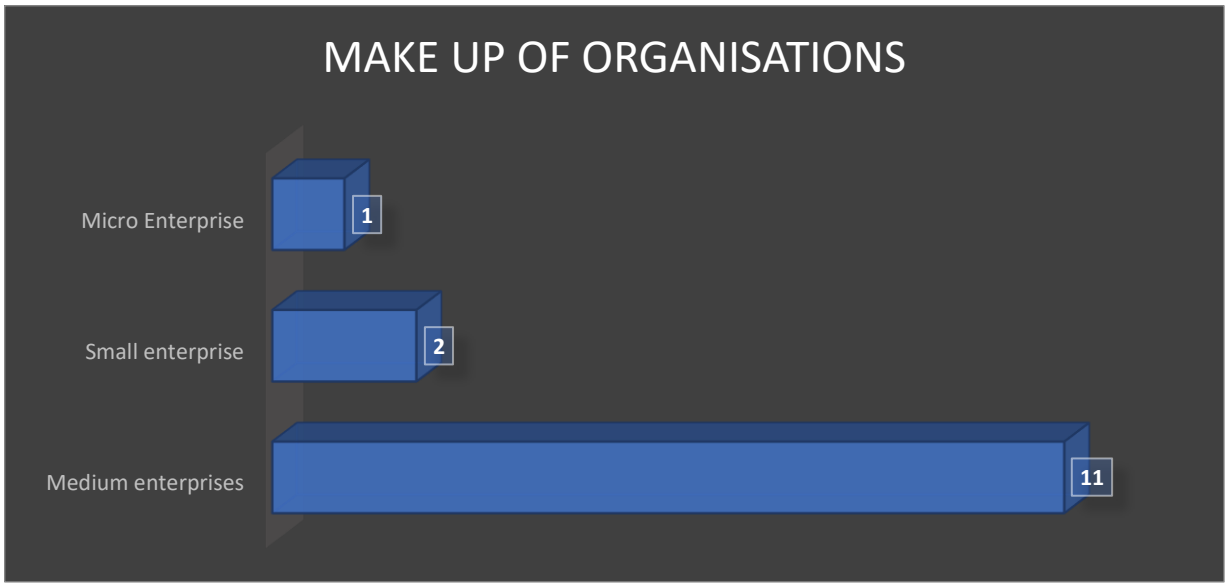
Organization's Code	SME Category	Number of Employees	Turnover of Organization	Interviewee's Position	Interviewee's Code	Length of Experience
SME 1	Small Enterprise	50	GHC 6.6m	CEO	CEO1	25
SME 2	Medium Enterprise	110	GHC 17.3m	Procurement Manager	PM1	13
SME 3	Medium Enterprise	135	GHC 18m	Purchasing Manager	PM2	8
SME 4	Small Enterprise	40	GHC 7.6m	Operations Manager	OP1	15
SME 5	Medium Enterprise	201	GHC 20m	Operations Manager	OP2	18
SME 6	Medium Enterprise	216	GHC 18.3m	Operations Manager	OP3	18
SME 7	Micro Enterprise	30	GHC 5m	CEO	CEO2	2
SME 8	Medium Enterprise	175	GHC 19m	Marketing Manager	MM1	7
SME 9	Medium Enterprise	218	GHC 20.3m	Marketing Manager	MM2	10
SME 10	Medium Enterprise	180	GHC 17.7m	Marketing Manager	MM3	13
SME 11	Medium Enterprise	230	GHC 21m	Sales & Marketing Manager	SMM1	5
SME 12	Medium Enterprise	250	GHC 26m	Sales & Marketing Manager	SMM2	23
SME 13	Medium Enterprise	223	GHC 17.3m	Marketing Manager	MM4	13
SME 14	Medium Enterprise	164	GHC 19.4m	Sales & Marketing Manager	SMM3	13

Source: Author 2019

From the data collected all 14 companies fell within the SME category (as per the classification of the Ghana National Board for Small and Medium Industries) of the

pharmaceutical manufacturing industry in Ghana, with 11 being medium enterprises, 2 small enterprises and 1 micro enterprise. Below is a chart of the make-up of the participating organisations

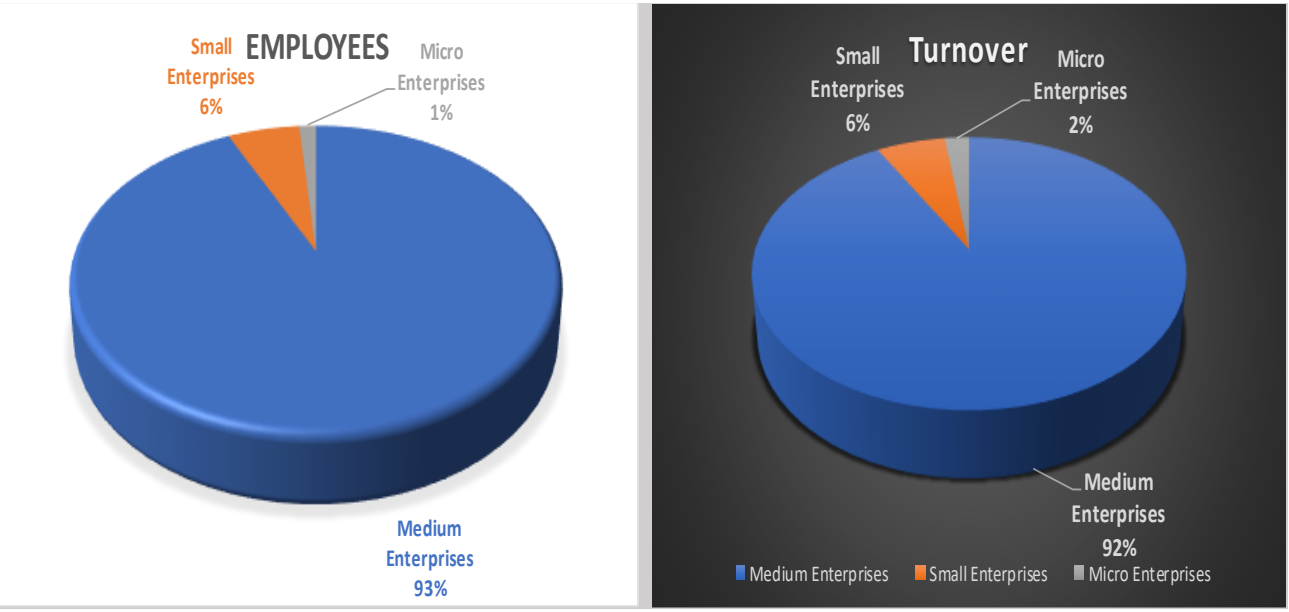
Figure 4.2 Breakdown of SMEs participating in the Case Study



Source: The Author

The medium enterprises employed a total of 2102 member of staff and had a total turnover of GH₵ 214.5 million which is equivalent to $39 million. The small enterprises employed a total number of 128 staff and had a total turnover of GH₵14.2 million equalling $2.6 million. Finally, the researcher interviewed a company in the micro enterprise which employed 30 staff members and had a turnover of GH₵ 5 million which is $0.91 million. The details of turnover and number of employees in each of the categories mentioned above have been expressed in percentages in the charts below.

Figure 4.3 Percentages in terms of number of employees & Turnover



Source: The Author

The figure 4.3 above indicate that the medium enterprises employ majority of people in the industry leading by 93% followed by the small enterprise and micro enterprises with 6% and 1% respectively. Revenue figures expressed in percentages are not any different only that the Micro Enterprise increases it share to 2% whiles the medium enterprises drop a percentage to 92%. These figures as well demonstrate the contribution of the pharmaceutical SMEs to the Ghanaian economy at large.

All in all, the 14 SMEs has a total of 2260 employees and total turnover of GH₵ 233.7 million, which $42 million (The exchange rate as at the date of conversion was $1 US Dollar to GH₵ 5.49 Ghanaian Cedi). It should be emphasised that the Micro enterprise was selected on purpose to obtain their perspective and understanding on forecasting process. Their feedback helped the researcher to cross compare findings with small and medium enterprises.

The general overview questions also helped in identifying the right individuals in the case study organizations who were involved in the productions of the company's demand forecast. The researcher interviewed 2 CEO's, 2 procurement managers, 3 operational managers, 3 Sales & marketing manager and 4 marketing managers.

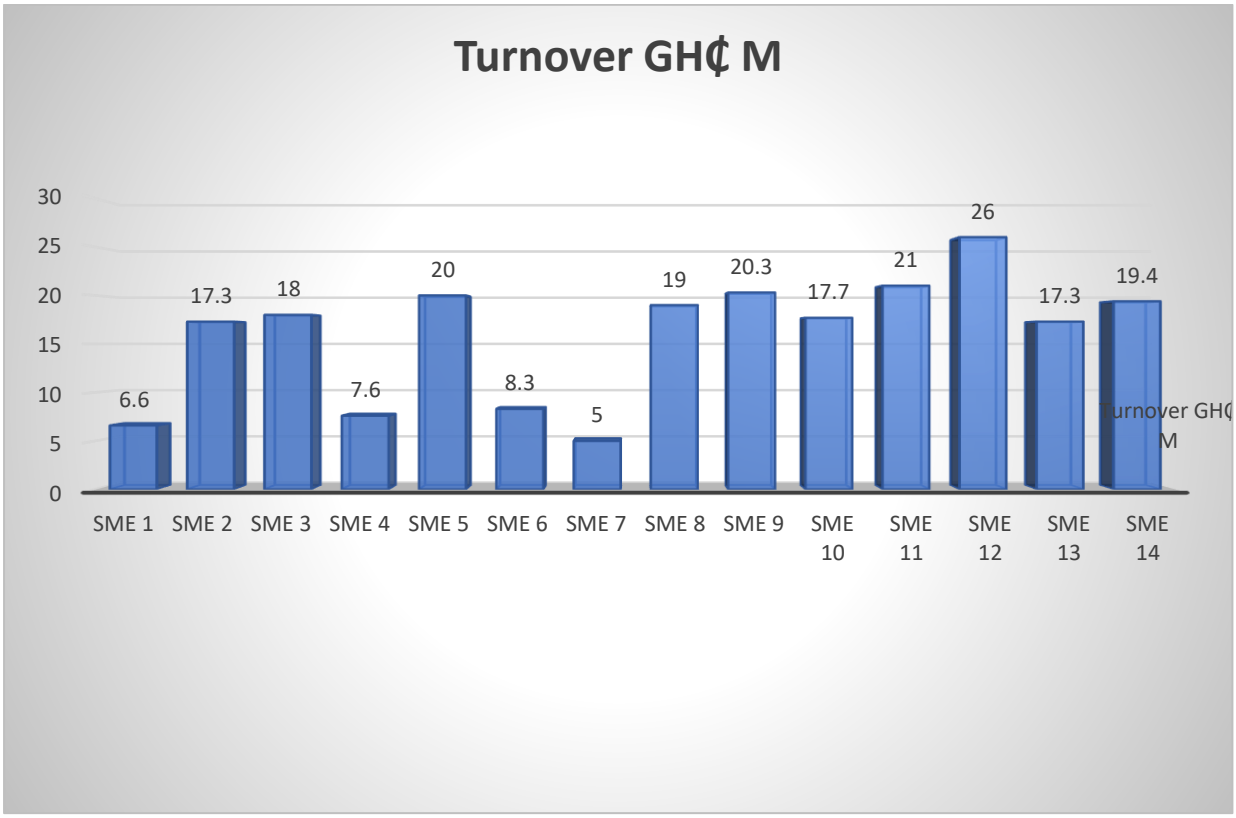
As depicted in the table 4.5 the CEOs together had a total of 62 years of experience in forecasting, Sales & marketing managers had 53 years whiles the marketing managers had a total of 51 years and finally procurement managers with 23 years'

experience of forecasting in their respective fields of operation. Averagely out of all the participant the CEO's had longest years of experience per participant in forecasting for demand, followed by operations managers, Sales & marketing managers, procurement managers and finally marketing managers in that order.

In ranking these SMEs in terms of Revenue and number of employees working for each of these companies, SME12 ranked highest with revenue of GHC 26 million, employing 250 individuals, followed by SME11 with a revenue of GH₵ 21 million with capacity of 230 employees, SME9 followed in third place with a revenue of GH₵ 20.3 million and total of 218 employees, the organization with the least revenue was SME7 with GH₵ 5 million employing 30 staff members. The ranking help establish the diversity of the various organizations represented in the case study indicating that the views captured from the interview are not reflect opinions of "big" companies but micro organisations as well.

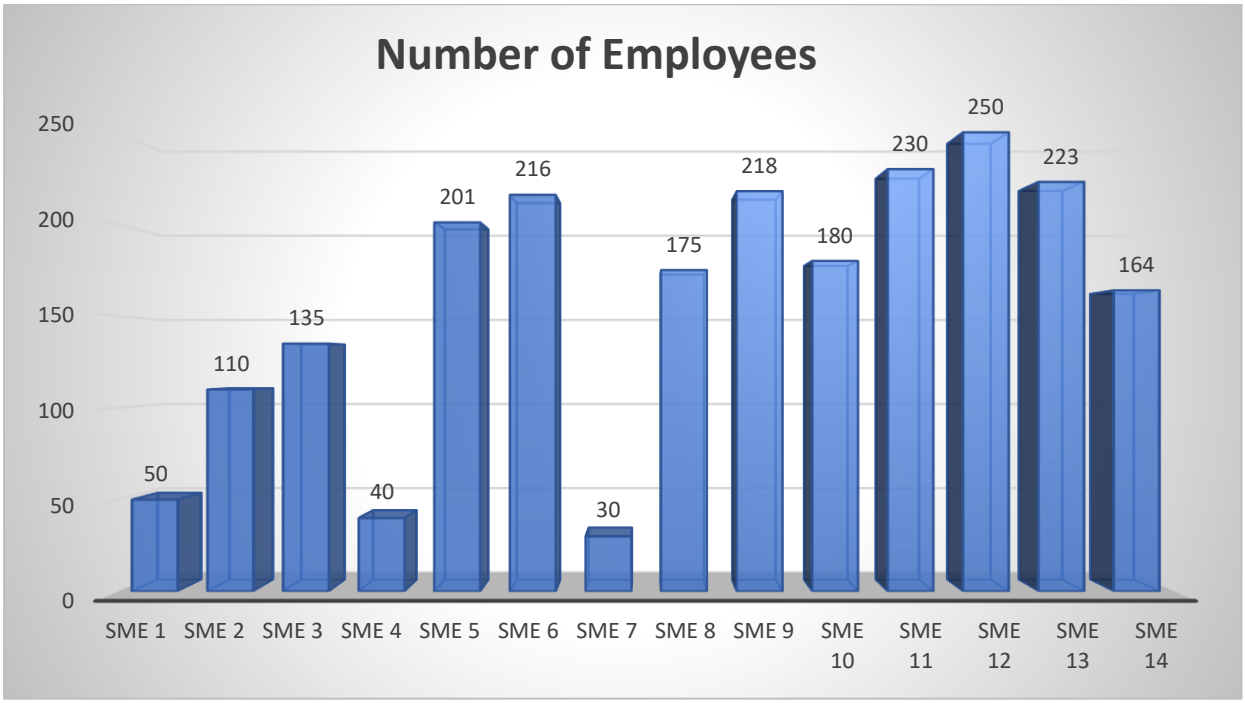
Below is a chart representing the ranking of the organisations in terms of turnover and number of employees.

Figure 4.4 Organisations turnover rankings in Millions of Ghana Cedis



Source: The Author

Figure 4.5 Number of Employees



Source: The Author

Another critical question that was asked to ensure the participating organizations were fit for the purpose of this research was to find out if the participating organizations forecasted for demand for finished goods, to this all the participating organizations answered in the affirmative.

Apart from asking about the length of experience the participant had spent on their current role, they were also asked about the length of time they have been involved in forecasting throughout their professional careers.

The table 4.4 below shows the details regarding the length of experience vis-à-vis their experience in forecasting.

Table 4.4 Years of Experience on the Job compared to Years involved in Forecasting

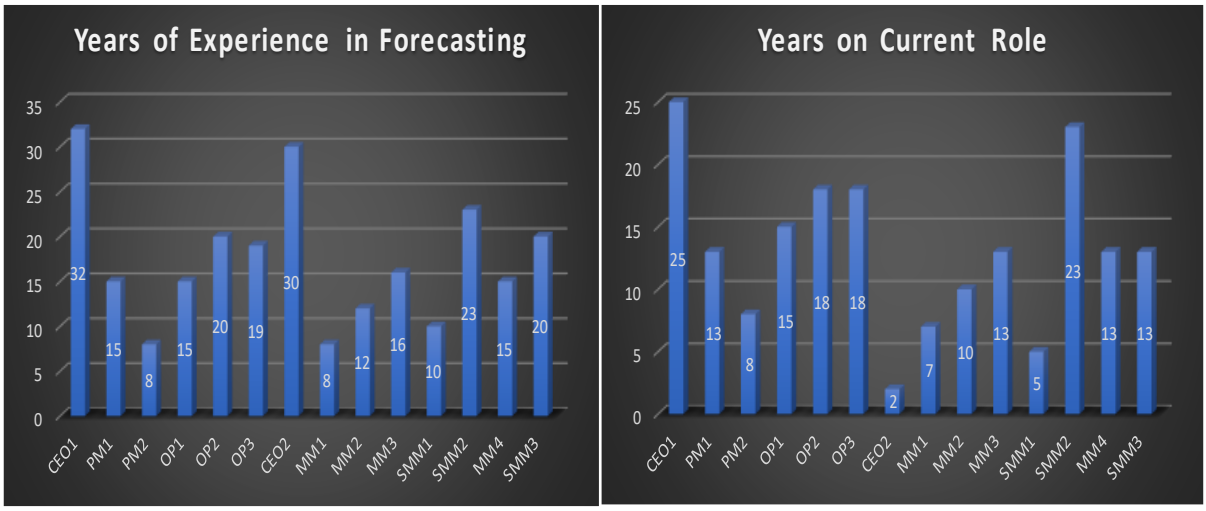
Participant's Code	Years on the Job	Experience in Forecasting
CEO1	25	32
PM1	13	15
PM2	8	8
OP1	15	15
OP2	18	20
OP3	18	19
CEO2	2	30
MM1	7	8
MM2	10	12
MM3	13	16
SMM1	5	10
SMM2	23	23
MM4	13	15
SMM3	13	20

Source: The Author

The table 4.4 above indicate that the length of years in forecasting the participants have surpasses the length of years they have spent on their current role. The average years of experience on the job compared to the experience with forecasting indicate that though some of the participants may not have been on their current role for long they are very much versed in with the issues of forecasting and are qualified to speak to the matter.

Below are charts comparing years on the job as well as years the participant have been involved in forecasting.

Figure 4.6 Years on Current Role Verses Years involved in Forecasting



Source: The Author

Moving on from the experience in forecasting, the participants were asked about their responsibilities or involvement with demand forecasting in their organisation. It is important to state that during the initial stages of inviting the participants to partake in the study, the Human Resources department of most of the SMEs directed the researcher to the marketing department indicating that the responsibility of forecasting demand mainly rested on the shoulders of the Marketing Managers, this notwithstanding was not the case in some of the SMEs that agreed to participate in the study, for some organisations , forecasting for demand was an activity performed either by the Operations managers, procurement managers and in some instances by the CEO's.

It is however worthwhile to mention that though the procurement Managers were not directly involved in the production of the company's demand forecast for finished goods, the procurement Managers had the responsibilities of forecasting for internal materials demand and therefore to a large extent contributed to demand forecasting for finished goods. Overall the participant with much experience in respect of forecasting happened to be CEO1 with 32 years of involvement whiles PM2 and MM1 had 8 years each in forecasting. This indicating that the participants selected were well versed in the subject matter of the research.

4.6.2 Forecasting Process Data and Methods

The class two sets of questions were made up of three main questions i.e. Q5, Q6 and Q7. These cliques of questions focused on the forecasting process, data and methods. There were supplementary questions on each of the three main questions Q5 had 4 follow-up questions, Q6 had 2 and Q7 had 4. It is worthwhile to state that not all the follow-up questions were asked during the entire case study, they were mainly asked to for more depth and insight where participants were not forthcoming with more details about the main questions. The same principle is applied in the other class of questions asked as well.

The principal aim of the Q5 was to ascertain in simple terms the totality of the forecasting process employed by the various SMEs. The follow up questions probed to know further the data or information needed before a drug is manufactured, and whether the availability of data influenced the choice of forecasting method used, who's responsibility it is to select the method and finally the extent to which business strategy or forecasters experiences influence the choice of method.

Responding to Q5, participant CEO1, who is the Chief Executive officer in SME1 which is classified as small scale enterprise, with over 30 years' experience in forecasting stated that their forecasting process is "*simple and straight forward*" "we forecast based on our previous year's sales data, from this data we have trends and patterns so we examine the data carefully and with our knowledge of the current market conditions we predict or if you like forecast our demand figures purely on our judgement".

Similarly, MM2 who is from a medium enterprise also stated "*our projections or forecast are based on past sales trends from the information we have at our disposal*. *In other words, we collect the data which is grouped into quarters of the year, and we forecast accordingly. By "we forecast" I mean, the Marketing team brainstorm and come out with the estimate* for every quarter.

However, CEO2 Chief Executive officer from SME7 a micro scale enterprise indicated that though they "forecast demand" their terminologies and processes are a bit different from the traditional way of forecasting demand. They refer to the process as planning and estimation. They approach their customers in advance to obtain

purchase orders or potential estimated orders for the year, and on the premise of these they plan or estimate factoring in management's projection.

In another breath SMM2 the Sales & Marketing Manager of SME12, the largest SME among the 14 participating organisations opined that their forecasting process starts from gathering their historical sales data, looking at market growth, seasonality of the various product lines, price sensitivity and upcoming changes i.e. new laws and legislation, before a decision is made on the type of method to apply to generate the forecast for the business. Indicating further that use all two traditional methods of forecasting as well as some sophisticated information technology software in their forecasting.

Contributing to the forecasting process question, SME4 and SME10 represented by operations manager and marketing manager respectively stated that they use market survey to forecast demand. They send out a form of questionnaires to their loyal customer asking about their requirement for the period they will be forecasting.

Additionally, 4 of the participating organizations SME12, SME11, SME9, and SME14 indicated that they have introduced some form of technology to their forecasting process. SME12 represented by SMM2 mentioned that about 90% of their forecasting process is based on technology. They have an information technology system that automatically generate past sales data, factor in a method and produce a forecast which is then subjected to management scrutiny or judgement before being approved. But also indicated that although they rely about 90% on the software, every product line and the method they combine with the IT system.

In other to obtain further details on the forecasting process the researcher also asked about the sort of Data or information usually needed before a drug is manufactured. In answering this question SMM2 representing SME12 which is by far the biggest SME among the lot and one of the organisations producing own branded drugs detailed the volume of information needed before a new drug is manufactured. The SMM2 mentioned that, before a new drug is forecasted it should have passed the stage of research and development as well as the clinical trials stage. During these two stages of the product a lot of data are gathered which helps in the forecasting for the finished product example of which include how humans reacted to the potency or the efficacy of the drug.

MM2 representing SME9 a fairly big organization among the 14 which massively manufacture new drugs suggested that product license a prerequisite when forecasting for new drugs was also obtained by market survey during the marketing authorization stage of the new drug. Before a drug is placed on the market, it must obtain product licence also known as marketing authorisation. During the licensing process manufacturers are asked to supply additional non clinical information. It is at this stage that they gather much of the data required from the field to build their forecast for the introductory stage of the product lifecycle.

Concerning how the availability of data influence the choice of method, OP2 from SME5 indicated that they use different quantitative methods to forecast demand and depending on the information available to them they choose a method.

"*if we have enough data which is very consistent then we use the quantitative approach to determine our forecast however if the data is hard to come by, we brainstorm to provide the forecasting numbers. In forecasting for Panadol for instance, the data we have is very rich and consistent therefore we use the moving averages quantitative method for the forecasting"*.

SMM2 from SME12 added that the decision on the type of method to apply to generate the forecast hinged on some variables, some of these variables include the product in question, the historical data and its pattern as well as the industry knowledge available to them.

SME7, SME4, and SME1 represented by CEO2, OP1 and CEO1 respectively indicated that they have simple and straight forward method for forecasting demand for finished products therefore the availability of data does not much influence their choice of forecasting method. The above three organizations further stated their preferred judgemental method of forecasting was market survey by SME7 and SME4, whiles SME1 indicated the internal experts opinion Method is used.

SMM3 from SME14 a medium enterprise also disclosed that data was a major factor in their selection process. They consider the consistency of the data, as well as other key component like price sensitivity and prevailing market conditions et cetera before a particular method is used to forecast for demand.

Responding to the question of who select the forecasting method CEO1, OP1, CEO2 MM3 and MM4 all indicated that their forecasting method are selected by

management without the consultation of the forecasting team. Similarly, PM1 & PM2 procurement managers for SME2 and SME3 respectively pointed out that they select the method to use to forecast for raw materials and that management do not play any key role in the selection of the method.

However, OP2, OP3, MM2 and SMM1, had a different selection method, for them it is the responsibility of the forecaster to select the method and present to management for approval, Nevertheless, MM1 and SMM3 both indicated that although the responsibility of choosing the method was done by management, the forecasters are consulted prior to adopting any method. The findings have been tabulated below.

Table 4.5 Responsible for Method Selection

Participant's Code	Responsible for Choosing Forecasting Method
CEO1	Management
PM1	Forecaster
PM2	Forecaster
OP1	Management
OP2	Forecaster/ Management
OP3	Forecaster/ Management
CEO2	Management
MM1	Management & Forecaster
MM2	Forecaster & Management
MM3	Management
SMM1	Forecaster & Management
SMM2	Management
MM4	Management
SMM3	Management & Forecaster

Source: The Author

Replying to the question on the extent to which business strategy or forecaster's assumption motivated the forecasting method selected by each organization, it was discovered that, where the forecasting method was selected by management it was business strategy that was the driver whiles forecasters who choose the forecasting methods were driven by their own assumptions. Feedback from the various participants has been presented in the table below.

Table 4.6 Drivers of Method Selection

Participant's Code	Drivers of Method Selection
CEO1	Business Strategy
PM1	Forecaster Assumption
PM2	Forecaster Assumption
OP1	Business Strategy
OP2	Business Strategy
OP3	Forecaster Assumption
CEO2	Business Strategy
MM1	Forecaster Assumption
MM2	Forecaster Assumption
MM3	Business Strategy
SMM1	Forecaster Assumption
SMM2	Business Strategy
MM4	Business Strategy
SMM3	Forecaster Assumption

Source: The Author

Q6 in the class two sets of questions focused on the impact of external factors on the forecasting process. SMM2 the sales and marketing manager for SME12 indicated that external factors influence the strategy they adopt in forecasting their various products. The interviewee highlighted that one factor that affect their forecasting method was new legislation from government institutions.

" When a new legislation is passed in our industry it can either favour you or disadvantage you (company). This year for example a particular chemical was banned by the food and drugs authority which meant that all our product which had that chemical had to be reviewed. Doing so meant that we change from using a quantitative method to a qualitative method of panel consensus to forecast demand. So in a nut shell external factors influence the choice of method and impact our forecasting process as well."

More so MM2 also emphasised that price of raw materials and consumer behaviour are some external factors that affect their method selection and to the larger extent their forecasting process.

OP2 who is the operations manager for SME5 indicated that external factors such as culture and climate also influence the forecasting process, "*for instance where there is an outbreak of a disease and demand for a particular product is high you cannot stick to your forecast, you change it to factor in the prevailing market conditions"*.
In contrast to the above claims however, OP1 and CEO2 who represented both SME4 and SME7 respectively indicated that because their forecasts are based on customer orders and hardly does external factors influence their method of forecasting. They both indicated that their organizations rely on qualitative methods for forecasting which to them cater for the external factors, in conclusion though they both admitted that external factors like prices of raw materials have no direct effects on their forecasting process but impacts their business however they lack the resources and knowhow to deal with the situation. When the participants were asked to identify at least one factor that impacted their forecasting method and to a greater extent their forecasting process, five key factors was identified and has been presented in the table below.

Table 4.7 External factors and its influence on the forecasting process

Participant's Code	External Factors Impact on Methods	Type of External Factors
PM1	Yes	Prices of Raw materials
PM2	Yes	Prices of Raw materials
OP2	Yes	Climate & Culture
CEO2		Prices of Raw materials
MM1		New/Changes in legislation
MM2	Yes	Prices of Raw materials/ Consumer behaviour
SMM1	Yes	New/Changes in legislation
SMM2	Yes	New/Changes in legislation
MM4	Yes	Competition
SMM3	Yes	Consumer Behaviour

Source: The Author

The feedback indicates that new legislation is one major external factor that affect the forecasting process.

The final question in the class 2 category was on information technology i.e. the use of software in the forecasting process.

In responding to this question SMM1 from SME11 stated that their organization have until recently introduced an IT software to forecast some of their product lines, whiles MM2, OP2, MM4 also indicated that they have as well in the past year adopted a software but it in the implementation stages and therefore not able to comment on the effectiveness of the system. SMM2 the sales and marketing manager of the biggest SMEs among the participating organizations held that they use an IT software for forecasting almost all their product lines and went on further to indicate that it a very effective tool which is fit for purpose.

In contrast the other 9 organizations indicated that they do not use any IT software in forecasting rather they use either quantitative or qualitative method, hence were not in a position to attest to its effectiveness or suitability.

Additional information gathered on the IT system to find out about the involvement of the end user in the software acquisition process revealed that all five participants who claimed to use IT software are consulted by management for input and are involved in the development and design of the software so its fit for purpose.

The researcher also wanted to find out whether there is overreliance on technology because of the believe that technology automatically produce accurate forecast. Commenting further on the trend of overreliance on technology SMM2 opined that though they use the IT software system extensively they always subject the forecast to judgement. However, the other participant could not comment on this issue of over reliance on Technology in the forecasting process as either they have just introduced it or are not using it at all, but all attested to the fact that their respective management have plans in acquiring one software or the other in the future.

Table 4.8 below present the response from all the organizations in respect to the use of IT software.

Table 4.8 Usage of IT Forecasting Software

Participant's Code	Use of IT Software	Over reliance on software
CEO1	No	No
PM1	No	No
PM2	No	No
OP1	No	No
OP2	Yes	No
OP3	NO	No
CEO2	No	No
MM1	No	No
MM2	Yes	No
MM3	No	No
SMM1	Yes	No
SMM2	Yes	Yes
MM4	Yes	No
SMM3	No	No

Source: The Author

4.6.3 Forecasting Demand

The third class of questions were made up of three major leading questions and one supplementary question, question 8 and a support question, then Q9 and Q10.

The aim of Q8 was to establish the steps the SMEs take to ensure that supply matches demand to avoid excess storage or lost sales in forecasting for both new and existing products.

The feedback received from this question indicate that all the fourteen SMEs encounter similar situation during forecasting and have taken steps to combat the issues of over forecasting and under forecasting.

In response, OP2 Operations Manager from a medium scale enterprise held that their organization use the "custom made" approach to address this issue in respect to new products. According to him "when forecasting for new drug you need your loyal customers to place order before you produce, therefore we obtain a written contract or purchase order from them which then become the basis of our forecast". "*you have to understand that forecasting is not done in isolation of data, hence the information we receive from customers concerning our new product are very vital"*

MM2 a marketing manager from medium enterprise SME9 reiterated that for old or existing product they have the data to base their forecast on, however the challenge of supply matching demand for new drugs is overcome by producing according to demand.

Adding to it, OP1 and MM1 both sales and marketing manager from SME4 and SME8 respectively indicated that it is very difficult to forecast for new drug, so their respective organisation both resort to Make -to-order, this way the issue of supply not matching to demand is curtailed in the introduction stage of the product.

In another interview, CEO2 and OP3 attested to the fact that when forecasting for new drug they use Market survey to gather vital information which enable them to gauge market place competition, price sensitivity and customer behaviour. According to them both the information they receive from the market survey and their prior experience and assumptions in forecasting for similar products help them to forecast for new drugs.

When asked about how the Product life cycle (i.e. the **introduction**, **growth**, **maturity**, and **decline) is** forecasted in order to apply the appropriate marketing strategies to each of the stage SMM1 indicated that it is very difficult to forecast demand for the introduction phase of a new product, simply because there is no historical sales data.

"What we do is to examine the launch of similar products sales records and use that data as a yardstick for our forecasts. If we don't have any product to compare with, we test the market by selling in smaller quantities of the new drug to groups representative of our target market. So, depending on how well the new product perform and the ratings we receive from these groups enables us to forecast for the introduction stage of the product life cycle".

Touching on the growth stage, SMM1 said that growth follows naturally after the introduction stage of the product life cycle. The way you identify it is by observing the linear growth after the introduction of the product and estimate using the percentage increment observed.

"*In our organization for instance if sales for a new drug shoot up from say 100 units in the initial week to about 1000 units by the fourth week, and then move up by 20 percent every week for the next month, the period from the fourth week upwards is*

our growth stage for the product so we forecast demand by estimating 20 percent increase on weekly basis for the period we classify as growth for the product."

In another development OP2 the operations manager of SME5 stated that the more a product gain popularity, sales begins to go up, this is the growth stage. Demand for the product can sometimes be sluggish, rapid, or highly erratic, but in any case, the sales figures will be on the increase. At this stage we forecast regularly base on the trend to make sure we have the correct material in store to meet the changing demand.

Moving on to maturity stage of the product, SMM1 opined that this is the stage where sales rate becomes very steady. When this stage begin you can tell because the steady increase of sales in the growth stage begins to fall.

"*in our case when the 20% of increase per week continue to go down gradually, we know the product is reaching maturity so instead of estimating a steady upward demand we switch to an estimation that focus on gradual increase."*

Lastly commenting on the decline, OP2 held that as a pattern of a drug change and demand begins to fall drastically it is essential to pull the breaks on the forecasting figures. The ability to see this trend and inform operations to reduce stock levels which in the end prevent goods from becoming obsolete and this in its self is a forecasting method that ensure that our organisation's money isn't locked up in the warehouse as inventory.

MM2 Marketing Manager from SME9 said that though sales will eventually decline their organization try to extend the mature stage of their product by changing the packaging, adding new improved features and also changing their promotion tools. But when sales begin to dwindle more rapidly from the mature stage then that is a sign of decline in the product life cycle. According to him the decline most of the time is linear with some level of approximation, so they forecast demand at the rate of decline. He gave an example that further clarify how they forecast the decline stage of the product life cycle,

"when the declining rate gets to say 30 percent and continue to stay there for quite a few more weeks we forecast demand at the declining rate of 30% per week and for the ensuing weeks".

The researcher uses Q9 to assess how the various SMEs forecast for products with sporadic and irregular demand patterns.

It is said that in the current competitive market, where manufacturing organisations operate in unstable environment, dealing with irregular and intermittent demand patterns presents complex issues. The difficulty of managing these categories of demand patterns hinges on discovering the best trade-off between adverse effects associated with high storing costs, for example the enormous amount of space and the wherewithal for keeping huge warehouse areas, holding costs, as well as risk of obsolescence of items, and the negative effects associated with low stowage levels, such as lost demand and potential clients.

It is however not surprising that all the SMEs in the pharmaceutical industry do not have any systematic approach towards forecasting intermittent demand. When asked the question how they forecast demand the feedback indicate that all the various participants stated that they deal with irregular and intermittent demand as and when it comes.

The researcher uses Q10 to obtain information regarding the obstacles to demand forecasting. The question draws from the experience and observations of the interviewees on what they perceive to be the obstacles to demand forecasting in the industry the causes and what could be done to eradicate or minimised the obstacles.

Responding to the question, sales & marketing manager SMM3 from SME14 indicated that one major obstacle they encounter during forecasting is forecasting promotional demand, he claimed that in Ghana about one third of the pharmaceutical industry's sales are driven by promotion. Therefore, our inability to forecast promotions correctly or factor it in to the forecasting process affect our forecast. Responding on how this challenge can be overcome he stated that there is the need to train forecasters properly to understand the dynamics of the market and be able to inculcate marketing strategies such as promotions into the forecasting process.

CEO1 with over 30 years of experience representing SME1 also said that wrong information and lack of data from key departments in the organization is a major obstacle to forecasting. He also maintained that sales data is very vital to accurate forecast however hardly is the sales data kept accurate. According to him even when

the sales data is maintained it is rarely expressed in quantitative terms and factored in the company's forecasting process. He further added that their sales channels and the forecasting tools used by the company are disconnected, there is no link between the sales data sets and the forecasting templates being used by the forecasters hence forecasters spend a lot of time obtaining the right info or in some situations cannot use the right data to produce accurate forecast in a timely manner.

OP1 also stated that lack of collaborations among the various teams within their organization is one of the challenges they encounter. He held that every head of department comes up with a forecast which is then fed into the main forecast of the organization. As a result of this strategy, different business units within the organization develop various forecasts which are not compatible. Each of these forecasts are based on the manager's opinions therefore any amendments or tweaks magnifies errors in the overall forecast.

OP2 also indicated that a major setback they encounter is their inability to forecast variations to potential future business either losses or wins. He stated that their approach to forecasting mostly does not factor in any bottom up data from the marketplace about possible wins, losses or leads that could be turned to opportunities. In his own words he said "*our approach is inward looking and does not factor in any fluctuations in competitive environment or price dwindling thereby losing out in potential future opportunities"*

SME7 a small enterprise who has been in business for two years represented by CEO2 also indicated that lack of firm base to build the forecast is an obstacle implying that funds devoted to forecasting are insufficient for any significant impact and also indicated that even when the funds have been committed, knowledge of right forecasting practice and existing methods are lacking during start-up like theirs.

In another development OP3 also stressed that a major challenge to demand forecasting is lack of consistent statistical method. He added that though there are lots of statistical software products that can help in forecasting, they still rely on judgement which is mostly skewed to the direction of the forecasters. This approach is not consistent and is not always able to detect trends and patterns which otherwise will be effortlessly detected using a statistical method. In his own word he stated that

"our approach works but only to certain extent and we have to intervene by adjusting our forecasted figures".

SMM1 commented that the pressure from management to either increase or decrease the forecast because it's not in line with company plan is a challenge. He further indicated that there are situations where the forecaster is told that the forecast is too low or too high and therefore must be changed to reflect management's objectives for either the year or a quarter, when that happen the forecast becomes unrealistic. Varying the forecast due to management political ambitions destroys the objectivity and functionality of the same.

MM1 submitted that lack of improvement in the forecasting process is a challenge. He stated that they have been using same method for the past ten years without any substantial improvement hence same forecasting errors keep coming up almost every year. He added that the reason for lack of improvement is that the resources dedicated to forecasting have become so stretched in maintaining ongoing procedures which makes new development practically impossible and, in some situations, there are not enough commitment to attain the next level of substantial progress.

From the feedback received regarding the challenges that pharmaceutical SMEs encounter during forecasting has been summarized in the table 4.9 below

Table 4.9 Forecasting Obstacles

Obstacles to demand forecasting
Inability to forecast promotions
Wrong information and lack of data
Lack of collaborations among the various teams
Inability to forecast variations to potential future
Lack of firm base to build the forecast
Lack of knowledge of the correct/ right methods
Lack of consistent statistical method
Undue pressure from management
lack of improvement in the forecasting process

Source: The Author

The other part of Q10 asked what could be done to eradicate or minimise the obstacles in demand forecasting.

In responding to this question OP1 who earlier stated lack of collaborations as obstacle submitted that collaboration is an integral part of forecasting process which has a lot of benefits that cannot be done away with, to have a good accurate forecast, members from each department within the company should represented. Adding that when this happens, you have members who understand various data sets at an expert level and can offer analyses that a sales person may overlook, depending on one set of data interpreted by the originator leads to skewed outcomes but using a collaborative process can explicitly incorporate a defence against any form of distortion. Also, collaboration breeds buy-in which is very important for the forecast to have an all-round effect on the organization's performance. When the various departments recognise that their inputs are of importance to the process, there is a high probability of accepting and running with the forecast as well as using them as a guide in their departments. Finally, in his own words he said "*A well formulated forecast processes data not only from the sales team but from the many units in the organisation to make an informed projection into the future. Also, when the process of forecasting imbibes the various voices and expertise you achieve at least two important goals which are increase in accuracy and better culture for the company".*

MM2 also said in other to have accurate forecasting there is the need to have a balance. It is essential to base forecast on past result or achievement however it is equally important to be able to flexible enough to make changes as and when evidence proves they are required. He further added that the ability for an organization to analyse past data in the light of present market conditions is the base of an accurate demand forecast. Also, client's circumstances as well as industry regulations and developments can change severely in an instant making prior assumptions inculcated in the forecasting process invalid, however when you have a real time information or data you are able to adapt and make changes instantly to reflect the circumstances.

CEO1 commenting on how to overcome the issues of wrong data and the lack of quality data indicated that this issue does not only involve correcting the data set but rather by adopting a top-down approach that makes collection of good data an integral

part of the day to day operations of the business and can happen by having in place a point of sale data collection directly into a database as well as ensuring that no matter the entry point of data best practices are maintained. In this way data will not only be consistent but robust and standard for effective forecasting.

SMM2 indicated that in other to circumvent the challenges associated with lack of knowledge of the correct or right forecasting methods, there should be adequate training not only for the forecaster but the users of the forecast as well. He added that the focus of the training also has to shift from the forecaster just acquiring more knowledge on complex techniques, as this does not primarily guarantee success or accurate forecasting. Instead, the focus should be on training on matter such as how to find suitable data, how identify trends and patterns in the data set, how to pick the right time frame, how to incorporate judgement into a technological and other forms of forecast and how huge fluctuations in the market can be mitigated. Also, users of the forecast should be trained to identify benefits and challenges associated with the forecasting method adopted along with recognising instances where adopting a consistent methodical approach can help in improving organization's decision making.

SMM1 indicated that management should at all cost have an opinion about the forecast but should not impose its political ambition over the forecasting process. To overcome this challenge there should be clear distinction between management's objectives and organisational forecast. SMM1 further stated that in his opinion the forecast should be the bedrock on which management make projections and not the other way around. When the forecaster is allowed to conduct its activities without any political influence, he is able to produce a forecast without any bias which in the long run help achieve a higher accuracy.

OP3 submitted that where there is lack of consistent there is no progress. Therefore, there is the need to adopt statistical method that is robust enough to cater for the ever changing environmental and economic changes rather than changing methods any time there is a shift or changes in the marketplace. Adopting a systematic approach also means that they are able to fine tune the system or method to address their needs.

In other development MM1 suggested that lack of improvement in the forecasting process can be overcome by ensuring adequate resources are dedicated to

forecasting not only for acquiring new software or methods but also training and improving the skills of the forecasters. He further suggested that to improve the process it essential that forecasters are exposed to what goes on in either similar organizations outside the country or even different manufacturing environment in the country to acquire different skill sets and as well sharpen their knowledge.

4.6.4 Forecasting Methods

The class four sets of questions were used to ascertain the forecasting methods used by the various SMEs to forecast demand. This section consisted of three major questions and three supporting questions.

Q11 sort to identify the forecasting method favoured by the participant and their respective organizations they represent. The responses received from the interviewees are presented in the table 4.10 below

Table 4.10 Forecasting Methods Preferred by the Organizations

Organization's Code	Interviewee's Code	Judgemental Method	Quantitative Method
SME 1	CEO1	✓	▪
SME 2	PM1	✓	▪
SME 3	PM2	▪	✓
SME 4	OP1	✓	▪
SME 5	OP2	▪	✓
SME 6	OP3	✓	▪
SME 7	CEO2	✓	▪
SME 8	MM1	✓	▪
SME 9	MM2	▪	✓
SME 10	MM3	✓	▪
SME 11	SMM1	▪	✓
SME 12	SMM2	✓	✓
SME 13	MM4	✓	▪
SME 14	SMM3	▪	✓

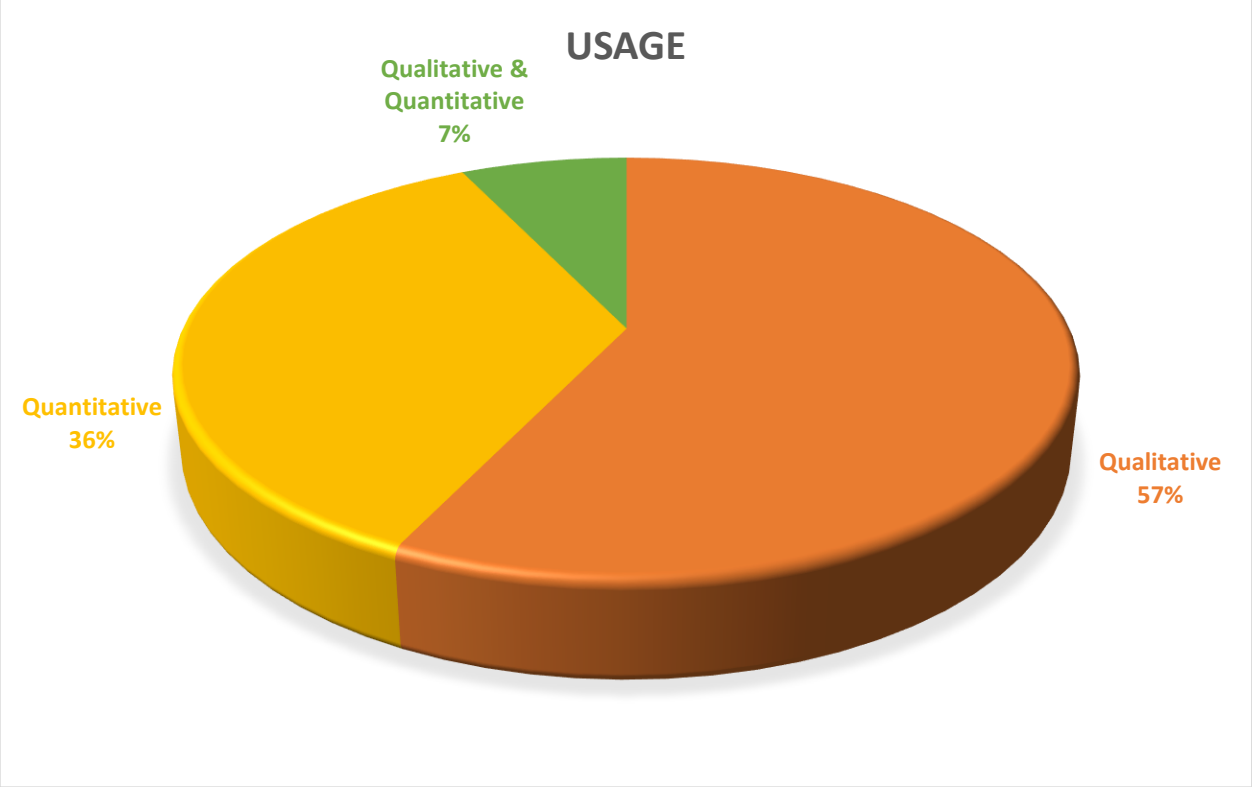
Source: The Author

The feedback indicates that out of the 14 organizations only one SME12 which is the largest among them used both methods that is judgemental and quantitative. The others either use only Judgemental, or quantitative method. As shown in the diagram (figure 4.1) below the method which is largely used by the organizations is the Judgemental, with 8 out of the 14 participating companies use only the said approach to forecast demand representing 50%, followed by quantitative method with 44%. As indicated earlier some of the organizations use mixed methods for forecasting, the feedback portrays that 6% combines both quantitative and the Judgemental method.

The interesting revelation however is that at the time of the interview with the exception of SME12 which used IT Software (SAP Integrated Business Planning tool) in their quantitative forecasting. OP2, MM2, SMM1 and MM4 representing SME5, SME9, SME11 and SME13 respectively had just introduced their software but was at the trial stages not fully in operation. The other 9 did not have any IT Software in place.

Below is a Pie Chart showing the preferred method percentages.

Figure 4.7 Forecasting Methods Preferred by the Organizations in Percentages



The Author

The researcher probed further to find out why the organizations prefer some methods over the other.

In response to this CEO21 from SME7 the least among the other SMEs in terms of turnover rankings submitted that whiles the judgemental method gives them the desired result, the lack of accurate consistent data and insufficient knowledge on the use of statistical or quantitative methods leaves them no choice than to use judgemental method.

However, MM2 Marketing Manager from SME9 indicated that using statistical approach to forecasting is not sophisticated as it is widely speculated, being claimed statistical approaches make it easy to spot patterns for sales data. He argued that inputting sales data into excel spreadsheet helps to find patterns that enables them to produce a more accurate forecast. Giving an example he added that the previous year sales of a top drug went up, but not as much as in prior years, this phenomenon helped them to identify that the product has reached maturity in its lifecycle hence forecasts were amended accordingly.

This notwithstanding, OP1 who represented SME4 which also uses judgemental method indicated that the benefit they derive from using judgement is enormous, and it is not driven by a lack of data or an inability to use statistical methods contradicting the views of CEO1. OP1 accentuated his point further intimating that the market survey method which is a judgemental method of forecasting allows them predicts possible variations in the sales patterns as well as customer behaviour through the apt judgement and experience of experts and senior managers. He also commented that in the past they had forecasted using a quantitative method however their method only focused on past results without considering the economic and environmental data such as unemployment and disease outbreak as resulting in many instances inaccurate forecast. This informed the decision to switch from quantitative to judgemental method.

MM4 marketing manager from SME13 stated that they prefer the Judgemental forecasting method of panel consensus purely because of the flexibility it affords management to inculcate non-numerical information in the forecasting process. He reasoned that there is no way you can quantify intuition and experts' opinions which are very vital in forecasting but is lacking in quantitative forecasting.

Meanwhile OP2 operations manager from SME5 whose organization uses quantitative data was of a different opinion and therefore eulogize quantitative forecasting techniques to be the best. He stressed that quantitative forecasting eradicates or lessens overblown Forecasts. He added that statistical approach prevents the use of falsified data from members of the forecasting team who for some reason will want to show off or impress management with inflated forecast.

Procurement manager PM2 from SME3 opined that he prefers quantitative techniques due to the fact that the forecast is based on actual data and not assumptions. Claiming that when forecast is based on recorded past data it eradicates ambiguity. He further added that "*Most of the qualitative methods are based on group consensus. These groups are made up of experts and consultants who fill questionnaires, discuss their opinions until they have come to a consensus before forecasting. In as much as these experts may be reliable you have to bear in mind, they can be wrong as well hence you don't assume consensus as certainty."*

CEO1 from SME1 with over 30 years' experience in forecasting and planning emphasised that though judgemental forecasting may lack numerical and graphical charts in its presentation, it is very rich in detail with a lot of information to help management take the right decisions, furthermore he indicated that they use brainstorming a form of judgemental method and this is very open and unrestricted which gives room for innovation.

In conclusion he said, *"remember forecasting is for management decision therefore what is the point of having a forecast full of numbers and graphs without any information, it is of no benefit to the lay person however qualitative forecast with its rich details from experts can help management to make the right choice".*

Nevertheless, the sales and marketing manager SMM3 from SME14 whose preference is the quantitative technique said numerical forecast are not difficult to interpret and are very easy to analyse. He again stated that with quantitative techniques data are objectively interpreted unlike qualitative methods which can be subjective and full of bias. In an example he said in interpreting answers from consumers in a qualitative market survey can be very subjective, consumers may feel pressured to give answers that the organizations want to hear, which in this case lack validity. Consumers may not like the product as much as they say. However, with

quantitative method sales data used for the forecast are recorded taking away any subjectivity from the forecast.

Adding to this SMM2 Sales and marketing Manager from SME12 who uses both methods Quantitative and judgemental to forecast stated that quantitative methods are mostly cheaper to use than judgemental method. Adding that the main resources needed for the forecast is the information or the data. Aside the costs involved in gathering the data there is little or no expenses to be incurred after. Whereas Judgemental methods may involve hiring expect for their opinions, using market surveys, which are very costly.

He however stated further that though judgemental can be expensive there are situations where the only option available to them is to use the qualitative approach due to the nature of the product, the data and other variables. He therefore could not choose a preferred method.

The researcher further asked which of the methods (judgemental or quantitative) were prone to errors and whether additional information makes any difference in the forecasting process.

SMM2 the sales and marketing manager of SME12 reiterated that they use all two methods at different times and for different product hence they are not able to pick any one method, indicating further that each of the methods have their own merits and demerits and that as with all the methods additional information or domain knowledge relating to current market situations, economic and environmental conditions are very helpful.

The other organizations could not comment on this as most of them uses only one method for forecasting. The others who had just adopted IT software's were as well not able to comment as it was still in the introduction stage.

(Q13) being the last question on the methods was to find out whether the SMEs combined methods during the forecasting process.

Responding to this question sales and marketing managers SMM3 and SMM1 as well marketing manager MM2 from SME14, SME11 and SME9 respectively indicated that they believe combining methods can produce best quality forecast but have no prove yet purely because their newly introduced IT software's which will be combined with their respective qualitative methods is in the introductory stage where forecasters are

now learning to use the software. They further commented that once it's up and running they are sure of obtaining superior forecast.

However, SMM2 indicated that although they are currently relying more on the software automation of their forecasting process, they always subject the forecast to judgemental scrutiny to ensure it is fit for purpose. Hence agrees that combining methods gives superior forecast.

4.6.5 Forecasting Accuracy

Moving on to the class five sets of questions which focuses on forecasting accuracy the researcher asked interviewees how important forecasting accuracy is to their respective organizations. To this the entire participant indicated that it is important to them and gave reasons.

CEO1 responding to the importance of accurate forecasting said accurate demand forecast is a vital tool for every organizations success and also it is the means that helps their organizations to identify their consumers and meet their needs.

Procurement Manager PM1 add that accurate forecast helps estimate correctly the demand for materials.

SMM1 submitted that with accurate demand forecast, they are able to attain a higher rate of "on time in full" delivery. Forecast accuracy ensures that enough of their products are manufactured and where necessary ordered on a timely manner to fulfil customer needs, which results in few complaints from clients and makes our customers happy.

PM2 held that accurate demand forecast, helps them to better manage their inventory which prevents stock out and over stocking situations. He also added that "Steady inventory in effects leads to better management of production."

Sales and marketing Manager SMM2 also added that accurate forecast helps them to maintain the right levels of inventories which prevent them from panic sales and excess promotions to get rid of unsold products. Sales are managed in a very thoughtful planned manner.

In line with what PM2 and SMM2 said OP2 also claimed that accurate forecast enables them to manage production more effectively and efficiently, as a result they

have better grip over their supply chain. Accurate forecast gives them the greater opportunity to take advantage of just-it-time ordering.

CEO2 opined that accurate demand forecast helps them to anticipate sales which in effects generate the numbers needed to gauge both revenue and profit. Having an accurate and reliable forecast affords them the ability to explore avenue to possibly increase both revenue and net income.

OP3 stated that accurate forecast means they have a grasp on the anticipated production rates in their organization which makes it possible for them to effectively control their internal operations. Indicating further that being able to anticipate future demand of their products aids them in decision making regarding hiring both casual and permanent employees as well as on future expansion projects.

OP1 also indicated that forecasting demand accurately breeds continuous improvement in their organization. Claiming further that as they constantly review the process to make it better, all other aspects of the organisation improves.

Finally, on the importance of accurate forecasting the sales and marketing manager SMM3 from SME14 opined that forecasting demand accurately affords the sales and marketing team foresight into future sales and helps them to effectively schedule promotions appropriately in the product life cycle as well as indicating to us products in their declining stage for us to either rebrand or withdraw the product from the market.

Some of the direct quotations from the participants have been presented in the table below.

Table 4.11 Benefits of Accurate forecasting

Participants	Benefits of Accurate forecasting
CEO1	*It helps us gauge the demand for our products.*
OP3	*It enables us to financially plan for the growth of our organization*
SMM2	*It helps us better manage our inventory.*
SMM3	*It helps the marketing team to identify and address potential decrease if future sales by introducing promotional offers*
CEO2	*Accurate forecast allows us to see into the future and plan strategically to increase growth*
OP2	*An accurate demand forecast enables us to measure the interest in our products.*

Source: The Author

Responding to the question of how inaccurate forecasting affect their organization CEO2 indicated that inaccurate forecast leads to loss in profit due to the fact that when forecast is inaccurate it leads to stock-out situations meaning not making enough sales, not only for a particular product, but for other items as well, explaining further he indicated that most of their customers buy in bulk to take advantage of discount and save on transportation cost, so when they place an order and we do not have a particular product(specific drug or medicine) on their shopping list they go somewhere obviously to their competitors so they can take advantage of discounts and other benefits as well. When this happens not only are they losing a customer but loss of sales and reduction in profit.

OP1, and SMM3 also agreed to the accretion of CEO2 by indicating that inaccurate forecasting impact on their profit and sales in the sense that it leads to excessive level of stock. They all indicated that holding excessive stock is a cost to their organization

which in the end goes to reduce their profit or revenue. SMM3 threw more light by giving the breakdown of the cost of holding excess level of inventory as results of poor forecasting, he highlighted that this situation both impact on overheads and direct cost some of which may include warehouse cost, electricity cost extra personnel in terms of security etc.

Giving an example he mentioned that "*in the year 2015 there was cholera outbreak in the northern part of Ghana and it was predicted based on the rate of infections that it was going to be a nationwide problem so we forecasted (Oral Rehydration Solution ORS) a drug that was in high demand taking that information into consideration, and produced 5times more than what we produced the prior year, however the spread stop midyear therefore there was no more demand for ORS, we have to higher a warehouse to store our not only the finished product but also the excess raw materials at a cost which in the end affected our revenue for the year".*

PM1 also expressed that when demand forecast is inaccurate it may results in ordering excessive stock and some products with short shelf-life span will end up being disposed should demand fall short. Even with evergreen pharmaceutical products which are not that many we may have to store them in the warehouse till consumers come asking for them which in the end affect the bottom line of the organization.

CEO1 also opined that inaccurate forecasting also affects customer satisfaction which may lead to loss of clients. He further recounted that clients have zero tolerance when it comes to unavailability of stock. In essence when inaccurate forecast which lead to stock out and in the end result in negative reviews from customers and deter potential clients. SMM3 could not agree more to the CEO1 claims when he indicated that inaccurate forecasts could result in underestimating the quantity of stock or logistics an organization may require in busy periods and fail to meet customers requirement. This could adversely affect the organizations reputation and move both loyal and potential client somewhere else.

MM2 on his part said that the inaccurate demand forecast cause both long- and short-term challenges to the organization. Firstly in the short -term it becomes difficult to understand your clients, and also makes it difficult to come out with a product that meet their needs or anticipate what particular product customers are most likely to purchase and when and this eventually prevent the organization from meeting its sales figures.

In his view OP1 who is the operations manager for SME4 indicated that inaccurate forecast prevents the organization from delivering a robust financial plan or come up with pragmatic key performance indicators (KPIs), resulting in business plan failure. He further stated that this situation affects the organization in so many ways, it affects the cashflow the business and possibly prevent the organization from obtaining the needed credit facility for expansion.

4.6.6 Forecast Errors

The researcher continued with the questions on how forecasting errors are identified and minimised in their respective organizations.

Answering the question 16 on how their organization identify errors from previous forecast in other not to repeat them SMM2 indicated that Neglecting and avoiding to examine the mistakes from your forecast renders the forecaster and the organization a lot less likely to develop and become better at forecasting. He further indicated that finding forecast errors or inaccuracies over hundreds, or perhaps thousands of items can be a bit difficult therefore they employ exceptions analysis by finding and understanding the causes of the major or very expensive forecast errors i.e. the large deviations which lead to the forecasting challenges. We use an internally built spreadsheet that lets you indicate the exception percent and only items which go beyond this threshold are captured in the report. We then examine these exceptions and give meaning to them and answer the question of whether the issues could have been foreseen. This process helps us to appreciate if there was a clearer information or analysis available when the forecast was being prepared that was not captured, we then learn valuable lessons and use them in the subsequent forecasts.

OP2 indicated that for their organization they rely on the Mean Absolute Deviation a mathematical metric in identifying the errors in their past forecast. He revealed that the formula shows them how far their actual demand in units is from the demand forecast in units by taking the total value of forecast errors and striking averages based on the time frame of the forecast.

SMM3 who also indicated that their organization use “mean absolute deviation” highlighted that the formula reveals how significant an error on average is in the organizations forecast. He added that though this approach in identifying errors is good it is not very helpful when you have to compare error with respect to different

products, as the formula provides you with the average error in units. Giving an example to clarify this assertion he indicated that you cannot compare a product that only retails 6000 units that has significant average error of 2000units with a product that sell 200000 units as that will be very insignificant. Due to this inherent challenge they turn to use Forecast bias which looks at the variance between sales and forecast and ensure that the factors that lead to the variance are considered and in the next forecast.

SMM1 and MM2 both indicated that they apply the Mean Absolute Percentage Error formula in detecting what went wrong in their past forecast. Explaining how the formula works MM2 indicated that the forecast error is expressed in relation to the volume of sales by indicating how far the forecast is off in percentage points on average.

SMM1 also indicated that this approach employs an equal weight to a percent deviation, no matter the scope of the actual or the forecast, a product that sells in thousands and other product that sells in hundreds have the same weight.

He opined that they use it because it is not very complicated, and the error can be interpreted and explained with ease.

The researcher probed further to ascertain whether turbulence in the environment such as stock price fluctuations, interest rates, exchange rates, high inflation rates and commodity price, sickness or disease outbreak have any significant impact on the forecast of the participating organizations.

All participant revealed that indeed instability in the environment as a result of changes in microeconomics and macroeconomics such as have been listed above impact greatly on their forecast.

CEO2 in his assertion disclosed that in interest rate exchange rate and change in commodity prices are their major worries as these changes by the day. He claimed that though they make room for such changes in their forecast, their forecast is always out because the rate of change in the price of commodities for example cannot be predicted as the suppliers are not regulated so they often changes prices of raw material (chemicals) for production at will and this affect the accuracy of their forecast.

In line with this OP1 also claimed that as most of their raw materials are imported hence changes in exchange rate affect their forecast , citing the year 2016 as an

example he claimed that due to some political situation in the country exchange rate change for the dollar was about 15% leading to loss of purchasing power for their organization as they were importing most of our raw materials with the dollar. Hence could not produce to achieve its sales target.

The last question on the forecast errors was on how forecasting errors could be minimised in the pharmaceutical SMEs in Ghana

CEO 2 intimated that using point of sale data is an approach they have adopted to minimize errors in their forecast, indicating that the approach has proved to be their best method of sensing demand, as the data capture essential time sensitive information such as the type of product and quantity sold, date, place and time of purchases. The amalgamated point of sale data is then compared to their interim forecast and any variance above the agreed threshold is used in tweaking the interim forecast.

Operations Manager OP1 held that aside scrutinizing historical data such as sales, current order history, tracking macroeconomic indicators has been one key tool they have use to reduce forecasts errors. This approach was further supported by CEO1 who maintained that monitoring macroeconomic movement such as GDP, stock market changes and other economic factors which can be linked to change in the end user demand is a very important tool in altering short term forecast to in other to avert excess stock or missed client orders.

SMM1 replying to the question, strongly and without any hesitation stated that quantitative technique of plotting actual sales data on a graph as and when the numbers are received help minimize forecast errors. He portrayed that many occasions you will have a deviation in the forest and actual graphs, however you are able to measure and calculate the percentage difference which in the end is used to adjust forecast.

In contrast MM1 argued that data should be evaluated before plotting the estimated numbers on the graph to get rid of any extraneous data, as much as possible rely only on reliable data which is very robust. The relevance of every data should be rated with an internally generated yardstick to separate valuable data from worthless data and avoid the use of complex model full of extensive data if the information is centred merely on speculation.

A more insightful response in relation minimising forecast errors was given by SMM2 who indicated that it is appropriate that every new data source is examined before relied on. Particularly if the product has been promoted severely it is essential to test using a quantitative technique that blend in promotional data into the process of demand forecasting other than just using a qualitative approach as this helps in minimizing errors. SMM2 also added to the macroeconomic indicators story by indicating that domain knowledge should exploited to ascertain whether macroeconomic indicators which impact the pharmaceutical industry can be incorporated into the organizations data using multiple regression analysis method as this also helps in minimizing forecast errors.

Though not mentioned by most of the participant CEO1 allude to the fact that monitoring competitor promotional offers can help mitigate forecast errors. It is very important to envisage the brunt in sales as a result of competitors moves and tweak the sales forecast appropriately. He indicated that their organization has been caught out of the blue by an eleventh-hour promotional offers and price cut by a rival organization and where they had not much time to respond to such circumstances and that adversely impacted on their sales forecast.

An interesting finding was giving by MM3 who opined that in the quest to minimizing forecast error there are few issues which are very important to consider, citing that focusing on data is good but evaluating the forecasting methods or models being used and the forecasting process are important in fight to reduce forecast errors, as there could be off-the-shelf methods that will perform incredibly better than the existing methods, or will be superior for different product lines. Giving an example he highlighted that in the past they used same quantitative method for all their product lines however review of their forecasting process lead them to try different forecasting methods for different products which has helped in reducing forecasting errors in their organization, but was quick to add that their success came after many testing.

On the other hand, PM1 was of the view that making a distinction between seasonality from regular demands pattern and having a separate forecast helps in reducing forecast errors. Emphasizing that best practice will be to address seasonal demand differently from the regular calculations of demand forecast so to have a clean and robust data free from inconsistencies. Adding to it he said that if any product line that

has seasonality the demand ought to be modified before being utilized in the forecast calculation.

OP2 on his part indicated that though seasonal variations can be followed in patterns with time, outliers are not very easy to anticipate. Such demand can be as a result of things the business may be aware of such as sales and marketing promotions, strike actions by employees or as a result of things the organization might not be aware of such as natural disasters, loyal customers going bankrupt, or even rival company's marketing promotions.

Indicating further that outliers can be detected in many ways however it is essential that they are highlighted as outliers in the process of forecasting demand else it can lead to a major adverse effect on the organizations resulting in forecast errors. He mentioned that excessive or minimal demand which is unusual should be recognized and not be factored in the calculations of demand forecasting as this can increase forecast errors.

MM2 also came to an agreement that another way to lessen errors is to make use of multiple forecasting techniques to cover the diverse needs of the consumer demands and trends.

4.6.7 Forecasting Climate / Culture

The class 7 set of questions was on the Forecasting Climate and Culture within the case study organizations, its aim was to investigate management's commitment on forecasting and collaboration among the various departments.

Almost all the 14-participant answered in the affirmative that their respective management are committed and very supportive of the forecasting process.

Responding to the questions SMM2 the sales and marketing manager of the biggest SMEs among the participating organization, indicated that their management are very keen on collaboration in the forecasting process, management appreciate that departmental collaboration produces value not only for staff members, who builds on their internal links, but also it supports the business resolve difficult forecasting issues encountered by any single department. He further indicated that their management has put together "unique teams" that brings employees from all departments who brainstorm on forecasting matters and leverage their distinct views to create a better

forecast, contribute to best practices and evaluate prevailing procedures to find segments that needs upgrading.

MM2 also opined that their management are very committed when it comes to collaboration on forecasting issues. He narrated how management has created a platform where employees connect with each other from different parts of the value chain in the organization. This platform provides timely point of sale information to any department which needs it at any given moment. He sustained that management through technology has made it possible for employees who are geographically and logistically spread to come together and deliberate on forecasting issues.
" In an example he indicated that they have distribution centres in all ten regions of Ghana, and every morning heads of these centres meets via Zoom to discuss inventory levels which is then passed on to forecasting team to adjust their forecast."

In support of SMM2 earlier submission, CEO1 management approach of involving personnel from different sectors of the business in the forecasting process foster collaboration and aid the team to capture errors otherwise would not have been noticed by only one department.
He further stated that during uncertain and volatile period where external factors such as competitors promotions, inflation, exchange rate etc are out of control there is the need to bring finance, marketing, operation and production teams together to bring their perspective on board to achieve a better forecast.
However, OP1 thought otherwise on the issue of collaboration and revealed that though management are committed and very supportive of the forecasting process, there is lack of collaborations among the various teams within their organization. He held that every head of department comes up with a forecast which is then fed into the main forecast of the organization. As a result of this strategy, different business units within the organization develop various forecasts which are not compatible. Each of these forecasts is based on the manager's opinions therefore any amendments or a tweak magnifies errors in the overall forecast.

Below is a summary of the participants' response to the question of collaboration

Table 4.12 Collaboration in forecasting demand

Participants	Management's commitment
CEO1	*Management approach of involving personnel from different sectors of the business in the forecasting process foster collaboration and aid the team to capture errors otherwise would not have been noticed by only one department.*
MM2	*Management are very committed when it comes to collaboration on forecasting issues*
SMM2	*Management appreciate that departmental collaboration produces value not only for staff members, who builds on their internal links, but also it supports the business resolve difficult forecasting issues encountered by any single department*
SMM3	*Management attaches a very high priority to collaboration*
CEO2	*Management takes collaboration towards forecasting very seriously as it enhances forecast accuracy*
OP1	Though management are committed and very supportive of the forecasting process, there is lack of collaborations among the various teams within their organization.

4.6.7 Industry dynamics- stakeholders' interaction

The last sets of questions focused on the dynamics of the industry and stakeholder's interaction. The emphasis was on the classification of drugs the participating organizations manufactured either generic, branded or both and how that shaped their forecasting processes. The questions also examined the impact of brand loyalty, industry regulations and government policies on the forecasting process.

It has to be stated that both branded and generic medicines come in various forms examples may include Liquid, solution or syrup, Tablet, Capsules creams, lotions Suppositories Drops Inhalers Injections Implants or patches

The responses of the various participants on the question of what classification of drug they manufactured, and the forecasting method used has been presented in the table below.

Table 4.13 Classification of Drug

Organization's Code	Interviewee's Code	Branded	Generic	Forecasting Method
SME 1	CEO1	▪	✓	**Judgemental**
SME 2	**PM1**	▪	✓	**Quantitative**
SME 3	PM2	▪	✓	**Quantitative**
SME 4	OP1	▪	✓	**Judgemental**
SME 5	OP2	▪	✓	**Quantitative**
SME 6	OP3	▪	✓	**Judgemental**
SME 7	CEO2	▪	✓	**Judgemental**
SME 8	MM1	▪	✓	**Judgemental**
SME 9	MM2	✓	✓	**Quantitative**
SME 10	MM3	▪	✓	**Judgemental**
SME 11	SMM1	✓	✓	**Quantitative**
SME 12	SMM2	✓	✓	**Quantitative/ Judgemental**
SME 13	MM4	▪	✓	**Judgemental**
SME 14	SMM3	✓	✓	**Quantitative**

Source: The Author

From the response as presented on the table 4.13 above only 4 out of the 14 participating company's manufactured branded medicines. It also indicates that with the exception of SME12 who uses both methods in forecasting demand, the other 3 who manufactured branded medicines relied on the quantitative forecasting method. The other ten organizations produced only generic medicines and their respective method has been highlighted in table 4.13 above. This information clearly portrays that the industry produces more generic medicines which are as effective as the branded drugs but are less expensive.

The researcher further probed to establish the importance of brand loyalty in forecasting demand especially for new drug.

On the question of brand loyalty, all the 14 organisations interviewed agreed that brand loyalty is crucial when predicting how well a drug especially a new introduction will perform. Brand loyalty is built over time and the sales information accumulated form the basis of future forecast or affinity to a new introduction. Answering the question on brand loyalty and its impact on forecasting, CEO 1 opined that customer loyalty helps to obtain more accurate forecasts. He opined that once customer become loyal to your brand, making repeat orders and forecasting sales becomes a whole lot easier. Customers' purchasing behaviour becomes more reliable as there is a detailed order history data. 6 out of the 14 interviewed however emphasised the influence of other factors. 2 out of these 6 particularly stressed price and competitors. They both narrated instances where failure to deliver on time or delay in entry due to unavoidable events resulted in competitors swaying even loyal customers causing inaccuracies which resulted in losses. Price volatility may also throw forecasts for loyal customers out, notwithstanding they acknowledged the price insensitivity of most loyal customers, and this knowledge increases the confidence of forecasters. As price is interpreted to signify shoddy (cheap) or efficacy, some customers would not complain about a price hike where they are assured of quality.

The final question was on how the industry regulations and the government health policy impact the SMEs demand forecast?

All respondents agreed that Industry regulations and the government health policy impact generally on their business.

Responding to this, SMM2 one of the biggest manufacturers and exporter to the sub-region affirmed that indeed government policies directly affect their forecast. He opined that Ghana compared to other countries in the region have well-established drug regulatory body through the food and drugs authority (FDA), this ensures that before approval is given to manufacture drugs, due diligence has been carried out and the appropriate boxes ticked. This process provides consumer confidence after the drug is released into the market so when all the forecasting has been concluded, it is unlikely for the product to fail post market checks.

In another instance CEO1 highlighted those two government policies i.e. government building more district hospitals and the National Health Insurance Scheme (NHIS) increases demand and therefore impact forecast. New hospitals mean increase demand for drugs (increase in access to medicines) Through the NHIS government policy of reducing cost through substituting foreign branded drugs with domestic generic less expensive drugs, limits foreign direct investment boosting and boost domestic capabilities, these directives help one way or the other impact the demand forecasting.

All the participants indicated that because of the FDA's Regulation on drug classification, some drugs which fall into the narcotic drug group can only be produced based on the quota given to them by the FDA; this really places restrictions on the forecast for such group of medicines.

They further agreed that Essential Medicines list from the health secretariat also informs demand forecast.

4 of the interviewees OP1, MM1, SMM3 and MM4 also touched on government policy that seeks to reduce VAT, indicating that means more can be produced. MM2 specifically stated that the demand for drug has always been high but capability is the major drawback. Removing taxes means cost can be reduced, forecast increased as they are very dependent on pharmaceutical imports.

SMM2 who also exports also identified how the policy on removing trade barriers and to promote Ghanaian pharmaceutical products within the West African sub region could translate to greater forecast.

CEO2 also commented that government policy to fund production plants to meet international quality standards as well impact on demand.

Table 4.14 Chapter Conclusion

Emergent Theme	Remarks	Emergent Theme	Remarks
Data	Past or historic sales data is heavily relied upon Trends, patterns and current market conditions are crucial Market survey to forecast demand. Availability of data has no influence in micro and small enterprises The process is referred as planning and estimation in small organisations Management make projection based on advance purchase orders or estimated orders In medium scale enterprises availability of data influence method choice. Brainstorming where data is inadequate	**Forecasting Methods**	The responsibility of selecting the forecasting method varies from each organisation. In some instances, management selects and in other instances management do not play any key role in the selection of the method. Management choose but consult marketing manager Method driven business strategy based on forecasters own assumption Judgemental Method is generally preferred however for some the choice is driven by lack of knowledge and consistent accurate data necessitate its use. The choice is not driven by a lack of data or an inability to use statistical methods Judgemental Methods preferred- Delphi method, brainstorming. Quantitative Method by medium enterprises. Judgemental forecasting method of Delphi they are able to predict possible variations in the sales patterns as well as customer behaviour counting on the judgement and experience of experts and senior managers.
Forecasting for new and existing drug	Difficult to forecast demand for the introduction phase due to the lack of historical sales data. Market survey is used for forecasting new drugs. Observing the linear growth after the introduction. Demand for new drugs projected through purchase order from potential customers Forecast at the growth and decline stage is based on the trend and the rate of decline.	**Collaboration**	The general consensus was management is committed and supportive of the forecasting process A few opined that silos exist, management do not ensure collaborations among the various teams within the organization. And other stated the opposite. In selecting IT software, end users are consulted and are involved in the development and design of the software
	Inaccurate forecasts affect customer satisfaction.		Accurate forecast helps organizations to identify their consumers and meet their needs.

Forecasting accuracy-Costs	Loss of clients as they hardly tolerate stock out. Excessive stock and wastage. Inability to understand clients' needs or anticipate demand. Unmet sales targets. impact on profit and sales	**Forecasting accuracy-benefits**	Correct materials estimate. Better management of inventory preventing stock out and over stocking. Results in better management of production. Prevent panic sales and excessive promotions to get rid of unsold products. Helps to effectively schedule promotions appropriately in the product life cycle. It enables financial planning for growth, Accurate forecast allows us to see into the future and plan strategically to increase growth Forecast accuracy ensures timely manufacturing and timely delivery resulting in few complaints from clients.
Sources of Forecasting Errors	Neglecting and not analysing mistakes inhibit the opportunity to grow and develop to be better at forecasting. Mean absolute deviation highlight how significant an error on average is to forecast accuracy. Macroeconomic indicators are key tool for reducing forecasts errors. Envisage brunt in sales due to competitors' actions and amend the sales forecast appropriately.	**Minimising error**	Excessive or minimal unusual demand should be measured when factoring forecast calculations or projections. Use point of sale data to minimize errors when forecasting, the data captures essential time sensitive information. Evaluate the forecasting methods or models being used and the forecasting process to reduce forecast errors. Quantitative technique help minimize forecast errors. Exception's analysis to understand the causes of the major or very expensive forecast errors. Scrutinise every new data source before using it especially if the product has been promoted before To lessen errors, use multiple forecasting techniques.

Demand forecasting obstacles	Wrong information and lack of data from key departments. Example Inaccurate sales data Lack of collaborations among the various teams Inability to forecast variations to potential future demand Lack of knowledge of the correct/ right methods Insufficient funds allocated to forecasting. Forecasters lack knowledge of right forecasting practices Lack of improvement in the forecasting process is a challenge. Same method over a long time with upgrade Undue pressure from management Inability to forecast promotional demand correctly.	**Mitigating forecasting obstacles**	Adopt a top-down approach that makes collection of good data an integral part of the day to day operations of the business Collaboration There is the need to adopt robust statistical methods whichever changing environmental and economic climate than changing methods when a shift occur in the market place Ensure there are adequate resources for forecasting, for acquiring new software and training and improving the skills of the forecasters. Exposure to what goes on in similar organizations Management opinion should not be imposed on the forecasting process. There should be adequate training for users of forecast. Forecaster should be able to inculcate marketing strategies such as promotions into the forecasting process.
Other External Influence	Cost of Raw materials Culture and climate. Cost of raw materials and consumer behaviour Competition Consumer Behaviour	**Regulations and Policies**	Brand loyalty is crucial when forecasting especially a new drug as Customers' purchasing behaviour becomes more reliable. Drug production quota policy Government cost reduction policy substituting branded drugs with domestic generic drugs Government policy to fund production plants. VAT reduction

Source: The Author

This chapter delineated the salient findings in this study.

The responses from the semi-structured interviews are summarised in appendix 8 and 9 to give a complete overview of the responses on the forecasting practices/processes, challenges, and opportunities that the Manufacturing pharmaceutical SMEs in Ghana encounters during forecasting demand.

After an initial analysis which informed the summary, some of the themes were combined as the responses given fits into both themes; for instance, class 2 and 4 responses were combined to give a clearer picture of the forecasting process in terms of data and method. As indicated the interview responses are classified based on the emerging themes from the responses to help answer the research questions. The discussions in the next chapter will follow these emerging themes. The themes have been colour coded for ease of identification in appendix 9.

The main findings for each classification are hereby recapitulated and discussed in the next chapter.

Chapter Five
Discussion

5.0 Introduction

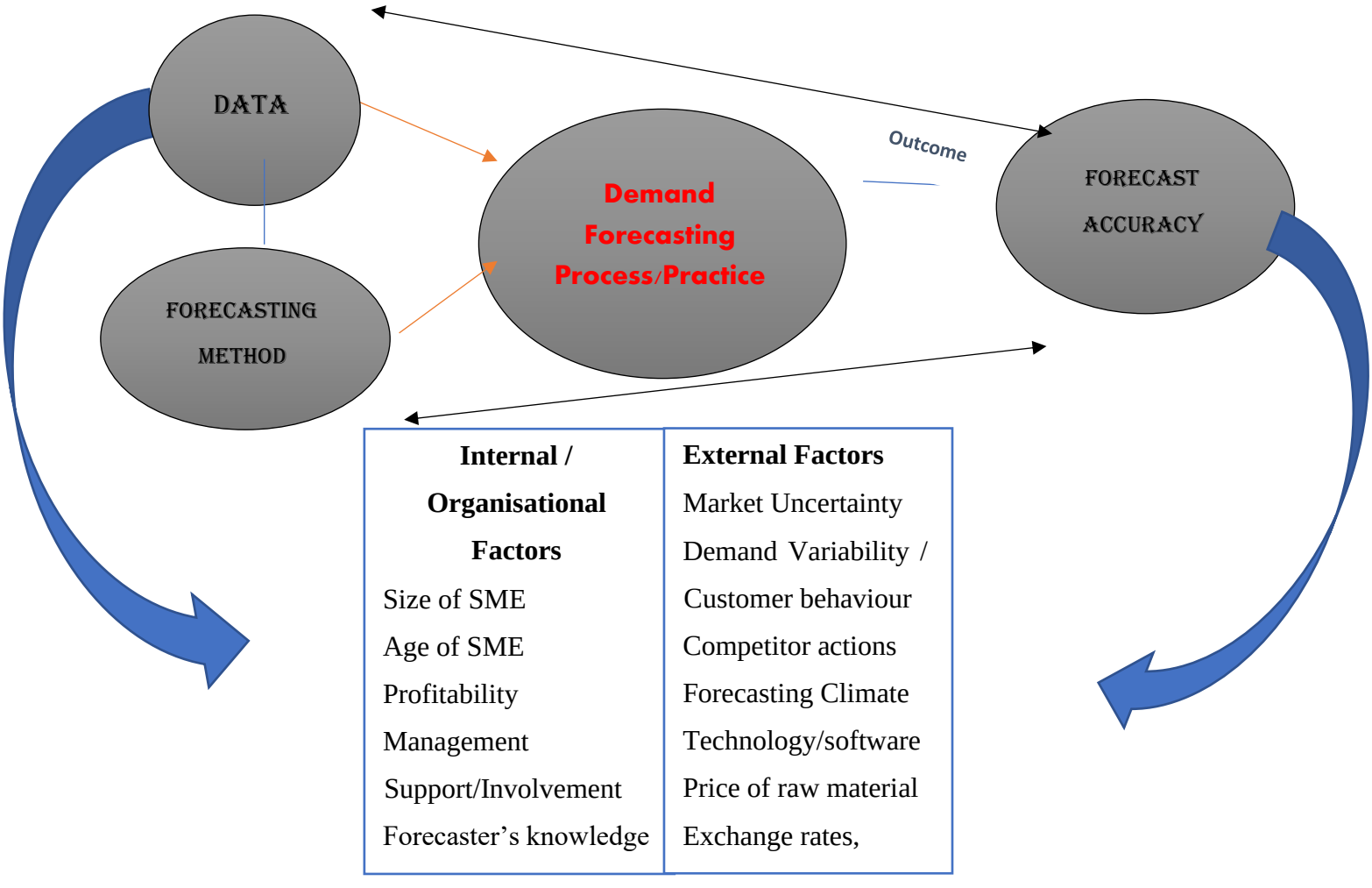
This chapter compares, contrast, evaluates and discusses the major findings from the interviews in light of the literature review. It provides additional comments and arguments to support the study. The study was undertaken with the aim of exploring the demand forecasting process of pharmaceutical SMEs and was steered by several research objectives. In order to realise the aim for undertaking the study, a qualitative research methodology was adopted and applied. Interviews were used to collect data from CEO's, sales and marketing managers, procurement mangers and operation managers in fourteen pharmaceutical SMEs in Ghana to unravel the concept of demand forecasting in their context.

In keeping with the main purpose of exploring the demand forecasting process and to present a holistic perspective of the major players of forecasting in the participating organisations, the analysis and discussion is divided into main parts, with subsections for each of the main parts. As in the previous chapter, the discussion will ensue from the emerging themes from the findings, interview question and the theoretical framework provided in chapter two for ease of referencing and clarity.

The chapter begins with a discussion of the major findings from the classification questions which is the first set of interview questions. It is followed by the other groups of questions from the interview structure. For clarity and continuity based on the responses from participants, some of the classes are merged to reflect the emerging themes for it to be a true representation of the data. Based on the analysis of previous research studies and theories and based on the aim and objectives of this current research, themes were identified in chapter two and the interview questions created from these relevant literature themes. Various outcome emerged from the data as a result of the inhomogeneity of the organisations and their unique context. The various arguments under each theme were categorised into enablers or barriers to demand forecasting accuracy as a framework to address the gaps in the forecasting process. The chapter also provides a summary and highlights the key points under each section. It must be stated that, participating organisations varied in terms of size, age of company and profitability, the influence of these differentiating factors were evident in the responses. The medium size companies varied in terms of number of employees, and this also influence the demand forecasting process and practices.

The analysis of the findings paints a picture which demonstrates that the demand forecasting process of the case organisations all aim at forecast accuracy as the outcome of the process. This outcome is however influenced by data availability or lack of it and the choice of method which may also be guided by a plethora of factors supporting the findings of prior research by scholars. Correspondingly, some internal organisational characteristics and external factors also influence the nature of the outcome whether accurate or saddled with errors. This interconnectedness is illustrated below.

Figure 5.1 Conceptualization of Demand Forecasting Process/Practice



Source: The Author: Based on the extant literature and findings

The main findings for the themes identified are recapitulated and discussed below.

5.1 Overview / Profile Questions

This class of questions inquired about the profile of the organisation, the interviewee characteristics in terms of length of service/experience, interviewee's role and involvement in demand forecasting process.

As previously shown in chapter 4, the average years of work experience in forecasting by the 14 interview participants is 17 years with interviewees holding various roles ranging from operations manager, sales and marketing manager, procurement manager and CEO. Participants had also worked on different spectrums on the SME scale being large, medium, small or micro. The experience acquired by participants working within the operations, procurement and marketing departments gives them adequate knowledge about the company processes, methods, and operations regarding demand forecasting. The diverse background of the interviewees and their experiences makes them suitable to provide insightful perspective to this study and also project representativeness which is useful for this study.

An important finding from the overview class of questions which corroborates assertions in the extant literature is forecasters experience. Land (2015) in explaining forecasting stated how an individual's experiences may form the basis for a theoretical model of forecasting. Makridakis (1998) also mentions the importance of past successes or experience in forecasting although he recognises, it will not solely determine future success. Similarly, Taylor and Letham (2017) commenting on the quality of forecasts asserted that forecasters with substantial experience are critical for producing quality forecasts. Koehler (2021) also emphasis this idea purporting that forecasting theory is established on the assumption that current and past knowledge could be used for predicting the future. From the interview responses, it became clear that majority of the participating organisations place a premium on the forecasters experience and knowledge of the current market since these experiences influence the forecasting practices of the organisation. This knowledge and experience which is gained through interaction with the environment and in the course of practitioners doing their job is widely referred to as domain knowledge (Sanders (2017), and this helps forecasters determine the signals in the environment which will have significant effects or not on forecasts. knowledge and information which practitioners gain through experience can hardly be modelled in forecasting models, reinforcing its

significance. It is stipulated that lack of forecasting knowledge means calculation of forecasting errors can be overlooked.

Though the afore discussion establishes the significance of experience when forecasting, other scholars submits that in most instances' lack of formal training in forecasting by forecasters cause them to rely exclusively on personal experiences. Chase (2013) goes further to call out gut-feeling forecasting which is not based on informed judgment or domain knowledge, but the feelings of the forecaster. He asserts that it may produce accurate forecasts where demand is easy to forecast but will cause problems for forecast accuracy in complex situations. He further argues that experience and gut feeling still need to be supported by data to validate or invalidate assumptions. This study did not inquire about the level of formal training of the forecasters but documents the experience and the length of time respondents have been involved in forecasting in their respective organisation and generally. Considering the longevity and valuable experience of the interviewees (since there is a positive correlation between longevity and experience) and based on Land (2015); Taylor and Letham (2017) and Makridakis (1998) submissions; forecasts from these SMEs have a chance of being more accurate and devoid of avoidable errors. This is because as Chase (2013) submits, the forecasting process for the SMEs interviewed are not complex. This notwithstanding, Armstrong and Green (2017) caution against the negative consequence on quality of forecasts where forecasters past experiences are the only yardstick and not more appropriate or contemporary forecasting models. Harvey and Fischer (1997) revealed skilled people's proclivity to overconfidence especially where judgement is concern might result in suboptimal forecasts and overestimation (Hribar &Yang 2010). Forecaster's optimism and overconfidence may stop them from conducting additional analysis and may lead to deviations. This is not different from Lim and O'Connor (1995), who asserted that people tend to weight their judgements highly when forecasting which could contribute to inaccurate forecast and conflicts. Human interventions in the forecasting process can be an opportunity for introducing bias and unnecessary inaccuracies (Makridakis et al., 2020). Logg et al., (2019) suggests guarding against overconfidence and anchoring to increase trust in forecasting experts since algorithms fades in the light of expertise and rust is important (O¨ nkal et al., 2019).

Emerging Finding: forecaster's experience and sufficient knowledge of the market was found to be important for most of the organisations. The forecasting process of majority of the organisation is simple making experience an integral part.

5.2 Forecasting Process

The three main set of questions under class two capture the forecasting process. It comprises data and choice of method. As Armstrong (2001) suggests, the forecasting process involves formulating a problem, obtaining information about it (data), selecting and applying methods, evaluating methods and using forecasts. Likewise, Zotteria and Kalchschmidt (2007) outlines the activities of the forecasting process as collecting information, generating and modify forecasts and finally measuring forecasting accuracy. The questions on forecasting process were intended to delve deeper to understand the availability of data and type of data required when forecasting demand as well as the impact on the choice of forecasting method. It explored who was responsible for selecting forecasting methods and the preferred IT system used in forecasting by the case organisations.

5.2.1 Data

The importance of data has been well articulated in the forecasting literature with Chase (2013) arguing that lack of access to data makes forecast inaccurate. It is also suggested that over time customer loyalty declines due to competition therefore demand forecast cannot solely depend on historical or past data as this can be awfully wrong. It was evident from the interview findings that forecasts by medium sized enterprises were predominately based on historic data (previous year's sales data) and judgement which some interviewees described as simple and straight forward. 8 out of the12 medium organisations interviewed confirmed the importance of historical data and past trends. Although historic sales data is heavily relied upon by medium size enterprises when forecasting as reported, three (3) of the respondents opined that where the historic data is inadequate, they usually resort to brainstorming to make projections relying on the experience of forecasters since the market does not change drastically in the short term. This suggests an interplay between availability of data and the method used. Though SMEs face stern competition from larger industry players, they have the opportunity to grow incremental, suggesting that historical data cannot be solely relied on.

According to Arvan et al. (2019) when forecasting is based on historical sales data, the forecasts produced may be wrong when information such as promotional activities engaged in are not considered in the extrapolation of the historic sales data. This observation presents some complexities when extrapolating past data to project the future demand especially for SMEs who due to size were found not to be too sophisticated in their approach to forecasting. Even though historical data formed the basis for forecasts in most of the participating organisations, it was not very clear from the interviews if forecasters are cognisant and perhaps act on the peculiar past activities which may influence the accuracy of forecasts when extrapolating sales history. They generally perceived the process as fairly straight forward with minimal turbulence though fraught with inefficiencies and inaccuracies and this will be discussed in subsequent sections.

The situation was found to be similar yet different in the case of small scale enterprises. Firstly, the terminologies used in the small-scale enterprises were different to an extent. Inherent in the terminologies were the scale of difference in the process among the participating organisations be it small or medium scale. Small scale enterprises refer to the forecasting process as planning and estimation as opposed to forecasting by some medium sized organisations or big organisations. The prevalent practice among the small enterprises is to conduct market surveys to help gauge demand and or ascertain estimated or actual orders for the period, by prior contact with potential or existing customers. Although Hyndman and Athanasopoulos (2018) define forecasting “as the estimation of some future events”, the case of these small sized pharmaceutical companies is different as most often the estimation is based on actual demand received in the form of purchase orders.

Data was found to be important for both small and medium enterprises as with any forecasting endeavour, but the point of difference was the type or nature of data. Whereas medium size companies had access to time series and previous sales data albeit without sophistication, small size enterprises depend on actual demand information. Though it could be argued that such a practice is safe and prevents unnecessary cost, it could equally be problematic and stifle growth. This is especially problematic because small and medium enterprises tend to be either at the introduction or growth stage of the organisational lifecycle, a stage with opportunities

to grow, thrive and expand and this will be difficult if demand forecasting is limited to actual purchase orders.

The practice among small organisations in this study is an aberration to the assumption that forecasting involves gathering repeated events or historical data and superimposing a method (Quantitative or judgemental) to predict future events.

Evidently, availability of historic data was found to have no influence on the forecasting process of small enterprises. As small organisations, their operational models were found not to be sophisticated.

When respondents were queried on their views on the impact of data availability on the choice of method; the responses were consistently heterogeneous. Mostly the medium size companies indicated that the approach engaged in to forecast demand depend on the information available to them. This affirms Martin et al (2010) postulation that, the choice of a forecasting approach is primarily dependant on the availability of data on explanatory variables and the availability of demand history data. One respondent explained that where sufficient and consistent data is available, then quantitative approach is used but where this is not the case the forecast figures are determined through brainstorming. It must be mentioned here however that across the scope, the quantitative methods by the organisations were very basic using spreadsheet and moving average quantitative method where there is consistency in the data. This finding is inconsistent with Weller and Crone (2012) study of pharmaceutical supply chain forecasting which found the most dominant methods to be simple methods performed in Excel such as average, naïve and smoothing methods.

Notwithstanding, a few respondents emphasised the influence of other variables such as the product line, industry knowledge, price sensitivity and prevailing market conditions on the choice of forecasting method. Some of these other variables are discussed later in this chapter in section 5.5.

5.2.1.1 Summary

The research observed that although historical data or past trend may not always be the basis of forecast either because they are inadequate, unavailable, or irrelevant to

a particular organisation mainly due to its size, data either through market surveys or purchase order is critical to the forecasting process. The data may be in the form of past trends, historic sales information, or actual purchase orders. The forecasting processes of the case organisations were found to be simple employing basic tools, even in the largest of the medium size organisation that used quantitative methods stated they use the method where consistent historical data is available.

5.2.2 Forecasting Method

This theme addresses question five under class two and class four interview questions category. These questions focus on forecasting methods; one of the components in the forecasting process besides data. As generally agreed, the choice of the appropriate forecasting method will most likely depend on the situation.

5.2.2.1 Selection of Method

The general findings from this research evidenced by the job role of respondents shows that demand forecasters in the pharmaceutical SMEs of the case organisations are mainly the operations, procurement, marketing and sales managers since their commitment is perceived to be intrinsically connected to achieving future forecasts. This might mean the interests and benefit of these departments may cloud the forecasting output as argued by Mentzer et al. (1999), since the various stakeholders may have their political interest, possibly skewing the forecasting process. To the marketing manager, performance is measured by achieving forecast and this can increase forecasting biasness if they are responsible for the forecast, resulting in departmental disagreement with forecasts. These disagreements can present all sorts of instability within the forecasting process and more so where there are many human interventions.

Irrespective of the potential conflict and disagreement among forecasting actors, promotion of collaboration and communication among the various departments or sections can reduce conflict and perceived forecast biases. Rostami-Tabar and Boylan (2020) makes a point about the two key factors to increase acceptance and use of forecasts. They suggested, what and how forecast is communicated with stakeholders. This is important for stakeholders to appreciate the information being given. The actors are the implementers of forecast in the forecasting machinery and a lack of clarity due to incomplete communication can cause grave inaccuracies.

Rostami-Tabar and Boylan (2020) also highlight recognising the development needs of forecast recipients. Proposing that sometimes training is needed to improve how forecasts are communicated on all streams and this is not usually recognised in organisations especially in less developed countries like Ghana.

Responding to the question of who select the forecasting method, the responses were split. The two small size enterprises in addition to three other medium size enterprises indicated that their forecasting methods are selected by management without any consultation with the forecasting team. Two other respondents who described a similar situation of management selecting the forecasting method specified that forecasters are consulted prior to adopting any method. Similarly, the procurement managers for two medium size companies both alluded that the method selection is executed by them without management intervention. Some also describe a scenario where forecasters select the method and management approves.

The only obvious pattern discovered from these responses was the case of micro and small enterprises. For micro and small size enterprises, management tend to be the major decision maker in the organisation. For the two small enterprises who participated in the study, the decision on the choice of method is made by management. SME1 which is the only medium size company with turnover under GHC10M and 50 employees, one employee more than a small size enterprise also had management making the decision. Interestingly, 3 other medium scale enterprises with relatively high turnover have only management making the decision without any mention of collaboration or input by the users of these forecasts. As it has been clearly articulated in the extant literature, the accuracy of forecast is influenced by the choice of forecasting method, by extension it is critical that whoever decides on the method to adopt is an expert or adequately informed.

Tyebjee (1987), makes a point that management are hardly experts in the forecasting methods. Therefore, management choosing forecasting methods without expert knowledge may be problematic.

Adebanjo and Mann (2000) in their study highlighted the impact of communication in the forecasting process postulating that effective communication ensures the entire organisation work with one forecast. Liravi (2020) researching on resilience in the supply chain also observed the importance of ease of communication amongst

employees at all in an organisation. Though it focused on the food supply an supply chain, the emphasis of communication cannot be ignored. Armstrong and Green (2005) stressed the importance of internal collaboration through discussions and incorporating each functional manager's domain knowledge to guarantee acceptance of forecasts at all levels. It is unclear from the findings why some of the medium enterprises relatively on the high end of the spectrum in terms of turnover and number of employees do not seem to show any evidence of collaboration in terms of the choice of forecasting method especially considering the premium the extant literature places on collaboration. The lack of collaboration observed may suggest an exclusion of key persons who possess the domain knowledge needed to offset some of the inherent forecasting errors and for determining future price changes over time as well as the possible effects of emerging technological trends.

The presumed lack of collaboration could be attributed to the organisational structure as postulated by Adebanjo and Mann (2000). Adebanjo and Mann (2000) advocate for an agreement amongst the functional managers by clearly indicating the functions or person responsible for each component of the forecasting process. The observation from the interviews and study of the organisation structures indicated that in the small organisations where CEOs are the main decision makers and responsible for the operations of the organisation, the organisation structure is not clearly defined therefore collaboration is non-existent as all decisions lies in the bosom of the CEO. All employees report to the CEO, the final authority in such organisations.

Although, none of the respondents had issues with the current structure and responsibilities, the structures could likely generate disagreement over the ownership of forecast as the organisation expands. Having a clearly outlined organisation structure ensures well defined responsibilities, avoiding duplication and also facilitates accountability. It is worth mentioning however that, five respondents (5) indicated some level of collaboration among the forecasters (functional manager). As argued by Rostami-Tabar and Boylan (2021) and Armstrong and Green (2005), effective communication amongst both internal and external actors in the forecasting process is important for successful collaboration. Incorporating each manager's domain knowledge ensures forecasts are readily acceptable by all the actors.

Two other respondents intimated that as forecasters they choose the methods without any consultation with management. These two forecasters are presumed to be experts with adequate domain knowledge and therefore deemed able to choose the method without any conferring or 'intrusion' by management. Though knowledge of domain is crucial when forecasting, the apparent lack of involvement by management can raise valid questions about the quality of communication when forecasting in these companies. This scenario may suggest that assumptions held and on which forecasts are based are undiscussed and in situations where forecast fails, management can quickly distant themselves from the inaccurate forecasts.

The forecasting machinery is largely a human activity system which involves people who undertake the activity; the recipient of the activity and decisions makers or owners with vested power to ignite or stop the system. Decision makers have the power to make decisions about the processes, resource investment and staff placement (Rostami-Tabar and Boylan, 2020). Though as argued owners may not necessarily be expert forecasters, they make decisions on how the limited resources of the organisation should be expended. Where they don't have an appreciation of the importance of the forecasting process and the benefits that can accrue to the business, the forecasting activity can be hindered. To have a system that works and accurately forecast the future, there should be communication and collaboration. An education where necessary to appreciate the benefits of better forecasting processes, to understand forecast and minimise the perception of bias as well as applying methods with full knowledge of the principles.

5.2.2.2 Preferred Method: Quantitative or Judgemental Forecasting

This sub section analyses the findings from class 4 questions, starting with the preferred forecasting method and the reasons participating companies proffered for their preferred methods. Based on this research finding, Ghana's pharmaceutical SMEs can be divided into those which favour either purely judgmental or statistical based forecasts and those who prefer integrated forecasts.

The majority of respondents stated that their organisation preferred either the judgemental or quantitative method. Only one organisation which happens to be the largest in terms of both turnover and size among the participating organisations uses

both judgemental and quantitative method. Eight (8) out of 13 participants use judgemental demand forecasting methods making judgement the most preferred method among both small and medium enterprises in the sample. Out of the thirteen (13) participants using either method, five medium scale enterprises prefer quantitative methods. It must be stressed however that these five (5) are amongst the most prominent in terms of turnover and number of employees. Lawrence et al (2006)'s conclusion that judgment is an indispensable component of forecasting reverberates with this research. Respondents' reasons for choosing judgemental methods includes richness in detail, lack of knowledge and consistent accurate data. Internal expert opinion based predominately on experience is used especially in situations where data availability is limited, and uncertainty is high confirming De Baets (2021) assertion. A couple of respondents who had experience working in larger organisation mentioned the Delphi method but were quick to add that, Delphi method cannot be used in small and medium enterprises due to the cost involved. In spite of its advantages of producing a more accurate forecast (Rowe and Wright 2011), the nature of demand forecasting in these organisations do not support it use. Armstrong and Green (2018) supports engaging experienced expert when making judgemental forecasts; but the difficulty sometimes is determining who a real expert. Lack of understanding of technical terminologies experts communicates forecast with may reduce the credibility of the expertise and trust in forecasts. Scholars have however shown that people trust human predictions (Eastwood et al., 2012; O¨ nkal et al., 2009; Diab et al., 2011) more than they do models or statistical algorithms (Meehl, 2013; Burton et al., 2020) largely due to the failings and errors of models and algorithms, even in situations when both approaches produce identical result.

The suggestion that the lack of forecasting knowledge result in the use of judgments by some respondents is congruent to the findings of Cerullo and Avila (1975) and Rothe (1978) who stated that where knowledge about statistical methods is low, judgements are used in forecasting, but this increase forecasting errors. Armstrong (2003) argument justifying using judgements in forecasting where useful knowledge is not available or accessible matches the views of some respondents who currently use judgement in forecasting.

There were other dissenting views with CEO1 suggesting that the reason for judgement is usually due to a lack of data or an inability to use statistical methods. This view was vehemently contradicted by the other seven respondents who use judgemental Methods submitting that judgemental forecasting method such as Delphi is able to predict possible variations in sales patterns as well as customer behaviour through the judgement and experience of experts and senior managers. The three main judgement methods used by participants are brainstorming, internal experts' opinions and market surveys. On the flipside, those who used predominately quantitative methods bemoaned the cost of judgements citing the cost involved in hiring experts.

From the viewpoint of Martin et al, (2010) the choice of a forecasting approach is essentially determined by the availability of demand history data and data on explanatory variables however this research found that for some organisations, the availability of data was not a major factor especially for small organisations who use actual demand in their projections rather than demand history. Quantitative method is usually recommended where there is enough data available; however, in situations where data is not available it is postulated that using judgemental method is sufficient. This assertion is supported by Sanders and Manrodt (2003) who concluded from a survey that organisations that prefer judgemental methods base it on such organisational characteristics as lack of relevant quantitative data, environmental uncertainty, and variability of associated data. This assertion seems to propound a notion that judgemental methods are subsidiary and mostly relevant in the absence or insufficiency of data. The contention is to employ forecasting methods that use data on actual behaviour other than predicting behaviour or intentions. The findings from this study however suggest that judgemental methods where preferred, were not only due to a lack of available data. As agreed in the literature the choice of the appropriate forecasting method may depend on the situation.

Enumerating the reasons for the preferred choice of methods, SME 5, 12 and 14 who prefers quantitative methods highlighted that they reduce the likelihood of overblown forecasts, prevents the use of falsified data, they are comparatively cheaper to use than judgemental method, they can be objectively interpreted unlike qualitative methods and are easy to analyse. SME 12 which uses both quantitative and

qualitative methods stated unlike quantitative methods judgemental methods may involve hiring experts for their opinions or market surveys, which could be very costly. Respondents who preferred qualitative methods mentioned how it is flexible and allows management to inculcate non-numerical information. The CEO of SME1 added that qualitative methods allow for detail and drives innovation. Remarkably though, a respondent whose organisation uses judgement criticised the approach saying it is skewed to opinions of the forecasters, inconsistent and unable to detect trends and patterns unlike statistical methods based on previous experience of using quantitative approaches.

The existing literature is split on which method is better though some researchers have been emphatic. Sanders & Manrodt, (2003) and Mentzer &Moon, (2005) have suggested that in practice, quantitative methods mostly deliver better accurate forecast than judgemental methods. Likewise, Makridakis and wheelwright (1989) postulated that systematic, explicit approaches to forecasting are more accurate and effective than subjective judgements. Petropoulos et al (2010) makes similar observations in their study examining the comparative forecasting performance of alternative statistical and judgmental approaches for Apple iPhone. They construed that, statistical extrapolations are more accurate and less biased than judgment and produce greater forecasts. Proponents of qualitative techniques defend its usefulness especially in situations where there are no historical data or where the buying habits of customers continuous change. Discussing respondents' opinions on forecast errors subsequently, it was suggested that quantitative techniques may not capture such useful information as the promotional activities, and it effect on forecast accuracy. Barron and Targett (1986) argued that the impact of future events cannot be modelled by statistical packages, which could lead to poor forecasting processes. This notwithstanding, there are some researchers who suppose the existence a gap between forecasting theory and practice mainly due to lack of communication between practitioners and academics (Mahmoud et al, 1992). These gaps are likely to be bridged as long as continuous communication occurs between both academics and practitioners. This study tends to reveal this gap as the result show a proclivity towards judgemental methods despite the existing literature predilection towards quantitative methods based on the presumed accuracy.

The Respondent of the company which uses both judgmental forecasting and statistical methods was of the view that integrating methods would most likely reduce errors. This ostensibly agrees with Arvan et al (2018) who opined that identifying variability when forecasting may be difficult in practice therefore the need for human judgement even when using quantitative/statistical forecasting methods. Using different methods to produce forecasts and then combining the forecasts has been shown to be very effective method of forecasting.

5.2.3 IT Software in forecasting

On the issue of the use of technological forecasting tools in the process, the responses were skewed. Majority of the organisations interviewed do not have any form of technology or software to aid in the process only 5 out of the 14 organisations have some form of technology apparatus even that 4 out of the 5 stated the implementation is still in the infantile stage. Only one (1) out of the five which utilises some form of technology intimated that 90% of their forecasting process is technology based. The percentage of IT usage in relation to the sample size is most probably a reflection of the low rate of IT adoption in forecasting in context. Most respondents hinted that their process uses simple qualitative or quantitative methods therefore software is irrelevant. The finding to a large extent agrees with Lawrence et al., (2006) conclusions that despite the technological advancement and the ease of access to a widespread of computer software programmes, most organisations nevertheless rely on judgmental forecasts. Similarly, Sanders and Manrodt (2003) in a survey concluded that analysts prefer spreadsheets for analysis instead of forecasting software for fear of it taking too much time to master. Even in the few cases where technology systems were in place, these systems automatically generated past sales data on which forecasts were predicted and subsequently subjected to judgement before being ratified. This process largely reiterates the importance of historic data.

Regarding the effectiveness of technology software in the forecasting process, interviewees who do not currently engage any software in their process could not comment and those who had recently implemented or in the process of adopting software indicated it was too early to comment as the system was not operational. The two biggest organisations interviewed found the software's currently being used as adequately effective. The extant literature is vocal on the rewards that may accrue

using advanced forecasting techniques and software; nevertheless, the fact that these advanced technologies or techniques require heaps of data which may be difficult to access is not overlooked. In organisations where data is unavailable, engaging software in the process may be far-fetched. As shown by this study, small to medium organisations due to their size do not have the luxury of investing in processes (technology or software) that may not significantly add value to their forecast. A portion of interviewees make the point that due to their organisation being small size enterprises and due to the constant changes in technology, it is difficult to determine the life cycle of any technology therefore there is no leverage for such small organisation to allocate chunk of resources to invest in technology.

Moreover, all the respondents who claimed their organisations use technology in forecasting stated the end users of these technology tools or software's are involved in the process of acquiring these tools.

Finally, the result from the interviews does not indicate an overreliance on technology in any of the case organisations. Moon (2018) postulation of a wrong perception of technology investment making forecast automatically accurate does not seem to be the view of the case organisations rather judgement based on the experience and knowledge of actors and simple quantitative methods using spread sheets is relied upon.

The low adoption of software systems in forecasting as revealed by the empirical finding can be curtailed through the development and availability of free open-source forecasting software although access could be an issue for developing countries specifically Ghanaian entrepreneur due to the high cost of broadband and telecommunication. This open access software is described by Rostami-Tabar and Boylan (2020) has a breakthrough for forecasting beneficiaries although the lack of objective comparative evidence on their accuracy is problematic.

5.2.4 Summary - Forecasting Process

The findings to a large extent give credence to the assertion that forecasters will in most cases apply the method they judge as best for the situation or most familiar to them. It also confirms Lawrence et al (2006) observations that in practice, the forecasting practitioner do not share the scepticism towards judgement by the researcher. Medium scale enterprises overreliances on judgement as found by this

study re-echoes the findings by Hofer, Eisl & Mayr, (2015), and Sanders and Manrodt, (2003) whose studies indicated that in practice, forecasting relies heavily on human judgement. The most essential consideration when selecting a method is for the selected method to produce an accurate and timely forecast which will be understood by management and all decision makers to facilitate the process.

As stated in the prior section, forecasting methods are generally divided into subjective (qualitative) and objective (quantitative) methods. The Choice of the appropriate forecasting method may depend on the situation.

Table 5.0 Forecasting Process Summary

• **Past or historic sales data is heavily relied upon by some organisations**
• **Trends, patterns and current market conditions are crucial when forecasting**
• **Predominant use of Market survey to forecast demand.**
• **Availability of historically data has no influence on small enterprises forecasting process**
• **The process is referred as planning and estimation in micro-organisations**
• **Management make projection based on advance purchase orders or estimated orders**
• **In medium scale enterprises availability of data influence method choice.**
• **The responsibility of selecting the forecasting method varies from each organisation. In some instances, management selects and in other instances management do not play any key role or consult the forecasters**
• **Method is either driven by business strategy or based on forecasters own assumption**
• **Judgemental Method is generally preferred however for some the choice is driven by lack of knowledge and consistent accurate data necessitate its use. The choice is not driven by a lack of data or an inability to use statistical methods**
• **Judgemental Methods preferred- Delphi method, brainstorming.**
• **Quantitative Method by medium enterprises.**

- **Some medium enterprises use both Quantitative Method / Judgemental Method**
- **Quantitative methods are mostly cheaper to use than judgemental method.**
- **IT has been introduced in some medium sized enterprises but not fully operational in most cases except two.**
- **Majority of participating organisations (All the small and some medium enterprises) have no IT Systems or software but rather use simple methods.**
- **IT software in use was found to be fit for purpose and effective in thee 5 organisations that use them.**
- **End users of the software technologies are involved in their acquisition**

5.3 Forecasting Demand

5.3.1 Forecasting Demand in the Product Life

The product lifecycle of new or existing pharmaceutical product is important for forecasting demand forecasting (Cook, 2006). At the product development stage and even for existing products, predicting demand or market share can be tasking.

When respondents were asked what steps, their company takes to ensure supply matches demand to avoid excess storage or lost sales when forecasting for new drugs; market survey emerged as the most cited consideration as indicated in chapter four. According to Moon, (2006) demand forecasting plays a critical role in the excellent management of supply-chain management and has a far-reaching consequence on the successful management of customer relations. The ideal situation in any organisation would be to keep the least amount of inventory necessary to satisfy customer demands at the minimal cost of buying and holding the inventory whilst being conscious of the disruptions that may occur in the supply chain. The evidence available from researchers is conflicting with regards to determining the most suitable approaches or methods for forecasting pharmaceutical life cycles.

Some previous researchers suggested complex diffusion models as the most accurate models (Lilien et al,1981) with others suggesting simpler diffusion models could produce more accurate forecasts in certain instances. Some have been more specific citing simple models such as the Naïve model as producing more accurate forecasts than complex econometric and diffusion models (Brodie and de Kluyver 1984: Aaker and Jacobson 1987). At the product development and introductory stage suggest qualitative methods are likely to be used since statistical data is not available. Existing products may use more of quantitative models or mixed method approach to estimate for growth in the share of market and possible decline

Though the literature has found different life cycle scenarios with different life cycle curves, this research focused on the four widely known stages in the product life cycle- introductory phase, growth, maturity and decline phase.

The introductory stage forecasting is one of the most challenging tasks for forecasters basically because of historic data is unavailable (Cook, 2006). One approach which was found to be significant is the “custom made” or ‘made-to-order’ approach where it was suggested that purchase orders from loyal customers form the basis of forecast, minimising the likelihood of supply not matching demand in the introductory stage of the product. Data generally has been found to be a vital component of any forecasting project and without it, no forecast can be produced. For any forecast to be remotely accurate, some level of data is needed. It was recognised that forecasting demand for a new product at the introductory stage is fraught with difficulties particularly due to lack of historical sales data. To overcome this inherent problem forecasters resort to purchase contracts and orders to make predictions.

Five respondents all indicated market survey as their best option for predicting demand especially for introductory drugs. This enables them to gauge the competition in the marketplace, price sensitivity and customer behaviour. According to the respondents the information gathered from the market survey, the prior experience and the forecasting assumptions held for similar products help them to forecast for new drugs.

Polychronakis and Syntetos (2007) acquiesce that on the introductory of a new product, it is at times difficult to identify potential customers and an inexpensive approach may be to ask subjects about their intentions to adopt the product.

Other approach preferred by other organisations is reviewing the sales record of similar products launched as a benchmark for forecasting new drugs. Forecasters assume that the new products are likely to behave in a similar way. In situations where no similar products have been previously launched, sales and marketing manager of SME11 indicated that they test the market by selling smaller quantities to representative groups in their target market. The sales performance and feedback from the representative groups informs the forecasts for the introduction stage of the product life cycle. According to Goodwin et al., (2013a), method which are usually used for predicting new products can be categorised into management judgment method, consumer judgment methods and diffusion/formal mathematical models. It has also been suggested (Hyndman and Athanasopoulos, 2018; Peres et al., 2010) that hybrid methods which combine different approaches have been found to be valuable.

At the growth stage it was agreed that there is usually consistent straight linear increase in sales, and according to SME 4 and 11, demand at the growth stage can be estimated using percentage increment. The growth stage is typically signified by either sluggish, rapid, or highly erratic demand. The forecasters for SME 5 stated that at this phase, trend is basically used to forecast demand. The operations manager of SME5 indicated that at the growth stage the product gain popularity, sales begin to go up.

When the steady increase in sales begins to fall it however implies the product is in its maturity phase. At this stage SMM1 suggested that instead of estimating a steady upward demand they switch to estimating gradual increase. This slow increase ushers in the decline stage. The Marketing Manager for SME9 commented they try to extend the maturity stage as much as practicable promotions. At the decline stage demand begins to fall drastically but the forecasters strength lies in the ability to see this downward spiral trend and to amend forecast accordingly. The forecasting method applied at this stage is crucial, informing operations to reduce stock levels which in the end prevent obsolescence and locked up capital in the form of unnecessary inventory. Commenting on the decline phase, OP2 also emphasised the importance of revising forecasted figures at the decline stage preferably at the rate of decline added by the Marketing Manager of SME9. Some suggested prolonging the

mature stage of the product making little changes such as changing the packaging, adding new improved features and promotions.

5.3.2 Forecasting Demand for Sporadic and irregular Drugs.

The aim of this question was to assess how drugs with irregular, sporadic demand patterns are forecasted. Sporadic demand most often varies in quantities and occur at irregular times (Syntetos, Boylan and Disney, 2009) and are seen as complex and erratic. It is especially perceived as complex in competitive markets and unstable environments. The erratic nature of the demand pattern of such drugs presents a conundrum to forecaster regarding the forecast method to use, either mean/ variance or some form of bootstrapping (Syntetos et al, 2015). For such demand, in some periods no demand will be recorded at all making it sporadic. The methods usually applied are statistical methods such as Simple Exponential Smoothing or statistical. Due to the complex erratic nature of intermittent demand and the fact that statistical applications are widely utilised, it is unsurprising that respondents from all the 14 pharmaceutical SMEs interviewed stated that they do not forecast for such demand. There was no systematic approach for forecasting irregular, sporadic demand by any of the companies interviewed. The feedback from respondents indicated that, irregular and intermittent demand are not planned for but are dealt with on need to basis. There was an admittance however that such demand does occur.

5.3.3 Classification of Drugs and Demand Forecasting

The researcher explored the class of drugs manufactured by the participating organizations whether generic, branded or both and if it has any influence on how demand is predicted. The findings indicated that majority (10 out of 14) of the companies manufacture generic drugs. Forecasting for branded pharmaceuticals can be comparatively complex and requires good accuracy measures since when the generic version of the pharmaceutical is introduced on the expiry of the patent, demand for branded products may significantly reduce due to the competition generic product presents. Generic drug manufacturing companies can develop supply chains which are less costly, efficient and effective (Merkuryeva et al, 2019). Generic pharmaceuticals when introduced to the market grow rapidly (Nikolopoulos et al 2016)

and would also need accurate forecast of their life cycle. The class of drug manufactured also impact on the marketing strategies to apply based on the forecast produced. Since generic pharmaceuticals do not go through the strenuous process of clinical testing and patenting which requires huge resource investment, it is no surprise that the majority of small and medium size enterprises concentrate on it. even with this some respondents intimated that they do face competition from larger pharmaceutical companies both domestic ones and multinationals since majority of such companies also manufacture mostly generic drugs. The forecasting methods adopted by majority of the generic manufacturers is judgemental whereas all 4 branded drug manufacturers use quantitative methods albeit simple quantitative methods.

5.4 Accuracy in Forecasting

The class five and six sets of questions address forecasting accuracy and errors. Under forecast accuracy the focus is on its importance to the organisations interviewed and the impact of inaccurate forecasting on sales, profits, and customers. The responses from these set of questions were broadly catalogued under benefits and cost of accurate forecasts discussed in the following subsection. Forecast errors is subsequently discussed.

Analysis of the data indicated that the size of the SME influence forecast accuracy.

5.4.1 Significance of forecast accuracy to organisation

The existing literature emphasises the necessity of accurate forecasting for achieving both management and operational objectives; and for better planning and decision making. Putting the question of the importance of accuracy when forecasting to interviewees, all the respondents were united in stating the positive effects of accurately forecasting demand. They unanimously agreed it is very pivotal when forecasting to aim at producing accurate forecasts. This confirms Dalrymple (1987), assertion that the key objective of the forecasting activity is accuracy. Respondents went forward to mention how accurate forecasts helps their organizations to identify their consumers and meet their needs, helps them estimate the demand for resources correctly and enable them to attain a higher rate of “on time in full” delivery. They also mentioned how accurate forecast ensures that the right quantities of products are

manufactured or ordered at the right time to fulfil customer needs to avoid customer complaints. Respondents also agreed that it helps proper inventory management preventing stock out or over stocking. These responses affirm the plethora of reasons proffered in the existing literature to reinforce the need for accurate forecasting. Cook, (2015); Chase, (2013); and Porasmaa and Ojala, (2011) alluded that accurate forecast shortens lead times, prevents scarcity of resources, increases customer expectations, and helps avoid the 'bullwhip effect'. Zhou et al (2017; 2006) has shown how reducing manufacturing lead times in terms of order and inventory variabilities can be beneficial, causing smooth production and also in meeting customer needs in a cost-effective way. Meeting customer expectations were foremost on the minds of most of the interviewees, theorising that their existence depends on their ability to satisfy customer needs. The bullwhip effect as articulated in the literature can be detrimental to forecasts due to the variability in demand upstream the supply chain, other scholars (eg Cachon et al. 2005) however contest the effects on demand vitality upstream the supply chain and spread. It is suggested however that the ability to accurately forecast and the avoidance of order-up systems can be beneficial. Though respondents did not particularly address the term or use it, they recognised how inaccurate forecasts do not adequately anticipate order variability and incorporate such variability in their forecasts.

5.4.2 Cost of Inaccurate Forecasts

Graefe, Green and Armstrong (2019) reinforces the importance of accurate forecasts suggesting that as forecast accuracy reduces, decisions which are based on these forecasts are likely to be wrong and may result in cost such as advertising and trade promotions. Nikolopoulos et al (2014) adds costs of new products development without adequate demand, pricing at the level that does not maximize profit contribution. Inaccurate forecasts may result in poor service levels resulting in loss of sales, customers or potential customers. This view was shared by respondents who indicated that most customers zero tolerance for stock out makes them shift allegiance to the next organisation able to satisfy their expectations. These unsatisfied clients are likely to spread the unavailability of stock by word of mouth which potentially deter prospective clients.

There was a widespread consensus among respondents on the cost of inaccurate forecasting. Respondents echoed the submissions in the literature stating that inaccurate forecast results in stock-out situations thereby affecting the level of sales. Two respondents indicated how the loss of sales do not only affect the particular product line, which was wrongly forecast, but also other products which are usually bought together with the wrongly forecasted ones. Customers would buy products in bulk for discounts as well as save on transportation, a stock out would mean additional cost to customers, and they would rather go to a competitor who may have everything they want than re-order. On the other hand, respondents intimated that holding excessive stock is also costly impacting overheads and other direct cost. These costs include warehouse cost, electricity cost and security. Overstocking may occur when demand is inaccurately forecasted when there is an outbreak of disease and in quest to ensure continuous supply and increase sales overestimate the duration of the outbreak. This can result in obsolescence and eventual disposal. These findings are similar to Merkuryeva et al (2019).

MM2 detailed how inaccurate demand forecast creates both long- and short-term challenges to the organization. He explained that, in the short run it becomes difficult to understand clients; to understand their needs and anticipate their purchasing pattern. Knowledge of when they are most likely to make purchases is exacerbated due to the lack of consistency in forecasting demand. This eventually prevents the organization from meeting its sales targets, affecting the reputation of the organisation and moving even loyal customers to competitors. Additionally, the operations manager for SME4 showed how inaccurate forecast affects cash flow and prevents the organisation from obtaining credit facility necessary for expansion.

5.4.3 Forecast Errors

In order to apply the best forecasting method and to reduce errors as practicable as possible, Questions under class six classification were around errors when forecasting demand. The first set of questions provided the opportunity for interviewees to share their opinions on how errors are identified particularly in previous forecast so as not to repeat in current forecasts. The second set of questions obtained views on how errors are minimised when forecasting. These questions were important because as presented in the literature review, forecast errors provide

invaluable information about the current state of the organization and also bring to the fore changes in past patterns or relationships (Armstrong 2006). It was also important to understand how errors identified when forecasting is or can be minimised. According to Lee, Padmanabhan and Whang (1997) if demand forecasting errors are not addressed appropriately, they could escalate in the supply chain and cause supply chain disruptions. O¨ nkal et al., (2019) emphasises trust between the provider of the forecast and the user as critical in the forecasting process, for acknowledging and accepting potential forecast errors and working together through honest communication of accuracy targets; sharing knowledge; communicating forecast rationale as well as transparency of methods (O¨ nkal et al., 2019; O¨ zer et al., 2011; Renzl, 2008). In other conversations relating to error measures, Davydenko and Fildes (2013), observed a lack error measurement metrics which rate forecasted accuracy with the actual use of the forecasts.

On the question of identifying errors when forecasting, SMM2 opined that neglecting and avoiding examining the mistakes from forecast does not give the forecaster and the organization opportunity to develop and become better at forecasting, implying that assessing past errors is a good place to learn. The findings from the case organisations showed a trend in terms of how they identify errors. For this question only five out of the14 total interviewees responded and all these five organisations are medium size with relatively high turnover. Out of the five respondents, one indicated that their organisation employs exceptions analysis to identify deviations. The other 4 respondents all indicated that their organization use Mean Absolute Deviation, a mathematical metric in identifying errors in their past forecast. This tool helps them calculate how far out their actual demand in units is from the forecasted demand in units. This total though a good tool to use, has its downsides as indicated by SMM3 who submitted that the mean Absolute Deviation method may not be very helpful when comparing errors for different products as it only provides the average error in units. SMM3 further claimed that they tend to use Forecast bias which looks at the variance between sales and forecast and ensure that the factors that lead to the variance are considered and in the next forecast. From the responses, the most prominent way of identifying errors is by mean absolute deviation. The majority of the interviewees do not have any defined process for identifying errors. The proportion

which responded is most probable reflection of the low level of error identification in the forecasting process until it is possibly too late.

When asked how forecast errors are minimised, respondents cited the methods or tools they use include macroeconomic indicators, predicting competitor action, historical data, point of sale data as well as evaluation of forecasting methods. Though each respondent had a specific dominant tool they rely on, the general responses were complementary and not necessarily exclusive. The CEO of SME 1 and the operations manager of SME 4 both commented extensively on how macroeconomic indicators help them reduce forecasts errors. They emphasised how monitoring macroeconomic shifts in GDP, stock market help gauge demand as these changes invariably affects end user demand. Though this corroborates Chase Jr (2013) submission to an extent that over time, patterns and relationships continuously change but they indicate that changes such as stock price fluctuations, interest rates, exchange rates, and commodity price cannot be accurately predicted due to unknown factors that may influence. This suggests that though organisations keeping track on these changes are commendable and may reduce the quantum of errors if they were not monitored, they do not accurately as they cannot but accurately predicted. Other forecast accuracy metrics used to measure forecast errors and to evaluate the quality reported in the existing literature includes such basic metrics as: Mean Absolute Deviation (MAD), Mean Absolute Percentage Error (MAPE), forecast Bias and Mean Squared Error (MSE).

SME 2 added that, competitor actions such as eleventh-hour promotional offers and price cut can adversely affect demand making it is imperative to envisage such competitor actions, to intervene on time by amending forecasts to minimise forecast errors. Naturally, even the most loyal customers may be lured by the marketing promotions of rival companies but knowledge of these promotions (when they are likely to be employed especially with seasonal or cyclical promotions) can better inform forecast. The respondent for SME 5 however intimated that rival company's marketing promotions are not very easy to anticipate just like natural disasters and behaviours of even most loyal customers. This can be cured to an extent by domain knowledge. The literature emphasises as critical domain knowledge for predicting average cyclical, seasonal patterns, emerging technological trends and its

corresponding influencing factors and general influencing factors helps minimise some of the inherent errors.

One of the ways trends can be determined as articulated in the literature and confirmed by some of the responses is by using historical data. SME 4 opined that they depend on historical data when forecasting to predict future demand; thus, what happened in the past will likely happen in the future. The CEO of SME 7 also suggested the use of point-of-sale data to minimize errors elaborating that, point of sale data capture essential time sensitive information such as the type of product and quantity sold, date, place and time. Conversely, Makridakis (1998) argues that overreliance on past data or merely replicating past successes will not exclusively result in future success but rather recognition of emerging trends in the environment, and an accurate prediction of imminent changes will essentially lead to success. Arvan et al. (2019) stresses this viewpoint by adding that excluding promotional activities from any quantitative method which extrapolate historical sales information may produce inaccurate forecasts. Three of the respondents SMEs suggested evaluating data before plotting the estimated numbers on graphs to eliminate any extraneous data leaving only robust reliable data.

SME 10 and 9 further contributed by suggesting that although focusing on data is good to help reduce forecasting errors, he suggested evaluating the forecasting methods or models in use as the methods and the forecasting process themselves can reduce forecast errors. SME12 also commented that using multiple forecasting techniques helps cover the diverse needs of the consumer demands and trends lessen errors. Using advanced forecasting techniques may also provide fewer forecasting errors, but these techniques require heaps of data, which may be difficult to acquire either because the organisations do not keep those data or not available as it is in the case of new products. Lawrence et al. (2000) evidenced that complex quantitative techniques do not necessarily reduce forecasting errors as opposed to the simple quantitative approaches, claiming that in some cases. Judgment is used to modify quantitative forecasts to increase their precision. Mathews and Diamantopoulos (1992, 1990, 1989) reiterates this point concluding that judgmental adjustments to statistical forecasts improves forecasts accuracy.

Makridakis et al. (1984) advise forecasters to understand better the forecasting methods which are appropriate for minimising post-sample forecasting errors beyond the data set as it has been found that the models which best fit the data are not automatically the most accurate beyond the data set (Makridakis, 1996). It is recommended that to reduce forecast errors and produce accurate forecasts, it is necessary to observe the forecasting method's performance as well as the forecasting team.

SME 13 also stressed the significance of examining the source of new data to avoid errors that may result from wrong new information. It will make sense for forecasters to progressively incorporate new information into their predictions after taking time to process the new information. SME 6 and13 both agreed that they usually scrutinise new information with SME 13 suggesting the use of a quantitative technique which inculcate promotional data into the process of forecasting. This is congruent to Arvan et al. (2019) who argues that when new product development and or promotional activities are not included extrapolating historical sales information using any quantitative methods may produce inaccurate forecasts. It is argued that judgmental forecasting tends to use historical data and domain knowledge that would usually include promotion plans, competitor intelligence and macro-economic condition.

SME6 made a point about how excessive or minimal unusual demand in a particular period if not discounted for can result in errored current demand calculations or projections adding that outliers must be included when forecasting demand prevent forecast errors.

Finally, SME 12 intimated that exceptions analysis can help understand the causes of the major forecast errors previous forecast so the mistake of wrongly sensing demand patterns or relationships or changes in patterns and relationships.

5.4.4 Summary

The response from the interviewees presents a very delicate picture which is not clear cut. It shows how there is not the best way for minimising errors when forecasting but rather intertwined intricate ways which are not mutually exclusive. The results showed the importance of data either at point of sale or past sales history, but it was quickly pointed out that data could be expensive and extraneous and might not capture imminent changes in the environment. It was clearly articulated also that data alone

is not sufficient, equally the forecasting method used is. The challenge however is that most sophisticated forecasting methods need big data in order to produce fairly accurate forecasts which reinforces the value of data. To minimize forecasting errors and produce good forecasts, both data and method must be right.

- **Better management of inventory preventing stock out or over stocking**

- **Estimate correctly the demand for materials**
- **Identifications of consumers and their needs; also measures interest in organisations products**
- **Assist in financially planning for the growth of the organization**
- **Prevent panic sales and excess promotions to get rid of unsold products.**
-
- **Assist in strategically planning for future growth**
- **Better management of production.**
- **Helps attain a higher rate of "on time in full" delivery. Forecast accuracy ensures timely manufacturing and timely delivery results in few complaints from clients and keeps customers happy.**
-
- **Help to effectively schedule promotions at the appropriate stage in the product life cycle.**

5.5 External Influences on the forecasting process

These sets of questions concentrated on industry dynamics and market complexities. It examined how external forces outside the direct control of any organisation influence the forecasting process and accuracy. The participating companies were asked the classification of drug they manufacture whether branded, generic or both and how that influenced their forecasting processes. Four out of the fourteen participating companies indicated they manufacture branded medicines. The other ten organizations produce only generic medicines, suggesting from the responses that the industry produces more generic medicines which are thought to be effective as the branded drugs but are less expensive though according to respondents, some consumers are sceptical about their efficacy.

Participants were also asked for their opinion on how turbulence in the external environment affect forecasting accuracy. Due to the complexity and dynamism in the marketplace and environment, organisations are always searching for how they can predict the future to ensure they remain successful and competitive (Polat, 2008). These complexities affect companies differently depending on the age and size. New companies for instance have little influence on their environment and may be impacted more by externalities. Organisations cannot stockpile, expand manufacturing plants without a clear knowledge of the volume of expected sales or certainty of demand especially as the actions of customers, competitors and regulatory bodies can be highly unpredictable. On the contrary, managers can plan better and make informed decisions through forecasting. One of the participating organisations SME12 specified that external factors influence the choice of strategy adopted when forecasting. Turbulence in the external environment affects the accuracy of demand forecast, the higher the turbulence, the higher the likelihood of inaccuracies in forecast since the nature of an organisation's environment constrains it. Armstrong (2017) succinctly stated that turbulence in the environment can hardly be predicted and is highly likely to increase forecasting errors.

The existing literature makes some observations on how turbulence affects the forecasting process. Makridakis et al (1993) showed the imperativeness of forecasting for identifying potential opportunities and threats in the environment and for predicting future uncertainties and its repercussion on a business. Prior to this publication, Makridakis, (1980) had concluded that forecasting models assumes constancy and stable demand which rarely allow for uncertainty, suggesting that turbulence in the environment and the resulting variability in demand are not reflected in the forecasting models. It is proper to use models that consider the impacts of changes /trends to help improve imminent threats and opportunities.

Intriguingly, the findings show the two smallest participating companies SME4 and 7 both implied their forecasts are based on actual customer orders therefore are usually not affected by external factors. Qualitative prediction methods are heavily relied upon which in their view mitigate the rampaging effects of external influences. They nevertheless admitted that though prices of raw materials may not have any direct effects on their forecasting process, it hugely impacts the overall business operation. They are however handicap due to the lack of resources and knowledge to deal with the situation when it arises. When the participants were asked to identify at least one

external factor that impact their forecasting process; respondents revealed four key factors which impact their forecasting process which included cost of raw material, legislation, competition, and consumer behaviour. Legislation changes was found to be the most cited external influence on the forecasting process. Rummaging, it was discovered that indicators such as stock price fluctuations, interest rates, exchange rates, high inflation rates and commodity price, sickness or disease outbreak also have significant impact on the forecast of the participating organizations. These indicators specifically interest rate and exchange rate really have a ripple effect on prices of raw material (chemicals). It was revealed by some participants that, the volatility is such that it cannot be accurately predicted to the extent that even when allowances are made to accommodate such occurrences; the lax attitude toward price regulation in the market affect eventual forecast. It is important to keep track of these macroeconomic indicators to better predict their behaviour and reduce forecast errors. The impact of cost of Raw materials, consumer behaviour & competition, technology, regulations, and policies on demand forecast and the organisation generally are discussed below.

5.5.1 Cost of Raw materials:

Respondents stated this affect their choice of method and the entire forecasting process. It came to light from the inquiry that most of the raw materials Ghanaian pharmaceutical SMEs use are imported hence changes in exchange rate affect forecast.

5.5.2 Consumer Behaviour & Competition

In assessing the effects stakeholders have on demand forecasting process, respondents were quizzed on the importance of brand loyalty to forecasting demand particularly for new drug.

In recent years customers have become more sophisticated with complex individual preference or needs, this drives competition among similar enterprises making them more customer focused. Brand loyalty is crucial when forecasting especially for a new drug as customers' purchasing behaviour becomes more reliable. On the question of brand loyalty, all the 14 organisations interviewed agreed that brand loyalty is crucial when predicting how well a drug especially a new introduction will perform. Brand loyalty is built over time and the sales information accumulated becomes the basis of

future forecast or affinity to a new introduction. Answering the question on brand loyalty and its impact on forecasting, CEO 1 opined that customer loyalty helps to obtain more accurate forecasts. He opined that once customers become loyal to your brand and make repeat orders, forecasting demand becomes a whole lot easier since customers' purchasing behaviour can be predicted from the detailed order history data. Customer or brand loyalty declines when customers become more informed and have more choices available to them. The decline in brand loyalty suggests over relying on historic sales data when forecasting may be problematic. The organisation's flexibility and agility to swiftly respond to customers unexpected demand is important when forecasting.

Six respondents out of the 14 interviewed however emphasised the influence of other factors on customer/ brand loyalty. Two out of these 6 particularly stressed competition and price. All respondents could relate a situation where their inability to deliver customer demands on time or delayed entry into the market due to unforeseen/ unpredictable events gave competitors an edge to the extent of swaying even their loyal customers resulting in losses. Competitors may use promotions to sway customers therefore the need to monitor competitor promotional offers. Some respondents narrated situations where their inability to foresee competitors eleventh-hour promotional offers and price cut resorted in low sales compared to forecast. Anticipating such strategies by competitors is necessary so forecast can be adjusted to reflect each stage of the product life cycle. Adebanjo and Mann (2000) suggested that information on previous impact of promotions on demand can be evaluated and included in current demand forecasts. Excluding promotional activities when using quantitative methods to extrapolate historic sales data may likely produce inaccurate forecasts (Arvan et al. 2019). Other researchers suggest judgmental forecasting methods which includes using historical data and domain knowledge including promotion plans, competitor intelligence and macro-economic situation.

In other instances, price volatility was cited as determinant of customer loyalty to organisation's brand. Price volatility will most likely affect forecasts although some respondents conceded that most loyal customers of their organisation were price insensitive to price variability which increases the confidence of forecasters. As loyal

customers devoted to the brand, they stick around regardless of the price when they are assured of quality.

5.5.3 Technology advancement

The adoption of technology by the pharmaceuticals industry has been low ostensibly due to the high level of regulations in the industry. Technology advancement is argued to be uncertain; invariably the market and technology would have significantly shifted between the conceptualisation stage of a new drug and when it is finally introduced into the market thus affecting the adoption and implementation of new technologies in the pharma industry. Where implemented, return on investment may not be forthright due in part to the regulatory process and the timelines of trials and the drug entering the market. Organisations are faced with a conundrum when investing in technology; whether the technology will produce the market scale needed for a good return on investment.

Though technology advancement is construed to be a general threat to demand forecasting accuracy in several industries, this study found technology or use of software not to be an issue for the participating organisations. Respondents intimated that using technology or software is either in the early introduction stage yet to be operationalised/ implemented or it is not used whatsoever in the forecasting process due to the size of operation. Small and medium companies due to their size and capital would rather invest in other seemingly viable processes that will yield results than the forecasting process. Moon (2006) observed that there is a perception albeit wrong that investing in technology robotically lead to forecast accuracy thereby technology is procured without an understanding of the forecasting process. This study did not however find the trend of overreliance on technology to be true and this could partly be attributed to the rate of technology usage in all the participating SMEs. Commenting on this, a sales and marketing manager of one of the companies using some form of technology indicated that judgement is used in connection to the software. The low adoption of technology by the participating companies is not surprising since according to World Bank estimates Ghana scores below average in terms of technology readiness even though it has a well-developed digital infrastructure.

In spite of the views of the respondents the recent COVID-19 pandemic has highlighted the need for all sectors to embrace technology and specially for pharmaceuticals to effectively use data and to streamline operations to reflect the current ways of working (remote working), to improve resilience especially in periods of economic downturn or pandemics. Small and medium pharmaceuticals should not discount technology adoption in their business models since it can be a source of competitive advantage even so now that bigger organisations are likely to depend on it more. Since data is an important component of forecasting in pharmaceuticals with the pandemic confirming the ubiquity of data for quick response and for saving life. Embedding technology in the processes can enhance the quality of data for better forecasts and decision making and improve competitive advantage post Covid19.

5.5.5 Regulations and Policies

This question focused on how industry regulations and government health policy impact manufacturing SMEs demand forecasts. There was a consensus among all respondents that Industry regulations and government health policy impact generally on their business and specifically demand for their products. It was clear from some of the opinions expressed that Ghana's drug regulatory body (food and drugs authority (FDA) is perceived as deep-rooted with very rigorous approval process compared to countries in the sub region. There are however lapses in the system which exposes the market to illegal entrants and influx of fake drugs. These activities become a problem especially for small and medium size manufacturers as it affects demand, making any intervention through regulation or policy very necessary.

Respondents cited some of the regulations and government policy which virtually changes the direction of their business and forecasts; chief among the regulations and policies is the drug production quota policy. Recently the government introduced cost reduction policy which substitutes branded drugs with domestic generic drugs. This limits foreign direct investment thereby enhancing domestic capabilities, this was found to be a welcome intervention tipped to positively increase demand for most of the respondents' drugs. As small and medium organisation predominately manufacture generic drugs, this policy is expected to remove to a large extent the competition and barriers posed by foreign branded drugs which in effect will increase demand for domestic generic drugs.

Other ways in which regulation and policy impact demand forecast as alluded to by the respondents included government building more district hospitals and the National Health Insurance Scheme (NHIS). These initiative means opportunity for the case organisations to grow and expand and by extension increase in the market share. The regulators operate a quota system to ensure some classes of drugs (narcotics) are controlled. As the quota changes regularly, it impacts the demand forecast for such classes of drugs. The essential medicines list declared by the health secretariat also changes which makes accurate demand forecast strenuous.

Respondents were vocal about how government legislation and policies affect their forecasting method. Since the Ghanaian pharmaceutical hub seem more established than most countries in the sub region, they are able to supply the sub region however these efforts are usually impeded by the incessant trade barriers, Ghana government's policy of removing trade barriers help promote Ghanaian pharmaceutical products within the West African sub region leading to increased demand. The initiative to reduce Value Added Tax translates into reduced cost and increased capabilities. Quality standard initiatives can make the Ghanaian domestic manufacturers global players.

5.5.6 Uncertainty of Pandemic and Forecasting Post Covid

The outset of what became a global pandemic causing disruptions to normal human activities from travel, employers devising new ways of working, to supply chain disruption risks both upstream and downstream. It affected the general well-being and health of many people; resulting in jobs loses and furloughs. The effects of the pandemic did not exclude supply chains but rather put immense strain to respective supply chains (Nikopoulos et al, 2021).

Even though the data collection for this study was completed couple of months before the outset of the Covid 19 pandemic which blighted the entire world, it impacts on the forecast capabilities of companies including pharmaceuticals is undeniable and therefore worth a mention. The pandemic proves how turbulence in the environment causes disruption risks. As Ivanov (2020) indicate the coronavirus pandemic, distinct from other disruptive risks to supply chain started small scaling up very quickly around the world; the impact being immediate and strong. This resulted in what is popularly known as the bullwhip effect (Khosroshahi, Husseini and Marjani 2016). The ripple

effect impacted organization performance (Hendricks & Singhal, 2003), ultimately affecting the bottom line as productivity and service level reduced. It raised questions about the resilience of a company for sustainable supply chain with past incidence like the 2011 tsunami and the financial crisis of 2008 demonstrating how little glitches in the supply chains can have global impact. And also, how well companies are positioned to recover post covid. For well-established pharmaceuticals like AstraZeneca and Pfizzer, they were the epicentre of the pandemic in finding solutions through developing a vaccine. This expectedly put additional demand pressure on their operational capabilities (Hobbs 2020) throwing previous forecast out though admittedly not on the same scale as SMEs. Even in predicting the release date of a vaccine the forecast consistently shifted, eventually though the vaccine became available earlier than previously predicted. The spike in demand for other over the counter drugs out of panic and the believe that such drugs (types) alleviate the symptoms of the covid virus lead to these drugs becoming price sensitive, and in some cases, they were rationed as demand the did not meet supply.

Forecasting became even more imperative during the pandemic however complicated, because forecasts were relied on for effective governmental decision making, for managing demand as well as supply chain resources (Nikolopoulos et al 2021). The novelty of Covid 19 pandemic made it the more complicated as there were little to no historical data to benchmark against or extrapolate. Some available data sources that could be used were google trends, twitter complaints and Amazon reviews as submitted by Nikolopoulos et al. (2021) but these sources cannot be completely relied on as they can be inaccurate and may be risky for driving important decisions though some may argue it is better than none at all.

Previous scholars have submitted various methods for forecasting pandemics and these are categorised into time-series methods, metapopulation and agent-based models, metrology approaches (Nsoesie et al., 2013; Nikolopoulos et al 2021); machine learning (ML) and deep learning (DL) methods (Yang et al., 2020). Petropoulos and Makridakis (2020) contributing to the Covid-19 discourse successfully applied ETS models of Hyndman, Koehler, Snyder & Grose, (2002) to accurately predict the global growth in the number of cases. Nikolopoulos et al (2021) also on the back of Petropoulos and Makridakis (2020) findings performed

empirical forecasting analysis at country-level using 5 countries. They sought to find out what the best models for forecasting the growth of Covid 19 at the country-level; how excess demand for products and services during the pandemic can be forecasted even before actual supply and demand data become available using what they referred to Partial Curve Nearest Neighbour Forecasting (PCNN).

Previous studies on forecasting as well as supply chain disruption have been instrumental in hinting on the factors that can lead to disruptions. Conversely these studies have exposed some of the challenges associated with identifying and responding to significant changes in the demand patterns during a pandemic. As Nikolopoulos et al (2021) assert, an early ability to forecast excess demand during pandemic could have considerable implications for policy makers and supply chain managers in terms of the data and resources needed.

Post-Covid 19, pharmaceutical SME's will need to rethink some of their practices, their production systems to a more desirable state. This may require financial investment to take advantage of the opportunity such turbulence present. The lure then will be for companies not to act on this opportunity but rather allow the global supply chains, and international trade relations to revert to normal (pre-covid) once the disruptions dissipate, though the long-term effects linger.

The pandemic has reinforced the utility in adopting new behaviours by forecasting actors, relevant technologies and the communications platforms (Hobbs 2020). Collaborative relationships amongst internal actors and suppliers is even more needed to reduce transaction costs, share risks, provide access to complementary resources and expertise, and enhance productivity (Cao and Zhang, 2011).

5.5.7 Summary

Market complexities, environmental/ industry dynamics and competition has the potential of forcing companies to increase their capabilities, become more flexible and agile avoid wrong forecast, increase forecast accuracy, avoid stock piling and plan

Turbulence in the environment such as high inflation rates and or recession likely result in forecasting errors due to their unpredictive nature.

Organizations need accurate forecasts to plan to meet demand for their goods and services (Armstrong and Green, 2017). Accurate forecasts can increase the efficiency in all sectors of the economy including the pharmaceutical industry. It is argued that where there is stability in the external environment, forecasting is an extension and continuations of established patterns/relationships and therefore accurate; however, where there is turbulence in the environment, forecasting errors are likely to be high since such occurrence as high inflation rates and or recession cannot be predicted.

5.6 Demand Forecasting Challenges

The interviewees were specifically asked about their opinions and perception of the obstacles to demand forecasting in the industry; and how these obstacles can be minimised based on their experience and observations. The issues raised by respondents have been discussed in different sections of this chapters and they include as below:

Forecasters have difficulty forecasting for promotional demand and to inculcate promotions into the forecasting process which eventually affect the accuracy of forecast. Some also indicated their inability to forecast demand variations. One respondent stated that their forecasting approach inward looking and does not consider any bottom-up data from the marketplace about possible wins, losses or opportunities.

Another issue which was highlighted by respondents is how wrong information and unavailability of data from key departments in the organization is a major setback to the forecasting process. One commented on the importance of sales data when

forecasting but bemoaned the persistent inaccuracy in sales data recording. It was also reported that even though the forecasting methods used is quantitative the sales data rarely uses this format. According to him even when the sales data is maintained it is rarely expressed in quantitative terms and factored in the company's forecasting process; there is no link between the sales data sets and the forecasting templates used.

The issue of collaborations was also prominent in the responses. The views highlighted how various head of department comes up with a forecast which is then fed into the main forecast of the organization, and this most often result in power wrangling as a rejection might be misinterpreted as a rejection of another's opinion or domain knowledge which informed the forecast. Most often any amendments or tweaks magnifies errors in the overall forecast. John Mello (2005) tags these corporate attitudes as an exhibition of misplaced strategies and a lack of understanding about how demand forecasting and its influence on the supply chain. For organisations were there is a lack of collaboration, the culture can be described as one devoid of teamwork and consensus which is needed for effective forecasting.

Management interference was reported as an obstacle also. The sales and marketing manager of one of the case organisations commented that sometimes management put pressure on forecasters to change forecasts in line with the company strategy or management's objectives and this can be challenging as they can magnify errors. Varying forecast due to management political ambitions was argued to affect the objectivity of forecasters. This observation is in line with Mentzer et al, (1997) who recognised that in most cases the disagreement stems from a lack of understanding by management on the importance of demand forecasting on the forecasting process. Management may not appreciate the effects of accurate prediction of future customer demand on the return of shareholder's investment, inventory, carrying costs and shipping costs (Mentzer 1999).

The operation manager for OP3 also stressed that one major challenge to demand forecasting is the lack of consistency in the statistical method applied. They most often rely on the judgement of the forecasters even though they could invest in statistical software products that could help achieve more accurate forecasts. He was of the

view that using statistical methods and possibly statistical software tools could help detect trends and patterns more easily.

MM1 submitted that lack commitment and resources to improve the forecasting process is an added obstacle. He intimated that their organisation for instance has used the same method for over ten years without any substantial improvement meaning the same forecasting errors are repeated each time.

Other obstacles stressed includes allocating insufficient funds to forecasting, lack of knowledge of right forecasting practice especially for start-up.

Moon (2006) in their study concluded that there are three typical obstacles to the forecast process which are wrong culture, perception of system as the solution and Management. Relatedly Moon and Mentzer (1999) states a lack of feedback to forecasters and resistance from the salespeople. These were confirmed to an extent by this study.

Summary of Challenges

- **Wrong information and lack of data from key departments. Example Inaccurate sales data**
- **Lack of collaborations among the various teams**
- **Inability to forecast variations to potential future demand**
- **Insufficient funds allocated to forecasting.**
- **Lack of knowledge of the basic methods and forecasting practices**
- **Undue pressure from management**
- **Inability to forecast promotional demand correctly.**
- **Lack of improvement in the forecasting process is a challenge. Same method over a long time without upgrading**

5.6.1 Overcoming Demand Forecasting Challenges

The suggestions by respondents were not adversarial to those offered in the existing literature but affirms them. The Respondents' submission included collaboration,

suggesting the need for members from each department within the company to be represented. When this is done, the members who understand various data sets at an expert level can offer analyses that a salesperson may overlook which may produce skewed outcomes; this may be avoided by simply using a collaborative process which incorporate a defence against any form of distortion.

Also, collaboration generates buy-in which is important for overall impact on the organization's performance. When the various departments recognise the importance of their knowledge and contribution to the forecasting process, there is a high probability of acceptance of the forecast as well as using it as a guide in their departments. This develops trust among the sales, marketing, finance, and operations functions for the process and become more aligned and strongly integrated.

Moon (2006) adds that communication can be formalised to enable the demand side and the supply side effectively communicate their capacity constraints. Training can also be given to both sides to overcome obstacles identified in forecasting process.

Collaboration with and support from senior managers also ensures they have a better understanding of what drives profitability to enable them efficiently allocate marketing resources, better understanding of the market, product and customers (Chase Jr 2013, Mentzer 1999). Showing them how accurate forecast reduce inventory, carrying costs and reduce shipping costs. SMM1 pointed out that management should have an opinion about the forecast process and the outcome, but they should not impose their political ambition on the forecasting process. Management should be able to clearly define and distinguish organisational goals and strategy from management's objectives. Further management projections should be predicated on the forecasts produced instead of, producing forecasts based on management projections. Forecasters having the freedom to conduct their activities without undue influence and pressure will produce forecasts which are likely to be accurate.

The lack of quality data and wrong data can be overcome by adopting a top-down approach that means data collection is an integral part of the day-to-day operations of the business as well as ensuring that best practices are maintained to ensure data is consistent and robust for effective forecasting added by CEO1.

SMM2 suggested adequate training for the forecaster and the users of the forecast to overcome the lack of knowledge of the correct or right forecasting method. The training

will be beneficial if it focuses on how to find suitable data and identify trends and patterns in the data set. It is also important to focus on how huge fluctuations in the market can be mitigated. Also, users of the forecast should be trained to identify benefits and challenges associated with the forecasting method adopted. Correspondingly, MM1 recommended allocating sufficient resources for acquiring new software and for training and improving the skills of the forecasters. It was further suggested that forecasters should be exposed to the processes and systems in other pharmaceutical organizations abroad or even in general manufacturing environments in the different industries. The view that decision makers which in this research were management or CEOs, override or revise predictions made by forecasters was strongly expressed to the effect that training only will not be sufficient if decision makers do not trust predictions of forecasters. This view is consistent with O¨ nkal (2021) who emphasised that training will be beneficial where decision makers trust the forecast and use them in their decisions (Alvarado-Valencia and Barrero, 2014).

Similarly, OP3 suggested adopting statistical method which is suitable even when there are economic and environmental changes rather than constantly changing forecasting methods whenever there are changes in the marketplace. A systematic approach ensures the method adopted address the needs of the organisation.

As a final point, MM2 proposed balance, explaining that although past result or data is essential as a basis for forecasts, it is equally imperative to be flexible to new information which may require tweaks and changes in forecasts due to either internal or external forces. Accurate forecasting requires that organizations are capable of analysing past data in light of current/expected changes in market conditions. Client's circumstances may change dramatically, or industry regulations and developments can change severely. This will mean the assumptions of constancy incorporated into the forecast may no longer be relevant, however where the systems adopted ensures real time information or data is readily accessible it can quickly adapt changes effected quickly to reflect these circumstantial changes.

In summary, Boylan and Syntetos (2017), summed the barriers to forecasting as issues linked with the prevalent culture and likewise, Davis and Mentzer (2007) make reference to the "forecasting climate" which in their postulation include leadership support, credibility of sales forecasting and reward alignment. These ideas were

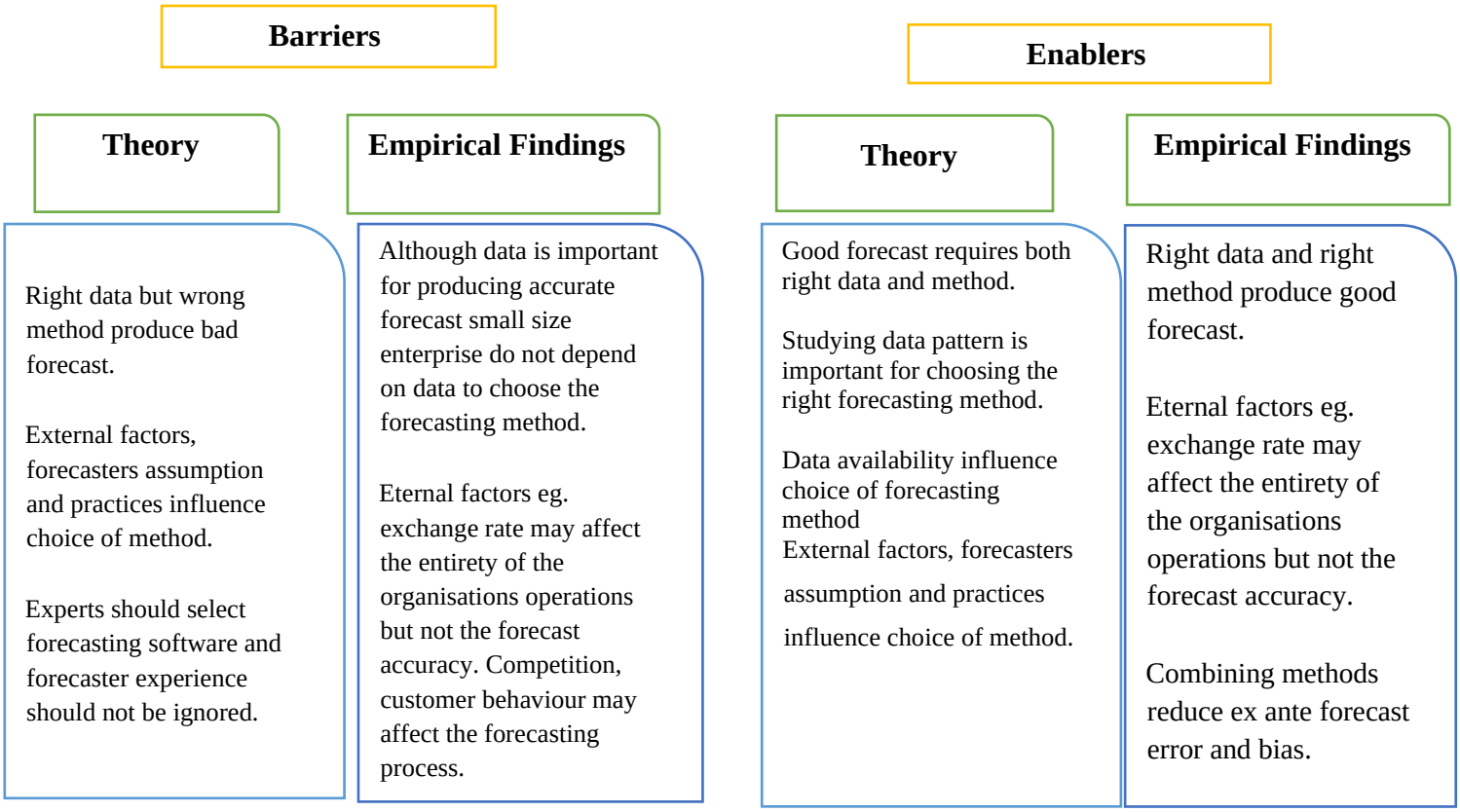
probed further in this study by asking respondents specifically if management were supportive and keen on ensuring collaboration. The consensus was that management of each of the participating organisation is committed and supportive of the forecasting process. Some accepted that silos do exist, with a handful indicating that management do not ensure collaborations among the various teams within the organization. A respondent held that each department head produces a forecast which is fused into the main forecast of the organization and in most cases the forecasts are incompatible.

5.7 Barriers and Enablers to Demand Forecasting

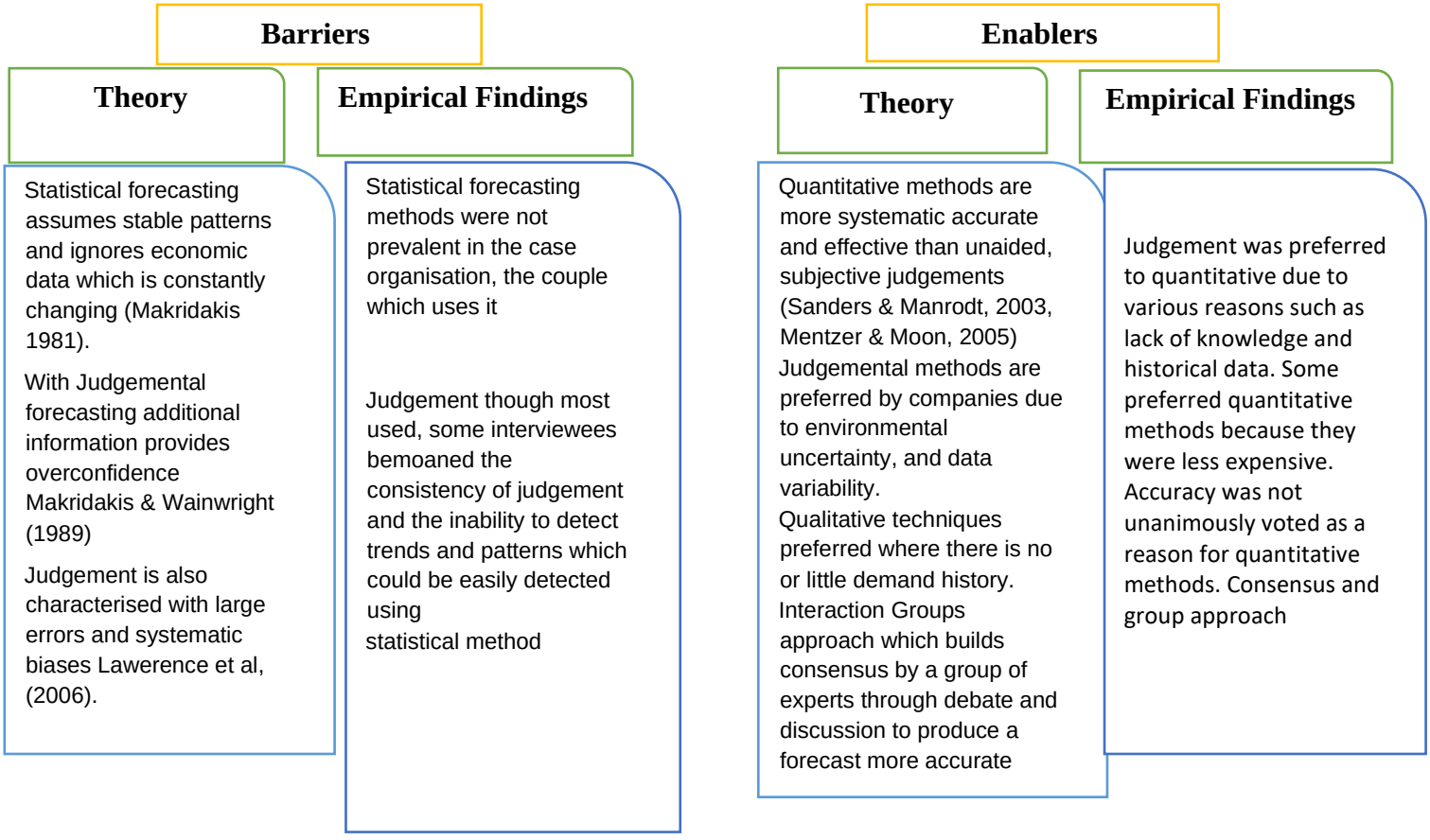
One of the objectives of this study is to develop a framework that addresses the theoretical and empirical findings within the case organisations. The theoretical framework developed highlighted a number of barriers and enablers as identified from prior studies. Forecasting, though beneficial to an organisation has potential barriers to these benefits. Previous work on forecasting have explored in-detail the challenges to implementing forecasting methods/process with Boylan and Syntetos (2017), suggesting that these barriers are predominately cultural issues others also highlight “forecasting climate” explained as the leadership support, credibility of sales forecasting and reward alignment. (Hughes, 2001), also evidenced lack of resources, expertise, high costs, insufficient time, limited historical database and insufficient training as possible hindrances to the implementation of some forecasting methods. These barriers and benefits suggested by researchers are juxtaposed against the perceived barriers identified from this study. They are discussed pictorially summarised in relation to emerging themes from the literature review in the next section.

Figure 5.2 Theoretical and Empirical Framework

1. Data and Choice of Method



2. Quantitative Vrs Judgemental Method



3. Forecasting Demand

Barriers

Theory	Empirical Findings
Intermittent Demand patterns are difficult to forecast (Syntetos and Boyan, 2011; Syntetos et al 2015) Availability and price basis for buyer's decision (Polychronakis and Syntetos 2007) Customer Expectations (Porasmaa and Ojala, 2011; Monczka et al., (2009) Identifying potential customers can be difficult for new drugs (Polychronakis and Syntetos 2007)	This was found to be the case for all the organisations since most manufacture generic drugs which are perceived by a good number as substandard. Customer's loyalty shifts depending on price and availability. Customer's sophistication and preferences drives competition among similar enterprises. Intermittent/ sporadic demand found to be difficult to forecast without any systematic approach to forecasting.

Enablers

Theory	Empirical Findings
Inventory Management (Moon, 2006) Capacity to fulfil customer demands (Chase Jr, 2013) Increase market share (Chase Jr, 2013)	All the case organization agreed demand forecasting is significant confirming the literature review findings.

4. Forecast Accuracy

Barriers

Theory	Empirical Findings
Turbulence in the environment will likely result in forecasting errors (Armstrong & Green 2017) Inaccurate forecasts lead to loss of sales, profit, and customers (Nikolopoulos et al 2014)	Interviewees agreed that inaccurate forecasts occur because order variability are usually inadequately anticipated and incorporated in forecasts and turbulence in the environment affect forecast accuracy.

Enablers

Theory	Empirical Findings
Accurate forecasts can increase efficiency (Armstrong & Green 2017). Stability in external environment result in accurate forecasts (Armstrong & Green 2017). Documenting all the assumptions made and all changes to the original forecast informs subsequent forecast (Armstrong & Green 2017).	Changes in the external environment is expected, stability is overemphasised though trends are a good source of forecasting. The suggestions proffered in the literature on the effects of accurate were confirmed by majority of interviewees.

5. Errors

Barriers

Theory	Empirical Findings
Mistakenly sensing demand signals or predicting false pattern (Armstrong, 2006). Insufficient or inability to identify wrong information can result in errors. Sporadic changes in patterns may cause continuous unpredicted errors Stock price fluctuations, interest rates exchange rates, and commodity price (Chase Jnr, 2013)	Overall, the empirical findings were in line with the literature review findings. However, no defined process for identifying errors was discovered in the case organisations. There was no evidence of a systematic approach to monitoring wrong information or false pattern. Errors are highly probable due to the low level of error identification practices.

Enablers

Theory	Empirical Findings
Analysing previous errors will determine systematic changes in past patterns. Domain knowledge essential for mitigating errors Advanced forecasting techniques- provide fewer forecasting errors. Management Information System will lead forecasters to rely more on informal information. (Chase Jnr, 2013)	Errors in previous estimates are hardly reviewed therefore historic errors can persist in current forecasts. Point of sale data are used for mitigating errors. Technology adoption is minimal, only handful have adopted some form technology and were in the early stage of adoption. Evaluation of forecasting methods and practice help reduce forecast errors. Using multiple forecasting techniques also helps.

6. Forecasting Culture/ Climate

Barriers

Theory	Empirical Findings
Lack of understanding by management (Mentzer, Moon, Kent, & Smith, 1997), Lack of specific training for forecasters Fildes and Hastings (1994), Lack of Collaboration or teamwork among the functional areas (Moon, 2006); as well as forecasters not consulted in decision making as the internal culture / factors which effectively affect forecast accuracy. Also, forecasting for new drugs is challenging since little to no historical data is available.	Management interference and pressure to produce forecast that suit their agenda found to be problematic. Different business units within the organization develop various forecasts which are not compatible and a rejection of either may result in animosity and threatens collaboration. Lack of knowledge was also prominently cited; this may stifle the process and most probably result in inaccuracies.

Enablers

Theory	Empirical Findings
Training for forecasters (Mentzer, Moon, Kent, & Smith, 1997), Performance Measurement (Moon, 2006), aligning reward to forecasts (Davis and Mentzer 2007), investment in the right Technology (Moon, 2006), Formalizing communication (Moon, 2006) as well Management Support Mentzer, Moon, Kent, & Smith, 1997)	The findings from the study are not adversarial to those reported in the existing literature. Improving collaboration, ensuring each department has representation around the forecasting table comes on top. management should have an opinion about the forecast process and the outcome, but they should not impose theirs on the process, clearly distinguishing between organisational and management goals.

7. External factor/Industry Dynamics

Barriers

Theory	Empirical Findings
Industry and health policy Customer Expectation/ Behaviour of stakeholders (Nikolopoulos et al, 2016). Competition affects customer behaviour. New companies may be impacted more by externalities. Technology advancement. Product availability and price basis for buyer's decision. Forecasting for new drugs challenging since little to no historical data is available (Nikolopoulos et al, 2016).	Generally found cost of raw material, legislation, competition, and consumer behaviour as the main external influences on forecasting practice. For some small businesses the prices of raw materials may not directly impact the forecasting process though it impacts overall business operation. Decline in brand loyalty usually occurs from competition and price variations, this makes historic sales data obsolete and unreliable. Technology or use of software was not found to have any effect.

Enablers

Theory	Empirical Findings
Brand Behaviour (Darroch & Miles, 2011) Regulation/ Government policy Pharmaceutical Product life cycle forecast allows the companies to formulate and apply the appropriate marketing strategies (Nikolopoulos et al, 2016). Generic Drug- grows rapidly immediately after the patent expiry of the branded alternative (Kanavos et al. 2008)	Customer loyalty makes demand forecasting easier since customers' purchasing behaviour can be predicted. Generic drugs are dominant and unlike branded drugs the manufacturing process is shorter and can be available immediately after the expiry of the branded drugs. They are low price. Government policy initiatives provides opportunity for the case organisations to grow and expand.

5.8 Chapter Summary

It is submitted in this research that, right data and wrong method produce bad forecast and vice versa hindering forecasting accuracy. However, where data is right and the right method is applied, forecasting accuracy is highly likely. The assertion stresses the importance of data and how insufficient data can be a barrier just like inaccurate data. Consequently, to minimise errors both data and method must be right. Data availability or lack determine the choice of forecasting method. The conundrum for practitioners however is determining the method which will be suitable for the available dataset. This is where the forecasters experience and training can be very crucial. Armstrong (2001) also submits that studying data pattern is important for choosing the right forecasting method and this can positively impact demand forecasting accuracy. The extant literature underscores the importance of domain when forecasting, suggesting that experts should be given the opportunity to select forecasting methods or software were applicable; and the forecaster's experience should not be ignored. But this will happen when decision makers and users are confident in the expertise of the forecaster, the process is objective, unbiased and devoid of organisational politics and personal agendas. This may be difficult to achieve considering forecasting is a human activity in social settings which may hence reflect aspirations and not objective prediction. Acceptance and use of forecast will influenced by the level of communication and collaboration among stakeholders are usually decision makers, recipients of forecasts and forecasters.

The available studies tend to agree on the effects of external factors, forecasters assumption and practices on the choice of method. The study proposed to find out the influence these factors can have on forecasting accuracy or forecasting efforts.

The empirical findings from this study largely confirm the importance of data and how it can be a barrier to forecasting efforts, it concluded that unavailability of historic data does not affect forecasting accuracy or choice of method for majority of small businesses since the data relied on by most SMEs for their estimation are actual purchase orders. Previous orders do not significantly influence current demand though it is an important source of data when available. This view was not unanimous as most of the medium sized enterprises do rely on available data when forecasting. As expected, and in consonance with the existing literature, the majority of SMEs

interviewed apply judgement as the preferred forecasting method for ensuring accuracy, invariably relying on the experience of forecasters and experts. Integrated methods were also used typically by SMEs who preferred quantitative methods. It must be stated that the statistical methods used were predominately excel functionalities. Combining methods were found to reduce errors especially were the data available cannot be relied on and the forecaster has a lot of experience. Collaboration and communication were found to be important to the use and acceptance of forecast, but in small enterprises where CEOs tend to be the forecasters and decision makers there was less consultation with the functional heads though this was not perceived as a major issue. Eternal factors e.g., exchange rate may affect the entirety of the organisations operations but had no significant impact on the forecast accuracy. Government policy and competitors' action were reported to be threats to forecast accuracy.

This study found evidence to support the body of literature that intermittent demand forecasting is difficult. Intermittent demand forecasting was not seen in practice in all 14 participating organisations.

The next chapter concludes this study and make recommendations

Chapter Six
Conclusion

6.1 Introduction

This concluding chapter of the thesis focuses on how the research achieves the research objectives and answers the research questions outlined. It summarises the major findings applying materials from previous chapters. Using the case organisations (14 Manufacturing Pharmaceutical SMEs) this research set out to study demand forecasting practices of Ghanaian pharmaceutical industry, concentrating on the forecasting process. It explored the preferred methods for forecasting demand as well as the barriers and enablers to the forecasting process with specific reference to SMEs; also focusing on forecast accuracy. As suggested by Moon (2018), the ability of the forecasting process to accurately forecast demand is doubted by many companies.

To help realize the main aim of this research and based on the objectives and research questions, phenomenology research philosophy and adopting an inductive approach with no predetermined hypothesis was found to be most the appropriate approach. As an exploratory case study research, primary data was collected using face-to-face semi-structured interviews and observation as well as documents review as the main sources of data collection. Semi-structured interview technique was used because they are flexible and allows the interviewer to vary the approach from each interview at the same time pursuing appropriate structure for reliable, comparable, qualitative data (Cohen and Crabtree, 2006). Interviewees for this project were either marketing and sales, procurement, purchasing and operation managers as well as CEOs for the participating small and medium sized enterprises who were responsible for the forecasting process and decision making. Forecasting by Pharmaceutical manufacturers could be on two levels- forecasting how a drug will perform commercially either at the clinical development stage or on the market once approved (Cha, Rifai and Sarraf, 2013). Pharmaceutical manufacturers predict the future with current unfulfilled needs and drug innovation in sight. This study focused on forecasting pharmaceutical demand after the clinical approval stage, considering majority of pharmaceutical companies in Ghana manufacture generic drugs and do not go through the long strenuous process of preclinical and clinical research or trials. As submitted by Chase, (2013) waiting for demand to occur and reacting to the demand by providing the right product at the right time in the right place cannot persist

in organisations, rather, companies should be able to sense demand signals and anticipate future demand and customer behaviour so customer orders can be quickly satisfied.

Indisputably, predicting the future accurately is challenging and made worse when externalities which cannot be easily foreseen are involved, for instance an outbreak of disease, actions of competitors and volatility/ market complexities. In the same way, internal factors influence the forecasting capabilities of an organisation. These factors include the forecasting methods preferred, the size and age of enterprise, new technologies as well as management support/ involvement. It has been suggested also that the best forecasting method to use when forecasting depend on the data pattern, forecast accuracy and forecast error.

In the majority of the cases, judgemental forecast methods were preferred respondents citing various and sometimes contradictory reasons for their choices. Only one out of the total cases use both judgement and quantitative methods. Adoption of software or technology in the forecasting process was significantly low. It also explored the impact of the choice of method on forecast accuracy.

The 7 themes which formed the theoretical framework developed from the literature review in chapter two was the basis for discussions in chapter five and for analysing the barriers and enablers of demand forecasting. Each theme (e g. Data and Method) had a list of factors which either enabled demand forecasting or inhibited it. From the analysis of findings predicated on the literature review, a framework was developed summarising and comparing the theoretical findings and empirical findings. A framework depicting the connectedness of the concepts in relation to demand forecasting and how the ultimate goal of the process is producing accurate forecast was also developed.

This chapter considers the four issues this study set out to investigate (1) the forecasting methods of pharmaceutical manufacturing SMEs in Ghana, (2) the importance of demand forecast accuracy to SMEs (3) the demand forecasting challenges within the Ghanaian Pharmaceutical SMEs and how they can be overcome, (4) the gaps within the pharmaceutical manufacturing SMEs in Ghana.

A framework that captures and address the theoretical and empirical findings within the case organisations is also provided. Following on, it discusses the research contributions, recommendations for future research and limitations.

Though there is a forecasting process in place in all the case organisations for this study, the forecasting practices differ in micro, small and medium size organisations.

6.2 Research Objectives and Summary

6.2.1 Objective One

- To investigate Ghanaian manufacturing Pharmaceutical SMEs demand forecasting methods.

This objective aimed at examining the demand forecasting methods pharmaceutical SMEs in Ghana use when forecasting. It evaluated the reasons given for choosing the preferred methods. The empirical findings indicate that, demand forecasting occurs in all the SMEs who participated although the micro and some small enterprises describe the process as estimation other than forecasting and the processes may not be formalised. Going by Hyndman and Athanasopoulos (2018) definition of forecasting “as the estimation of some future events or conditions outside an organisations control which provides a basis for management planning”; it can be unambiguously concluded that all 14-organisation forecast demand. Though it has been submitted by some researchers that organisations most often confuse planning with forecasting, the researcher is of the view that since planning involves forecasting to make informed decisions, it cannot be dismissed on the basis of semantics or ambiguity.

Exploring this objective, it quickly became clear, the importance of data in choosing the forecasting method. The ubiquitousness of data in the forecasting process cannot be overemphasised with the data being from either previous sales record (historic data) or as found from this study, potential sales through actual purchase orders. It became apparent from the data analysis that the forecasting process (method and data) of SMEs are significantly influenced by size and capital. The size of the organisation and access to capital have implications on the availability of historic data and the choice of method. Although Demand forecasting involves using historic demand data to approximate future demand, overreliance on historic data to forecast

has been found to produce forecast errors, nevertheless, its role in the process cannot be discounted.

Availability of historic data largely determines the demand forecasting method employed. Unlike new entrants, or new product lines which will likely not have any historic data, all other forecasts are likely to include a review of previous forecasts or sales to better make predictions. Nevertheless, this study found that a segment of respondents does not find historic data indispensable submitting that their forecasts are based on actual purchase orders. Participants who did not appreciate the importance of historic sales data were the archetypical micro and small size enterprises who are either new entrants into the industry or who have recently started manufacturing a limited line of generic drugs. Their size and market share are relatively small which makes demand prediction for such category of companies fairly straight forward. In two of these case companies the CEO's who are the business owners are themselves the forecasters. In instances where the sales or procurement manager is tasked with this activity, final approval of forecast was given by either the CEO or management. The customers of these companies (both wholesalers/retailers) are well known and there is a level of communication which allows for the companies to know the level of demand before manufacture is initiated- more like a pre-order. Inventory management is very controlled, the drugs manufactured are those demanded all year through and fluctuation in demand do not adversely impact on forecasts or estimates. They also suggested that turbulence in the external environment might have implication on the operation of the business as a whole but not particularly on forecasts. The case of these small enterprises reinforces the postulation in the literature that the choice of the appropriate forecasting method depends on the situation, whether it is for a new or existing product, or for long or short term.

The discussion on the demand forecast methods the case companies use was based on Mentzer & Moon (2005) categorisation of forecasting methods into qualitative (Judgement) and quantitative methods. The study found judgemental methods as the predominately used method of forecasting, consistent with Cerullo and Avila (1975) study of the forecasting practices of 110 companies who concluded that, majority of the companies used judgmental rather than statistical methods. According to the

respondents using judgment in forecasts simply means the opinions of managers, forecasters, or expert. The use of judgement when forecasting has gained currency in recent past; example Lawrence (2006); however, some researchers take issue with it use. Despite the reported biasness inherent in judgement, the empirical finding reported judgement as the predominate method. The finding categorised pharmaceutical SMEs into those using judgment-based forecasts, those using quantitative based forecast and those using integrated methods. Using Forecasting experts or external forecasters in pharmaceutical SMEs is not very common because of the sensitive nature of data and the high costs of employing the services of forecasting experts; however not using experts may reduce the confidence reposed in the forecast and also increase forecast errors. This is essential due to the complex nature of the pharmaceutical industry which requires that forecasters are able to track the myriad of external controllable and uncontrollable influences in the industry (Smith, 2011). To mitigate the lack of experts in pharmaceutical companies, there is the need to invest in training more people to support the forecasting process.

Rothe (1978) supported by Armstrong, (2003) argued that increased use of judgement is occasioned by the low level of forecasting knowledge. This assertion put forward by some researchers which suggests a lack of knowledge of statistical methods drives the use of judgement was consistent with the empirical findings with a proportion of the sample consenting; a number of respondents who also use judgemental methods contradicted this view of lack of knowledge as the driver. Lack of knowledge was however strongly linked to forecast inaccuracies or errors. These group of respondents argued that the current methods serve the purpose and did not see the need to change to complex methods which may not produce the accurate outcome. This view supports Armstrong and Green (2017) who argues that there is no evidence to support the assumption that complex methods are relatively more accurate than simple methods.

As expected, branded companies commit a lot financially to future investment, innovation, research and development thereby requiring forecasters with a higher level of forecasting experience compared to generic companies. Most of the case companies manufacture generic drugs with only four involved in branded drugs. Branded pharmaceuticals need much more in terms of forecasting compared to

generic ones and need more sophisticated and integrated methods to ensure accurate forecast especially because they generally have patent expiry at which point generic prototypes are allowed in the market. Branded pharmaceutical need to forecast how many prescriptions a specific medicine will generate for better planning and decision making, whether the product lifecycle should be altered to prevent early decline or implement strategies to increase sales and profitability (Nikolopoulos et al, 2016).

Every stage of a product lifecycle requires different approaches and methods for forecasting demand as the characteristics of each stage is unique. The evidence available from researchers is conflicting with regards to determining the most suitable approaches or methods for forecasting pharmaceutical life cycles. Some previous researchers suggested complex diffusion models as the most accurate models with others suggesting simpler diffusion models could produce more accurate forecasts in certain instances. Some have been more specific citing simple models such as the Naïve model as producing more accurate forecasts than complex econometric and diffusion models. Though the literature has found different life cycle scenarios with different life cycle curves, this research focused on the four widely known stages in the product life cycle and the findings indicated different approaches for each stage. For new products benchmarking was preferred. Market survey emerged as the most utilised forecasting method for new drugs.

Though more than half of respondents chose judgement as the appropriate forecasting method a good number of respondents representing 36% preferred quantitative methods. Some researchers argue that statistical forecasting approaches produce more reliable forecasts even though it has been shown that, statistical methods which use historic data may not capture unpredictable events making forecasts obsolete. According to Sanders & Manrodt, (2003) and Mentzer &Moon, (2005) there is empirical evidence to suggest that quantitative methods generally deliver better forecast accuracy than judgemental method; although quantitative/ statistical methods are criticised for being unreliable especially when established patterns or relationships change. This notwithstanding, the case companies that prefer quantitative methods indicated how the methods reduce the likelihood of overblown forecasts, averts the use of falsified data, it is cost effective than

judgemental methods and forecast produced are not prone to bias but can be objectively interpreted as opposed to qualitative methods.

It is argued that integrating quantitative and judgements methods increase forecasts accuracy and this is further improved by availability of domain knowledge. Armstrong and Green (2017) also adds that combining methods is superior even when there is the certainty of the best method for the forecast, similarly it is postulated that combining methods has been found to reduce ex ante forecast error and help protect against bias. Integration of methods was not evident in any of the case organisation although one of the case organisations uses both methods for different forecasts. Domain knowledge was rather very important for forecasters, and this was exhibited in the years of experience of the forecasters. All respondents involved in the forecasting process could all boast of many years of experience either with the current organisation or previous employer though some were more knowledgeable than others. Domain knowledge is particularly important when using judgement as it helps predict competitors' actions, promotion plans, and macro-economic conditions.

Technological advancement has also been found to impact the forecasting process making computer software more accessible to forecasters; purporting to increase the accuracy and confidence in forecasts. For the case companies only 3 out of the 14 had some form of technology introduced in their forecasting process, even though they alluded it was still in its infantile stage, 2 of these companies could not comment on the effectiveness of the software. One out of the three could attest to its effectiveness, since they use software for all their product lines. This is congruent to Sanders and Manrodt (2003) findings after surveying 240 US firms on the adoption of forecasting software and the level of satisfaction. They found that majority of the analysts preferred their traditional spreadsheets to the new technologies and forecasting software. Indicatively, the size of the business impact the level of technology adoption and use.

It was also discovered that the case companies like others in the pharmaceutical industry do not have systematic approaches for forecasting intermittent demand. Irregular or intermittent demand according to the responses are dealt with on need to basis. The general methods respondents use in the forecasting process according to their responses include 'made-to-order' approach based on purchase orders and market surveys.

In summary, the forecasting methods of Pharmaceutical SMEs in Ghana as reported by this study is predominately judgemental methods and specifically internal expert opinion, market survey and brainstorming. They use generally basic simple methods and where quantitative or software is used, they are simple Excel applications/ spreadsheets. The size of the SME influences the choice of method.

6.2.2 Objective Two

- To investigate the importance of forecast accuracy in demand forecasting.

The expected outcome of any forecasting process or practice is arguably accurate forecast. As depicted in Figure 5.1, the findings point to a unanimous agreement on the importance of accurate forecasting, neither were the cost of inaccurate forecast contested. Inaccurate forecast of demand especially for new drugs adds to the cost of developing the product and may result in selling at prices which does not maximise profit as new products or introducing an existing product into a new market requires large investments with high uncertainty. Accurate forecasts of demand however increase revenue, helps maintain loyal customers, reduce waste and stock out.

Accuracy in forecast depends on the data, method, internal capabilities and external complexities or environment. As shown previously, the data available will influence the method chosen and vice versa and this ultimately affect the forecast outcome, whether accurate or inaccurate. As submitted by Hanke and Wichern (2008) from an empirical study, an essential criterion for choosing a method is for the method to produce accurate forecast. It is therefore critical who chooses the method to be adopted, and how the decision is made. For micro and small size enterprises in the case companies, this study found management choose the preferred method without any consultation with any functional manager or forecasting team, the case was no different in three other medium scale enterprises. For the small-scale enterprises this was not unexpected since as previously alluded to, the CEO's or entrepreneurs tend to take all major decisions whiles the employees implement these decisions. In other cases, though management make the final decisions there is consultation and collaboration with the forecasters. While the literature hints on allowing experts to

make the decision, the scenario is different for the case organisations. For these companies, the decision is dependent on the internal factors of the company. Owner CEO's usually have expertise and domain knowledge from practicing in the field, either working for other companies in various capacities before setting up their own small-scale business; they therefore can be held as having adequate expertise to choose the appropriate method. Although, Tyebjee (1987), cautioned that management are hardly experts in forecasting methods and are therefore not the best persons to choose the methods as this can result in errors.

Even Though this assertion makes sense, domain knowledge cannot be discounted in the process as it is essential to help counteract some of the inherent errors. Domain knowledge may assist in determining price changes over time and it is critical for predicting seasonal patterns, emerging technological trends and its corresponding influencing factors. It brings to bear knowledge of time series, the nature and associated context. Context is very important when using historical data and choosing the method. Contextual knowledge may be perceived to be more significant to forecast accuracy than technical knowledge as concluded by some researchers. Webby & O'Connor, (1996), likewise submitted that combining statistical and judgemental forecasts generally improves the accuracy of forecasts when the experts have domain knowledge.

Discussing demand forecasting, Moon (2018), suggested that companies in practice question how demand can be accurately forecast, doubting the very process of forecasting. This in part could be explained by Makridakis, (1980); observations that forecasting assumes constancy and a stable demand process without considering uncertainty in forecasting modelling; when in reality patterns and relationships become unpredictable over time as they continuously change making forecasting an almost impossible task. These unpredicted changes can cause unpredicted errors and less accurate forecast. Changes in quotas imposed by government, legislation, stock price fluctuations, interest rates, exchange rates, and commodity price are difficult to predict accurately due to unknown factors that may influence them.

Measuring forecasting accuracy is also necessary to assess the effectiveness of the forecasting process by observing performance of both the forecasting method and the forecasting team. Repeating processes or methods which always produce

inaccurate outcomes will be absurd. The responses indicated a lack of improvement and innovation in the forecasting process. Some bemoaned how for years they have used the same method without any signs of it being improved resulting in recycled forecasting errors. The lack of improvement was largely attributed to already stretched resources and the lack of drive to progress as a business. It was common for businesses to stick to the status quo so long as the current situation does not present any financial losses in terms of profits.

To accurately forecast it is essential to have a mechanism that identify errors, but majority of the case companies intimated they do not have any defined process for identifying errors. Early identification of errors could result in amendment to forecast to avoid the costs associated with inaccurate forecast. For those companies which attempt to detect errors in the process, they usually use exceptions analysis, mean absolute deviation and forecast bias to identify deviations. Forecast bias assess the variance between actual sales and forecast ensuring the drivers of the variance are reviewed and taken care off in subsequent forecast. From the responses, the commonly used technique for identifying errors is the mean absolute deviation.

In a nutshell, a forecasting process which does not have accuracy as the goal is not worth the effort. All the activities in the process, choosing the right method should be geared towards producing accurate forecasts which can be relied on to plan and make decisions. The appropriate tool likely to produce the desired outcome with less errors will envisage competitors' action, inculcate periods of excessive or minimal unusual demand and make provision for amendment. Forecast accuracy ensures timely manufacturing and delivery resulting in customer satisfaction, fewer complaints from clients and enables financial and strategical planning for growth.

6.2.3 Objective Three

- To identify the demand forecasting challenges within the Ghanaian Pharmaceutical SMEs and how they can be mitigated.

The importance of demand forecasting is widely researched and cannot be overstated.

They are useful for planning inventory levels to provide acceptable level of service to customers (Kolassa, et al., 2016), prevent stock out and unnecessary warehouse or

storage cost. To successfully forecast demand certain factors, need to be present and their absence can severely affect the accuracy and usefulness of the outcome. These factors can either be internal variables or external environmental factors. The empirical findings highlight some of the barriers identified by the case companies as lack of collaborations among the various teams, Inability to forecast variations to potential future demand, insufficient funds allocated to forecasting, lack of improvement in the forecasting process, inflexibility in the use of forecast methods-no upgrade over a long period and undue pressure from management. These were consistent with the existing literature.

As shown by this research, forecasters in the pharmaceutical case companies tend to be marketing managers, sales managers, procurement or purchasing managers, CEO's or company owners depending on the size of the company. This inadvertently result in biased forecasts where collaboration and communication with other departments directly affected by the forecast is not pursued. Then, the interests and benefits of the forecaster is put above all others producing biased unrealistic forecasts either intentionally or unintentionally. Unrealistic forecasts may influence the behaviours of the forecast users which eventually affects the success of forecasts. Contrariwise, effective communication and collaboration ensures each functional manager's domain knowledge is incorporated to produce one forecast for the entire organisation to work with.

The feedback from respondents on collaboration was split, it revealed a lack of collaboration when choosing forecasting methods in some medium size enterprises, small companies understandably due to their relatively small size did not do much of collaboration as in most cases, usually the entrepreneur owner is the forecaster and decision maker. The lack of collaboration could alienate persons who may be able to contribute their domain knowledge to the process, creating animosity and unratified forecasts. Indicatively, a department or manager's rejected input or forecast could be interpreted by them as a rejection of their opinion or domain knowledge. Conversely, some respondents indicated some level of collaboration among forecasters, management and functional heads. Generally, small and medium sized enterprises utilise extensively the experiences available to them to avoid forecast errors and the associated risks of extrapolating historic trend.

On the other hand, reliance on forecasters judgement when forecasting result in inconsistencies. Some respondents were of the view that investing in statistical software products could help achieve more accurate forecasts. Using statistical methods and or software tools in their opinion could improve the detection of trends and patterns effortlessly. Some stated their organisation had used the same method for years without any improvement producing the same forecast errors each time. These were attributed in part to the lack of commitment and resources to improve the forecasting process.

Also, management involvement, not pressure or sabotage was found to be critical especially in situations where forecasts and plans fail, forecasters do not have to bear the brunt alone with management distancing themselves and blaming the forecaster. This scenario may suggest that assumptions held and on which forecasts are based are undiscussed and in situations where forecast fails, management can quickly distant themselves from the inaccurate forecasts. Though knowledge of domain is crucial, the apparent lack of involvement by management can raise valid questions about the quality of communication when forecasting in these companies. Still on the issue of communication, respondents highlighted how wrong information and unavailability of data from key departments in the organization is a setback to the forecasting process. Persistently churning out inaccurate sales data, most often there is no linkages between the sales data sets and the forecasting templates used.

Evidently, SMEs do not experience massive variability in demand, notwithstanding, when they occur, it is difficult for SMEs to forecast these demand variations as well as promotional demand; eventually it affects the accuracy of forecast. The forecasting approach of some of the companies were inward looking with no consideration for bottom-up data from the marketplace.

Finally lack of knowledge of the right forecasting practice especially for new companies was also cited as a challenge. This confirms Rostami-Tabara and Boylan (2021) finding that many forecasting players lack an understanding of basic theory on forecasting in developing countries. Most of the case organisations have little to no knowledge of developments in theory as proposed by academics. The knowledge

relied on is mostly the experience and domain knowledge of forecasting. Data quality was also an issue in most situations.

The lack of quality data as well as wrong data can be mitigated by making data collection an integral part of the day-to-day operations of the business. Opinions of management should not be imposed on the forecasting process. Forecasters should be free to conduct their activities without interference or undue pressure. Moreover, Investment in advanced systems and software that guarantee forecast accuracy. By adopting suitable statistical method which takes into account economic and environmental changes rather than constantly changing forecasting methods whenever there are changes in the environment or marketplace. Having a systematic approach to forecasting ensures the method adopted are consistent. Many advanced software is available and accessible, and these can be used to mark forecasts relatively more accurate.

Suggestions on the efforts that could mitigate the identified obstacles to the forecasting practices of SMEs were found not to be novel or adversarial to what has been suggested by prior researchers. The suggestions which include collaboration and training corroborate propositions in the theoretical framework developed. On collaboration, it was suggested that a collaborative process be adopted; obtaining support from senior managers and people with relevant domain knowledge to ensure a better understanding of the drivers of profitability. Training both the forecaster and the users of the forecast help overcome issues of lack of knowledge of the right forecasting method. Training on how to identify the right data, patterns in the data set as well as the benefits and challenges associated with the forecasting methods. As Rostami-Tabar and Boylan (2021) reported, less developed economies have not quite understood the necessity of developing the knowledge and skills of forecasting actors. The forecasting process should be flexible to new information in the internal or external environment without being fixated on trends and past data to achieve accurate forecasts.

6.2.4 Objective Four

- To identify the demand forecasting gaps

Another objective of this research was to identify demand forecasting gaps in the pharmaceutical industry in Ghana. Scholars have consistently pointed out gaps between the theory and the practice of forecasting (Boylan and Syntetos, 2016; Mahmoud et al., 1992; Singh 2016,) and more recently Rostami-Tabara and Boylan (2021). Boylan and Syntetos, (2016) categorised these gaps into three- knowledge, research, and implementation.

From the interactions between the researcher and the interview participants and other stakeholders, the following gaps were identified:

1. Data quality is generally poor
2. Lack of contextual research
3. Nonexistence of intermittent forecasting
4. Lack of knowledge of basic forecasting theory and methods by forecasters, forecasters rely heavily on experience of forecasters.
5. The practices of the case studies were found to be distant from academic recommendations.

6.2.5 Objective Five

- To develop a framework that will capture and address theoretical and empirical findings within the case organisations.

The theoretical framework developed identified 7 themes from the literature review and highlighted under each theme the propositions which are enablers or barriers of demand forecasting in pharmaceutical SMEs. This is seen in figure 5.2.

6.3 Key empirical findings

- Size, access to capital/ profitability and management decisions influence the forecasting process and practices of pharmaceutical SMEs in Ghana
- The forecasting process of the case organisations are quite simple and flexible adopting basic forecasting methods either quantitative or qualitative.
- Though some benchmarking studies in the pharmaceutical industry concluded that time-series models are the most used methods (Jain, 2003) this study found judgemental methods as the most utilised confirming Lawrence (2006) conclusion.

- Medium size enterprises rely heavily on past or historic sales data when forecasting demand.
- For micro and small enterprises, availability of historical data has no influence on the choice of method or process.
- Market survey, brainstorming and management projection based on advance purchase orders or estimated orders (internal expert opinion) are the main methods for forecasting demand.
- Technology adoption is very low, the closet software in use is Excel spreadsheet, quantitative methods in use are basic such as simple average.
- Lack of knowledge of forecasting informs choice though the finding was not conclusive.
- Cost, avoidance of misrepresented data and objective interpretation of forecast are the reasons cited for preference of quantitative methods
- Intermittent demand is not forecasted.
- The reasons for judgmental methods include flexibility, size, cost, lack of knowledge.
- Government policy and industry regulation were found to impact the general operations of the companies and profitability.

6.4 Contribution to Knowledge

This research contributes generally to demand forecasting in SMEs and specifically to research on demand forecasting practices of pharmaceutical SMEs. It contributes to the extant literature by demonstrating the forecasting processes of small and medium size pharmaceuticals, comparing existing theoretical and empirical literature on forecasting methods with the case companies thereby developing understanding. It confirms a number of earlier research findings on demand forecasting (Lawrence 2006, Merkuryeva et al 2019; Weller and Crone 2012). It has shown that difference in size, availability of data and profitability impact the level of management support/ interference, the methods employed, collaboration as well as the accuracy of forecast. It has established that the forecasting process of SMEs are simple, not sophisticated and in the majority of cases there is no adoption of technology or software in the forecasting process.

The level of forecasting knowledge which in most cases was evident from the years of experience of forecasters was also key. The findings challenged the general assumption that statistical methodologies produce more accurate forecast arguing from the research findings that SMEs are more inclined to judgemental approaches. This study argued that there are obvious differences between branded drugs manufacturing companies and generic drug manufacturers. Generic drugs manufacturing SMEs as was the case in this study lack structure and had more forecasting ambiguity compared to large corporations, which are mostly foreign owned and have dedicated forecasters and a more structured organisation. The flexibility in small and medium companies means they are able to amend forecasts easily to achieve accuracy although they still encounter issues with forecasting errors and biases.

Consequently, this study, consistent with other research studies, concluded that judgement is the preferred method of forecasting for pharmaceutical SMEs, domain knowledge is pertinent and expressed in this study by the number of years' experience of the forecasters. Simple methods of forecasting are used with Excel spreadsheets being the dominant software or quantitative approach consistent with the industry wide picture as reported by (Merkuryeva et al 2019; Weller and Crone 2012).

Lack of knowledge of forecasting methods makes judgement the preference, even though for most of the SMEs the nature of their business and size does not require advanced methods or technologies.

Previous studies have generally focused on historical data and extrapolating time series, though this is very important and prevalent even in pharmaceutical industry (Merkuryeva et al 2019, Jain 2003) this was not the case for participating SMEs, they tend to focus on purchases orders, domain knowledge of experienced forecasters and internal expert opinion.

This study contributes to scholarly discus and aim to bridge the gap between theory and practice applying the concepts of demand forecasting to the practice of demand forecasting in the pharmaceutical SMEs. It also provides a comprehensive conceptual framework which delineates demand forecasting in the pharmaceutical industry into barriers and enablers to add to the body of knowledge on demand

forecasting and which can assist scholars as well as business practitioners and industry experts with the practices that enables or hinders forecasting efforts.

Finally, a summary table is developed with theoretical and empirical findings, and the differences between the theory and the practice were highlighted.

6.4.1 Generalisability of the Study

The methodological approach for this study was inductive with phenomenology philosophy, this approach typically implies the empirical findings cannot be generalised unlike combining an inductive approach with a positivist viewpoint. In the grand scheme, this research is not generalisable however considering that firstly, the existing literature to a large extent is supported by the research findings of this study, it can be generalised to pharmaceutical SMEs in the Ghanaian context as they tend to exhibit similar characteristics. The research focused on manufacturing pharmaceutical SMEs with all the participating pharmaceuticals being in one geographical region (Accra) which happens to be the hub for enterprise. Regional influences were not therefore reflected in the findings; this notwithstanding, the factors explored were not peculiar to a region though for other sectors it may not be the case. Government regulations and policies affect all regions equally.

For the African sub region, specifically the western belt, the social, economic, technology, ecological and legal environment of the member nations are similar although the political landscape differ with Ghana being relatively stable. The findings from this research can therefore be generalised to pharmaceuticals within the ECOWAS market that exhibit similar characteristics like the data from this research.

6.5 Recommendations for further studies and Practice

To support the existing theoretical and empirical findings in the area of demand forecasting, forecasting methods, Pharmaceutical small and medium size enterprise in Ghana as well forecasting accuracy for decision making, the ensuing are recommended for further studies.

- Similar studies can be replicated in major manufacturing pharmaceuticals in Ghana owned by either indigenous or foreigners to understand if any similarities

or difference existing. This study focusing on SMEs found some differences in how smaller pharmaceutical predict future demand and even in the tools they employ. The internal capabilities of these different business had an influence in their forecasting practices. To further explore how internal factors such as size, profitability, collaboration and management support influence the forecasting practices of large pharmaceuticals in Ghana.

- Future research can explore how organisational and the national culture, their values, risk averseness or otherwise of the Ghanaian society impact businesses approach to predicting the future. A study of such variables can throw light on the complexity of forecasting and how unscientific but social variables impact the process.
- This work also contributes to the ongoing research on forecasting effectiveness by studying the relationship between the management of the forecasting process and operational performance. We argue that this work provides a noteworthy result from a managerial perspective as well because it shows that companies should pay attention to their specific environment in designing a forecasting system, paying attention to the perceived effectiveness of general principles. In addition, companies should focus on designing an internally coherent forecasting system rather than simply relying on forecasting techniques.
- Though this study explored the factors that impact the forecast accuracy, an in-depth assessment of these factors was not conducted, further research projects can analyse these factors for deeper understanding of these factors.
- This study found that the case organisations did not have well formalised and structured forecasting systems, the business strategies were not clear, and forecasts are subject to many unclear factors. Companies can move to more structured processes especially adopting more structured forecasting methods even where qualitative methods are preferred.
- Training both formal and informal for forecasters should be normalised. Forecasters experiences alone without any form of training can be very detrimental especially in situation where they become overconfident, wrong predict trends or interpret data. And as Makridakis *et al* (2020) aptly put it, experience has limited value beyond a certain minimal level. Training can help reduce errors.

- Investment in advanced forecasting techniques and software should be prioritised especially as both small and medium pursue growth and expansion and the market become more digitised and complex. Currently many open-source software are available for free and this can be implemented rather done the reliance of judgemental approaches especially with the advent of artificial intelligence and other learning applications the role of humans in forecasting may markedly change, embracing technology or some level of automation is recommended. Advanced techniques have been found where used to reduce forecasting errors. These techniques may require heaps of data therefore companies should endeavour to store data properly and accurately. Historic sales data should be stored in ways it can be easily accessed without distortions to the original data which may be difficult to acquire either because the organisations do not keep those data or are not available as it is in the case of new products. Modern software systems are designed to constantly learn from data and behaviour.

6.6 Study's Limitations

As typical of all research projects, this study also has it fair share of limitations which all enumerated below.

- This study focused on demand forecasting practices of pharmaceutical SMEs in Ghana. It is context specific though some of the findings compare to findings in other jurisdictions and context, as a qualitative study it is not intended to be generalised but to extend understanding. The forecasting process of SMEs are different compared to larger enterprises.
- This study was exploratory and did not aim to propose new forecasting models but rather how already developed models are adopted and used if being used.
- SMEs generally due to their size are financially constrained and may not be in positions to contract professionally trained forecasters. As was the case in this study, in most of the organisations the forecasting function was committed to the sales and marketing managers who may not be experts in forecasting, though with significant forecasting experience.
- The intended sample size for the research reduced significantly due to issues with access causing enormous delays. SMEs that agreed to participate initially,

later proved difficult to access either by not turning up for agreed meetings or nominating individuals who had inconsequential knowledge about the forecasting practices of the organisation. Some participants were not willing to give in depth explanation for confidentiality reasons despite the reassurance, the sensitivity of the pharmaceutical sector meant they were extremely conservative. Ultimately 14 participants across 14 SMEs were interviewed, though the number was enough to accomplish the research, slightly more participants would have enriched the research.

- Though the internal organisational influences enabling or inhibiting the forecasting practices in the case organisation were broadly referred to as climate / culture factors, as submitted by moon (2007). This research did not particularly focus on how organisational culture as explained by Hofstede (1994) to include norms, attitude, values, beliefs influence the demand forecasting practice/process. Culture in that sense was beyond the scope of this research although from hindsight, they could be useful for explaining the variations in forecasting practices of case organisations. Future studies can explore the impact of organisational culture on demand forecasting practices.
- Time constraint meant some of the interview questions were not exhausted during some of the interview sessions. In such situations the researcher had to make the decision of asking questions which was deemed very important for achieving the aim and objectives, in other instances ideas and opinions could not be explored further as desired.

6.7 Conclusion

Forecasting demand like any other management decision making activity requires data. The data can be historic which can be subjected to judgement or statistical methods to make future reliable demand predictions that can inform organisation's decisions. In certain situations, historic data may not be available or accessible because it has not been properly stored or because the forecast is for new products. It has been shown in this research that an organisations ability to forecast accurately, to access the right data and employ the right methods to an extent depend on the size, age and profitability. Forecasting accuracy hinges not only on the forecasting method but also on the performance of the forecasting team as well. Deciding on the

right forecasting method to apply can depend on data pattern, forecast accuracy or error. When a poor choice of forecast method is made by an individual with little or no knowledge of forecasting methods, without consulting or in collaboration with experts with domain knowledge; and when accuracy of forecast is not the focus of the process; whiles high forecast errors are neglected, the result will be high inventory levels and its associated cost. Undeniably, knowledge of forecasting methods and domain knowledge are critical when forecasting demand, nevertheless, the influences of internal attributes and the external environment cannot be ignored. These includes management support, competitors' action and market turbulence.

Small and Medium size enterprises may have distinct forecasting processes compared to large enterprises. Most SMEs due to their size, limited financial and manufacturing resources do not typically have formal organisation structures and dedicated /expert forecasters rather the forecasting activity is generally performed by the marketing, sales or purchasing managers; and in other situations, as was the case in this research, owner CEO'S perform the dual function of being forecaster and decision makers. Nevertheless, the forecasting process of these SMEs are relatively simple and for most product lines, variability in demand is minimal. Forecasting for small organisation are more flexible and adaptable to market volatility making it easier to amend to improve forecast accuracy.

Though typically the forecasting process of pharmaceuticals is long and winding, the case is different for generic drug manufacturers. Contrasting, generic drugs do not go through preclinical and clinical trials that branded products are imperilled with making forecasting for generic drugs simple and straightforward. Most pharmaceuticals in Ghana produce generic drugs explaining the flexibility but lack of structure of their forecasting processes. Generic manufacturing has more forecasting ambiguities (terms, judgement, tools) compared to branded manufacturers, however they both are riddled with issues of biases and errors. The forecasting systems do have myriad of advantages, but the limitations cannot be overlooked neither can performance be exaggerated. Finally, as stated by Makridakis et al (2020) forecasting methods do not have prophetic powers, "they simply extrapolate established patterns and relationships to predict the future and assess its uncertainty".

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Appendices

Appendix 1 Ethical Approval

Research, Innovation and Academic Engagement Ethical Approval Panel

Doctoral & Research Support
Research and Knowledge Exchange,
Room 827, Maxwell Building
University of Salford
Manchester
M5 4WT

T +44(0)161 295 7012

www.salford.ac.uk/

1st March 2019

Albert Anderson

Dear Albert,

RE: ETHICS APPLICATION SBSR1718-16: Demand Forecasting in Ghanaian Manufacturing Pharmaceutical Small and Medium-sized Enterprise's (SME's).

Based on the information that you provided, I am pleased to inform you that your application SBSR1718-16 has been approved.

If there are any changes to the project or its methodology, please inform the Panel as soon as possible by contacting SBS-ResearchEthics@salford.ac.uk.

Yours sincerely,

Professor David F. Percy
Chair of the Staff and Postgraduate Research Ethics Panel Salford Business School

Appendix 2 Participant Invitation Letter

Salford Business School
University of Salford,
Salford M5 4WT

1st April, 2019

Dear Madam/Sir,

REQUEST FOR YOUR PARTICIPATION IN A RESEARCH STUDY TITLED 'DEMAND FORECASTING IN GHANAIAN MANUFACTURING PHARMACEUTICAL SME's

I am a PhD Student of the University of Salford, Manchester, United Kingdom and I am currently undertaking a PhD programme at the School of Business and being supervised by Dr Yiannis Polychronakis. As part of the PhD programme, I am conducting a research study titled '**Demand forecasting in Ghanaian Manufacturing Pharmaceutical SMEs'.**

I am by this letter inviting you to take part in this study. Your participation will be through semi structured interviews. Your cooperation would be very much appreciated since the information you provide will help in better understanding the forecasting process in SME's and the barriers SME's encounter in Demand forecasting. This information should assist in the development of Framework for forecasting demand in Pharmaceutical SME's.

Your confidentiality will be safeguarded during and after the study. All information which is collected during the course of the research will be kept strictly confidential, and no personal details or details about the organisation will be disclosed.
The data collected will appear anonymously in the PhD dissertation and other related publications.

I have enclosed a participant information sheet which has full information about the study.

I look forward for a favourable response.

Thank you.

_____

Albert Aidoo-Anderson

(PhD Student)

Appendix 3 Participant Information Sheet

Research Title: **Demand forecasting in Ghanaian Manufacturing Pharmaceutical SME's**

Invitation paragraph

I would like to invite you to take part in a research study. Before you decide you need to understand why the research is being done and what it would involve for you. Please find below some information which you may want to know about this research. Please take time to read the following information carefully. Ask questions if anything you read is not clear or would like more information. If you require additional information, please feel free to contact me or my supervisors on the contact details at the end of this information sheet. Take time to decide whether or not to take part. If you decide to participate in the study, you will need to sign a written consent form. Its hope that the study will be beneficial to academia, and SME's forecasting practitioners

What is the purpose of the study?

The purpose of the research is to investigate Forecasting practises in manufacturing Pharmaceutical SMEs in Ghana. It centres on how manufacturing Pharmaceutical SMEs in Ghana forecast demand, the methods used in forecasting and the barriers Pharmaceutical SMEs in Ghana encounters in forecasting demand and how these challenges are minimised.

Why have I been invited?

38 organisations were invited to be part of this study and your organisation is one of these. Forecasting practitioners in each organisation will be asked a number of questions in semi-structured interviews to help complete this research.

Do I have to take part?

Your participation in the research is entirely voluntary. It is therefore up to you to decide whether to take part in the study or not. You will be interviewed by the researcher and one research assistant. We will describe the study and go through the information sheet and address all your concerns. If you agree to participate in the study, we will ask you to sign a consent form to show you agreed to take part in the study. You are free to withdraw from the interview at any time, without giving a reason. However, if you decide to withdraw and

wish the information you have given not to be used in the study you need to let us know within 30 days of being interviewed.

What will happen to me if I take part?
There is face-to-face semi-structured interview. Each individual interview should take about one to one-and-a-half hours. The interviews will take place at convenient location suitable for you, and with your kind permission, the individual interview will be audio recorded, which will be used solely for the study. During the interview, you will be asked questions related to your views, perceptions and experiences regarding forecasting Practices and barriers encountered during forecasting demand in the pharmaceutical industry.

What are the possible disadvantages and risks of taking part?
There are no disadvantages or risks in this study.

What are the possible benefits of taking part?
We cannot promise the study will help your organisation but the information we get from the study will help to increase the understanding of forecasting Practices and how barriers to forecasting can be minimised and also contribute to knowledge.

What if there is a problem?
If you have a concern about any aspect of this study, you should ask to speak to the researchers who will do their best to answer your questions.

Will my taking part in the study be kept confidential?
All information which is collected about you during the course of the research will be kept strictly confidential, and any information about you which leaves the university will have your name and address removed so that you cannot be recognised.
What will happen if I don't carry on with the study?
If you withdraw from the study all the information and data collected from you, to date, will be destroyed and you name removed from all the study files.

What will happen to the results of the research study?

All the results will be used to validate the framework. Part of the result will be published. You will not be identified in any report/publication unless you have given your consent.
Who is organising or sponsoring the research?
Salford University

Contact details:
Researcher Name: Albert Aidoo-Anderson
Phone No: 07500043573
E-mail: a.aidoo-anderson@edu.salford.ac.uk

Appendix 4 Research Participant Consent Form

Title of Project Demand forecasting in Ghanaian Manufacturing Pharmaceutical SME's

Name of Researcher: Albert Aidoo-Anderson

(Tick as appropriate)

• I confirm that I have read and understood the information sheet for the above study (version x- date) and what my contribution will be.	**Yes**	**No**
• I have been given the opportunity to ask questions (face to face, via telephone and e-mail)	**Yes**	**No**
• I agree to take part in the of the semi-structured interview	**Yes**	**No**
• I understand that my participation is voluntary and that I can withdraw from the research at any time **without giving any reason**	**Yes**	**No**
• I understand how the researcher will use my responses, who will see them and how the data will be stored.	**Yes**	**No**
• **I agree to take part in the above study**	**Yes**	**No**

Name of participant…….

Signature……

Date ……

Name of researcher taking consent ……

Researcher's e-mail address ……

Appendix 5 Letter Of Approach/Organisational Agreement

Salford Business School
University of Salford,
Salford M5 4WT

1st April , 2019

Dear Sir/Madam,

REQUEST FOR APPROVAL TO CONDUCT A RESEARCH STUDY TITLED 'DEMAND FORECASTING IN GHANAIAN MANUFACTURING PHARMACEUTICAL SME's

I am a PhD Student of the University of Salford, Manchester, United Kingdom and I am currently undertaking a PhD programme at the School of Business and being supervised by Dr Yiannis Polychronakis. As part of the PhD programme, I am conducting a research study titled '**Demand forecasting in Ghanaian Manufacturing Pharmaceutical SMEs'.**

Prior to undertaking the study, I need your agreement/consent to approach the forecasters within your organisation to take part in the study.

Your cooperation would be very much appreciated since the information obtained will help in better understanding the forecasting process in SME's and the barriers SME's encounter in Demand forecasting. This information should assist in the development of Framework for forecasting demand in Pharmaceutical SME's.

Your organizations confidentiality will be safeguarded during and after the study. All information which is collected during the course of the research will be kept strictly confidential, and no personal details or details about the organisation will be disclosed.
The data collected will appear anonymously in the PhD dissertation and other related publications.

I have enclosed a participant information sheet which has full information about the study.

Thank you.

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Albert Aidoo-Anderson

(PhD Student)

Appendix 6 Interview Guide

RE: DEMAND FORECASTING IN GHANAIAN MANUFACTURING PHARMACEUTICAL SME's

Name of Researcher:

1.1. Introduction & Debriefing

Good morning/ afternoon and welcome to our session. Thank you for agreeing and for taking the time to be part of this interview. I appreciate your willingness to participate. I am conducting this study as a requirement for the award of a Doctor of Philosophy (PhD) in Operations Management at the University of Salford, Manchester, United Kingdom. We are going to have a conversation about your perception, views and experiences in forecasting demand in the pharmaceutical industry. We need your **input** and want you to **share your honest** and open thoughts with us. It is important that we discuss this topic as honestly as we can so that the appropriate strategies and framework can be developed to aid demand forecasting in the industry. I am having same discussions like this with several other SME's in the pharmaceutical industry. Before we start, let us introduce ourselves. My name is Albert Aidoo-Anderson, the Moderator and I am a student of the University of Salford, Manchester. Please mention your name. Just the first name is okay.

Ground rules

a) **Confidentiality:**
Your confidentiality will be safeguarded during and after the study. All information which is collected about you during the course of the research will be kept strictly confidential, and any information about you which leaves the health facility will never have your name and address so you can never be recognized. Everything we discuss should be kept in the room and that no one will be able to link statements to individuals.

b) **We will be tape recording the interview:**
You have probably noticed the recorder. With your kind permission we will be tape recording the session because we do not want to miss any of your comments. People often say very helpful things in these discussions, and we cannot write fast enough to get them all down. We would not use any names in our reports. You may be assured of

complete confidentiality. We want to capture everything you have to say. We would not identify anyone by name in our report. You will remain anonymous.

c) **We want you to do the talking:**
We would like you to participate. My role as moderator will be to guide the discussion.

d) **There are no right or wrong answers:**
All your experiences and opinions are important. We want to hear a wide range of opinions, views and experiences. Please feel free to share your point of view. Keep in mind that we are just as interested in negative comments as positive comments, and at times the negative comments are the most helpful.

e) **Cell phones on vibration/ silent/ off**:
I would be grateful if you could please turn off/ put your phone on vibration or silence so you can focus on the topic.

Appendix 7 Summary of Responses- Sample

Code	SME 1	SME 2	SME 3	SME 4	SME 5	SME 6	SME 7
Employee Count	50	110	135	40	201	216	30
Type	Medium	Medium	Medium	Small	Medium	Medium	Small
Turnover	GHC 6.6m	GHC 17.3m	GHC 18m	GHC 7.6m	GHC 20m	GHC 18.3m	GHC 5m
Role/Position of interviewee	CEO	Procurement Manager	Procurement Manager	Operation Manager	Operation Manager	Operation Manager	CEO
Experience (Years)	32	15	8	15	20	19	30
Forecasting process – Data and Process							
Type of Data, data availability and impact on choice of forecasting	Forecasting is simple and straight forward based on previous year's sales data, study of trends and patterns, current market conditions. Availability of data has no influence			Market survey to forecast demand. Availability of data has no influence	Depending on the information available they choose a method. If information is scanty brainstorm		The process is referred as planning and estimation. Customers are approached in advance to obtain purchase orders or estimated orders for the year and based on this management make projection. Historical orders are factored into the estimates. Availability of data has no influence
Method Selection Responsibility	Management chooses the method. Method. driven by business strategy	Procurement managers select the method, management do not play any key role in the selection of the method. Method is based on forecasters own assumption	Procurement managers select the method, management do not play any key role in the selection of the method. Method is based on forecasters own assumption	Management forecast. Method driven business strategy	Forecaster (operation manager) select the method and brainstorm with Management for approval Method driven business strategy	Operation managers select the Method and Management approve. Method is based on forecasters own assumption	Management makes the projections from the information gathered by sales team from customers purchase orders. Method driven business strategy
Forecasting Methods Preferred	Judgemental Method Prefers expert opinion. Judgement forecasting may lack numerical and graphical charts but very rich in detail. Use brainstorming a form of judgemental method and this drives innovation.	Quantitative Method	Quantitative Method Forecast is based on actual data and not assumptions	Judgemental Method specifically expert opinion. The choice is not driven by a lack of data or an inability to use statistical methods contradicting the views of CEO1.	Quantitative Method Reduces the likelihood of overblown forecasts Prevents the use of falsified data. Brainstorming	Judgemental Method	Judgemental Method though has it challenges, the lack of knowledge and consistent accurate data necessitate its use.

IT Software used in Forecasting	**No IT Systems used**	**No IT Systems used**	**No IT Systems used**	**Simple methods no IT systems required**	**IT has been introduced but not fully operational. End users IT software are consulted and are involved in the development and design of the software s**	**No IT Systems used**	**Simple methods no IT systems required**
FORECASTING DEMAND							
Forecasting for new drugs & the stages in PLC				**Difficult to forecast demand for the introduction phase due to the lack of historical sales data. Observing the linear growth after the introduction and estimate using the percentage increment. A steady increase of sales signifies maturity**	**They "custom made" approach to address new products. They obtain a written contract or purchase order from potential customers which then becomes the basis of forecast" for new drugs. At the growth stage demand can be sluggish, rapid, or highly erratic, at this stage forecast is based on the trend. At decline stage demand begins to fall drastically and the ability to see this trend to amend forecast is crucial.**	**When forecasting for new drug they use Market survey**	**When forecasting for new drug they use Market survey to gather vital information on marketplace competition, price sensitivity and customer behaviour. This information together with the market survey, experience and assumptions help them to forecast for new drugs.**
Drug Classification manufactured							
Obstacles to demand forecast	**The obstacle they have identified are wrong information and lack of data from key departments. Inaccurate sales data**	**Wrong information and lack of data**		**Lack of collaborations among the various teams**	**Inability to forecast variations to potential future**	**Lack of knowledge of the correct/ right methods**	**Insufficient funds allocated to forecasting. Forecasters lack knowledge of right forecasting practices**
How they overcome the obstacles	**Adopting a top-down approach that makes collection of good data an integral part of the day-to-day operations of the business**			**Collaboration**		**There is the need to adopt statistical method that is robust enough to cater for the ever changing environmental and economic changes rather than changing methods any time there is a shift or changes in the marketplace**	
Forecast Accuracy & Error							
Benefit	**Forecast helps organizations to**	**Accurate forecast helps**	**Accurate demand**	**Accurate forecast helps**	**An accurate demand**	**It enables us to financially plan**	**Accurate forecast**

	identify their consumers and meet their needs.	estimate correctly the demand for materials.	forecast helps them to better manage their inventory preventing stock out and over stocking. Results in better management of production.	them to maintain the right levels of inventories which prevent them from panic sales and excess promotions to get rid of unsold products.	forecast enables us to measure the interest in our products.	for the growth of our organization	allows us to see into the future and plan strategically to increase growth
Cost	Inaccurate forecasts affect customer satisfaction. Loss of clients as they hardly tolerate stock out.	Inaccurate demand forecast results in ordering excessive stock and some products with short shelf-life span will end up being disposed should demand fall short.					
Identifying Errors					Mean Absolute Deviation a mathematical metric is used to identify errors in their past forecast. It takes the total value of forecast errors and strike averages based on the time frame of the forecast.		
Minimising Error	Macroeconomic indicators is key tool for reducing forecasts errors. Monitoring macroeconomic movement such as GDP, stock market that can linked to change in the end user demand.	Envisage brunt in sales due competitors' actions and amend the sales forecast appropriately. Eleventh-hour promotional offers and price cut by a rivals should be prepared for, for timely intervention and response to minimise the effects on forecast.		Use of historical data and macroeconomic indicators	Natural disasters, customer behaviours - loyal customers going bankrupt, or even rival company's marketing promotions are not very easy to anticipate,	Outliers must be included in the process of forecasting demand else it can lead to forecast errors. Excessive or minimal unusual demand should be measured when factoring forecast calculations or projections.	Use of point-of-sale data to minimize errors in their forecast, The data capture essential time sensitive information such as the type of product and quantity sold, date, place, and time
Forecasting climate							
Collaboration	Management is committed and supportive Management involves personnel from different sectors of the business in the process.	Management is committed and supportive	Management is committed and supportive	Management is committed and supportive but do not ensure collaborations among the various teams within their organization.	Management is committed and supportive	Management is committed and supportive	Management is committed and supportive
Brand loyalty & Industry regulations and the gov't policy	Brand loyalty is crucial when forecasting especially a new drug as Customers' purchasing behaviour becomes more reliable.	Brand loyalty is crucial when forecasting especially a new drug. Drug production quota policy	Brand loyalty is crucial when forecasting especially a new drug	Brand loyalty is crucial when forecasting especially a new drug. Government policies and regulations affect their forecast. Cost reduction policy	Brand loyalty is crucial when forecasting especially a new drug Government policies and regulations affect their forecast. Drug	Brand loyalty is crucial when forecasting especially a new drug. Quota	Brand loyalty is crucial when forecasting especially a new drug government policy to fund production plants.

				substituting branded drugs with domestic generic drugs.	**production quota policy**		
External impact		**Cost of Raw materials**	**Cost of Raw materials**		**Culture and climate eg demand for a particular product demands change in forecast to meet prevailing market conditions**		

Appendix 8 Summary of Responses

Organisation				Class 1 General Overview		Class 2 & 4 Forecasting Process - Data and Methods				Class 3 Forecasting Demand			Class 5 Forecasting Accuracy		Class 6 Forecast Errors		Class 7	Class 8 Industry dynamics- stakeholders' interaction	
No.employees	Code	Type	Turnover	Role/Position of Interviewee	Experience in forecasting (Years)	Type of Data, data availability and impact on choice of forecasting	Method Selection Responsibility	Forecasting Methods Preferred	IT Software used in Forecasting	Forecasting for new drugs & the stagesin PLC	Obstacles to demand forecast	How they overcome the obstacles	Benefit	Cost	Identifying Errors	Minimising Error	Collaboration in forecasting demand	Drug Classification, brand loyalty & Industry regulations and the government policy	External impact
50	SME 1	Medium	GHC 6.6m	CEO	32	Forcasting is simple and straight forward based on previous year's sales data, study of trends and patterns, current market conditions. Availability of data has no influence	Management chooses the method Method driven by business strategy	Judgemental Method Prefers Delphi method Judgemental forecasting may lack numerical and graphical charts but very rich in detail Use brainstorming a form of judgemental method and this drives innovation.	No IT Systems used		The obstacle they have identified are wrong information and lack of data from key departments. Inaccurate sales data	Adopting a top-down approach that makes collection of good data an integral part of the day to day operations of the business	Forecast helps organizations to identify their consumers and meet their needs.	Inaccurate forecasts affects customer satisfaction. Loss of clients as they hardly tolerate stock out.		Macroeconomic indicators is key tool for reducing forecasts errors. Monitoring macroeconomic movement such as GDP, stock market that can linked to change in the end user demand.	Management is committed and supportive Management involves personnel from different sectors of the business in the process.	Brand loyalty is crucial when forecasting especially a new drug as Customers' purchasing behaviour becomes more reliable.	No comments
110	SME 2	Medium	GHC 17.3m	Procurement Manager	15		Procurement manager select the method, management do not play any key role in the selection of the method. Method is based on forecasters own assumption	Quantitative Method	No IT Systems used		Wrong information and lack of data		Accurate forecast helps estimate correctly the demand for materials.	Inaccurate demand forecast results in ordering excessive stock and some products with short shelf-life span will end up being disposed should demand fall short.			Envisage brunt in sales due competitors actions and amend the sales forecast appropriately. Eleventh-hour promotional offers and price cut by a rivals should be prepared for, for timely intervention and reponse to minimise the effects on forecast.	Management is committed and supportive	Brand loyalty is crucial when forecasting especially a new drug. Drug production quota policy	Cost of Raw materials
135	SME 3	Medium	GHC 18m	Procurement Manager	8		Procurement manager select the method, management do not play any key role in the selection of the method. Method is based on forecasters own assumption	Quantitative Method Forecast is based on actual data and not assumptions	No IT Systems used				Accurate demand forecast helps them to better manage their inventory preventing stock out and over stocking. Results in better management of production.				Management is committed and supportive	Brand loyalty is crucial when forecasting especially a new drug	Cost of Raw materials
40	SME 4	Small	GHC 7.6m	Operation Manager	15	Market survey to forecast demand. Availability of data has no influence	Management forecast Method driven business strategy	Judgemental Method specifically Delphi Method. The choice is not driven by a lack of data or an inability to use statistical methods contradicting the views of CEO1.	Simple methods no IT systems required	Difficult to forecast demand for the introduction phase due to the lackof historical sales data. Observing the linear growth after the introduction and estimate using the percentage increment. A steady increase of sales signifies maturity	Lack of collaborations among the various teams	collaboration	Accurate forecast helps them to maintain the right levels of inventories which prevent them from panic sales and excess promotions to get rid of unsold products.			Use of historical data and macroeconomic indicators	Management is committed and supportive but do not ensure collaborations among the various teams within their organization.	Brand loyalty is crucial when forecasting especially a new drug. Government policies and regulations affect their forecast. Cost reduction policy substituting branded drugs with domestic generic drugs	
201	SME 5	Medium	GHC 20m	Operation Manager	20	Depending on the information available they choose a method. If information is scanty brainstorm	Forecaster (operation manager) select the method and brainstorm with Management for approval Method driven business strategy	Quantitative Method Reduces the likelihood of overblown forecasts Prevents the use of falsified data	IT has been introduced but not fully operational. End users IT software are consulted and are involved in the development and design of the software s	They "custommade" approach to address new products. They obtain a written contract or purchase order from potential customers which then becomes the basis of forecast" forwewdrugs. At the growth stagedemand can be sluggish, rapid, or highly erratic, at this stage forecast is based on the trend. At decline stage demand begins to fall drastically and the ability to see this trend to amendforecast is crucial.	Inability to forecast variations to potential future		An accurate demand forecast enables us to measure the interest in our products.		Mean Absolute Deviation a mathematical metric isused to identify errors in their past forecast. It takes the total value of forecast errors and strike averages based on the time frame of the forecast.	Natural disasters, customer behaviours - loyal customers going bankrupt, or even rival company's marketing promotions are not very easy to anticipate,	Management is committed and supportive	Brand loyalty is crucial when forecasting especially a new drug Government policies and regulations affect their forecast. Drug production quota policy	Culture and climate eg demand for a particular product demands change in forecast to meet prevailing market conditions.
216	SME 6	Medium	GHC 18.3m	Operation Manager	19		Operation manager select the Method and Management approve. Method is based on forecasters own assumption	Judgemental Method	No IT Systems used	When forecasting for new drug they use Market survey	Lack of knowledge of the correct right methods	There is the need to adopt statistical method that is robust enough to cater for the ever changing environmental and economic changes rather than changing methods anytime there is a shift or changes in the market place	It enables us to financially plan for the growth of our organization			Outliers must be included in the process of forecasting demand else it can lead to forecast errors. Excessive or minimal unusual demand should be measured when factoring forecast calculations or projections.	Management is committed and supportive	Brand loyalty is crucial when forecasting especially a new drug. Quota	
30	SME 7	Small	GHC 5m	CEO	30	The process is referred as planning and estimation. Customers are approached in advance to obtain purchase orders or estimated orders for the year and based on this management make projection. Historical orders are factored into the estimates. Availability of data has no influence	Management make the projections from the information gathered by sales team from customers purchase orders Method driven business strategy	Judgemental Method though has it challenges, the lack of knowledge and consistent accurate data necessitate its use.	Simple methods no IT systems required	When forecasting for new drug they use Market survey to gather vital information on market place competition, price sensitivity and customer behaviour. This information together with the market survey, experience and assumptions help them to forecast for new drugs.	Insufficient funds allocated to forecasting. Forecasters lack knowledge of right forecasting practices		Accurate forecast allows us to see into the future and plan strategically to increase growth			Use of point of sale data to minimize errors in their forecast, The data capture essential time sensitive information such as the type of product and quantity sold, date, place and time	Management is committed and supportive	Brand loyalty is crucial when forecasting especially a new drug government policy to fund production plants.	
175	SME 8	Medium	GHC 19m	Marketing Manager	8		Management choose but consult marketing manager	Judgemental Method	No IT Systems used	Forecasting for new drug is difficult, they Make -to-order, to avoid supply not matching to demand in the introduction stage of the product.	lack of improvement in the forecasting process is a challenge. Some method over a long time without upgrade	Ensure there is adequate resources for forecasting not only for acquiring new software or methods but also training and improving the skills of the forecasters. Exposure to what goes on in similar organizations					Management is committed and supportive	Brand loyalty is crucial when forecasting especially a new drug Brand loyalty is crucial when forecasting especially a new drug VAT reduction	Changes in legislation
218	SME 9	Medium	GHC 20.3m	Marketing Manager	12	"our projections or forecast are based on past sales trends from the information we have at our disposal. basically we collect the data which is grouped into quarters of the year, and we forecast accordingly"	The Marketing team brainstorm and come out with the estimate for every quarter then management approve	Quantitative Method and that it is not the lack of data or their inability to use statistical methods that lead them to use judgemental method as claimed by CEO1, claiming that with judgemental forecasting method of Delphi they are able to predict possible variations in the sales patterns as well as customer behaviour counting on the judgement and experience of experts and senior managers.	A software for forecasting has been adopted but still in the implementation stage	Old or existing product they have the data to back their forecast, for new drugs they produce based on actual demand. They extend the mature stage of the product by changing the packaging, adding new improved features and also changing their promotion tools. According to him the decline mostly is linear with some level of approximation, they forecast demand at the rate of decline.	lack of improvement in the forecasting process	There should be balance. Essential to base forecast on past outcomes but flexible enough to make changes when needed		Inaccurate demand forecast has both long- and short-term consequences to the organisation. It makes it difficult to understand clients needs or anticipate the particular product customers are most likely to purchase . Sales targetare not met.	Mean Absolute Percentage Error formula to detect past forecast errors.	Data should be evaluated before plotting the estimated numbers on the graph to get rid of any extraneous data, robust reliable data should be used. To lessen errors, use multiple forecasting techniques to cover the diverse needs of the consumer demands and trends.	Management is committed and supportive Management is collaborative and drives collaboration among the teams through technology	Produce both generic and branded drugs. Brand loyalty is crucial when forecasting especially a new drug	Cost of raw materials and consumer behaviour
180	SME 10	Medium	GHC 17.7m	Marketing Manager	16	market survey to forecast demand. They send out a form of questionnaires to their loyal customer asking about their requirement for the period they will be forecasting.		Judgemental Method	No IT Systems used							Focusing on data is good but evaluating the forecasting methods or models being used and the forecasting process are important in reducing forecast errors.	To lessen errors, use multiple forecasting techniques to cover the diverse needs of the consumer demands and trends. Management is committed and supportive	Brand loyalty is crucial when forecasting especially a new drug	New legislation
230	SME 11	Medium	GHC 21m	Sales & Marketing Manager	10		Sales and marketing manager select the method and Management approve	Quantitative Method	Recently introduced an IT software to forecast for a selected product lines End users IT software are consulted and are involved in the development and design of the software s	Difficult to forecast demand for the introduction phase odue to the lackof historical sales data. Observing the linear growth after the introduction and estimate using the percentage increment. A steady increase of sales signifies maturity	Undue pressure from management	Management opinionor political ambition about forecast should not be imposed on the forecasting process. There should be clear distinction between management's objectives and organisational forecast.	..they are able to attain a higher rate of "on time in full" delivery. Forecast accuracy ensures timely manufacturing and timely delivery results in few complaints from clients and keeps customers happy.		Mean Absolute Percentage Error ito detect past forecast errors to inform current decisions.	Qantitative technique of plotting actual sales data on a graph as and when the numbers are received help minimize forecast errors.	Management is committed and supportive	Produce both generic and branded drugs	New legislation
250	SME 12	Medium	GHC 26m	Sales & Marketing Manager	23	Forecasting for them begins by first gathering their historical sales data, analysising market growth, the seasonality of the different product lines, price and introduction of new laws and legislation, before a decision is made on the type of method to apply to generate the forecast.	Management select the method Method driven business strategy	Both Quantitative Method / Judgemental Method Quantitative methods are mostly cheaper to use than judgemental method. Judgemental methods may involve hiring expect for their opinions, using market surveys, which are very costly	They use information technology software eg. SAP Integrated Business Planning tool in their forecasting. 95% of the forecasting process is based on technology, however different for each product line IT software system are not overly relied on but judgement plays a role. End users of the IT software are consulted			There should be adequate training not only for the forecaster but the users. He added that the focus of the training also has to shift from the forecaster just acquiring more knowledge on complex techniques	Helps maintain the right levels of inventories which prevent them from panic sales and excess promotions to get rid of unsold products. Sales are managed in a very thoughtful planned manner.		Neglecting and not analysing mistakes inhibit the opportunity to grow and develop to be better at forecasting.	Exceptions analysis to understand the causes of the major or very expensive forecast errors. Scrutinise every new data source before using it especially if the product has been promoted before	Management is committed and supportive. Management is very keen on collaboration	Produce both generic and branded drugs. Brand loyalty is crucial when forecasting especially a new drug Government policies directly affect their forecast.	Cited Government legislation as it can be favourable or not. Eg ban on the use of a chemical meant forecasts needed to change and depend on judgement
223	SME 13	Medium	GHC 17.3m	Marketing Manager	15		Management make the projections	Judgemental Method specifically panel consensus This is because of the flexibility it affords management to inculcate non-numerical information.	Like SME5 and 9, some software has been introduced but too early to comment on it effectiveness. End users IT software are consulted and are involved in the development and design of the software s							Examine the source of new data. Test new data using a quantitative technique that blend in promotional data into the process of demand forecasting.	Management is committed and supportive	Brand loyalty is crucial when forecasting especially a new drug VAT reduction	Competition
164	SME 14	Medium	GHC 19.4m	Sales & Marketing Manager	20	Disclosed that data is important to the method selection process.	Management & Forecaster Method driven business strategy	Quantitative Method numerical forecast are not difficult to interpret and easy to analyse. Quantitative techniques objectively interpreted data unlike qualitative methods	No IT Systems used		Inability to forecasting promotional demand correctly. One third of the pharmaceutical industry's sales are driven by promotion. to our forecasting process affect our forecast.	the need to train forecasters properly to understand the dynamics of the market and be able to inculcate marketing strategies such as promotions in to the forecasting process.	Helps to effectively schedule promotions appropriately in the product life cycle.	Inaccurate forecasting impact on their profit and sales	Mean absolute deviation highlight how significant an error on average is to forecast accuracy. It is not however very helpful when comparing error among different		Management is committed and supportive	Produce both generic and branded drugs. Brand loyalty is crucial when forecasting especially a new drug VAT reduction	Consumer Behaviour