Modelling supply chain basic health sanitation challenges in district high schools: North West Province

by

Remofilwe V. Tlhabudugwane

204011626

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Supervisor

Dr T.P. Mbhele

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Declaration

I, Remofilwe Virginia Tlhabudugwane, declare that:

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Abstract

Basic health sanitation is an essential human need. However, many South African schools confront challenges in providing a sufficient level of basic health sanitation. These have been exacerbated by the global Covid-19 pandemic. This study employed the Supply Chain Operations Reference model to examine the challenges affecting efficient and effective supply chain sanitation operations in high schools. Its objectives were to establish how high schools develop an operations plan for integrated supply chain sanitation and hygiene; evaluate how these schools' sourcing strategies facilitate improved service delivery; establish how high schools' operations processes influence sanitation, hygiene and service delivery; and to determine how schools' waste management systems in relation to sanitation and hygiene influence the type of material, products and packaging systems.

An exploratory design was adopted to examine the challenges affecting high schools' supply chain sanitation operations. Thematic analysis was used to analyse the data collected from 21 participants in high schools in Ngaka Modiri Molema District, and two from the Department of Basic Education in North West Province. The results showed that the majority of schools, especially those in rural areas, confront supply chain basic health sanitation challenges such as a shortage of water and sanitary pads as well as vandalism, with the lack of financial resources identified as a significant challenge. Based on the findings, supply chain integration is recommended as a possible solution to these challenges.

Key Concepts: Supply Chain; Integration; Supply Chain Operations Reference (SCOR) Model; Water, Sanitation and Hygiene; Service Delivery

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List of Abbreviations

APICS	American Production and Inventory Control Society
COVID-19	Coronavirus Disease 2019
DBE	Department of Basic Education
DOH	Department of Health
DRDLR	Department of Rural Development and Land Reform
DWS	Department of Water and Sanitation
SA	South Africa
SAFE	Sanitation Approach for Education
SC	Supply Chain
SCC	Supply Chain Council
SCI	Supply Chain Integration
SCM	Supply Chain Management
SCOR	Supply Chain Operation Reference
SGB	School Governing Body
TCO	Total Cost of Ownership
UNICEF	United Nations International Children's Emergency Fund
WHO	World Health Organisation

CHAPTER ONE

INTRODUCTION TO THE STUDY

1.1 Introduction

Health, sanitation and hygiene are basic human needs. Globally, around 1.8 million people die due to diarrheal diseases each year, in many cases spread as a result of poor basic health sanitation (World Health Organisation, 2009). According to Snel, Ganguly and Shordt (2002, "sanitation and hygiene is globally recognised as key intervention to promote children's right to health and clean environment, it influences generational change in health promotion behaviour and attitudes". Equal Education (2018) notes that many South African high schools have poor sanitation and hygiene practices. For example, if learners are expected to clean toilets, they should wear equipment such as mouth and nose masks and gloves and the cleaning material should not be harmful to their health.

This study of basic health sanitation and hygiene in high schools employs the SCOR version 11.0, which is a common tool used to assist organisations to evaluate and rapidly improve supply chain processes. The SCOR's six primary management processes, Plan, Source, Make, Deliver, Return and Enable are powerful tools for supply chain management (SCM) (Supply Chain Council, 2012). While it previously included five processes, the Enable process was recently introduced to describe how the supply chain is managed. It includes management of business rules, data, contracts, facilities, performance, resources supply chain network management, governance and compliance and risk management (Supply Chain Council, 2012). This study applies these six management processes to assess schools' sanitation and hygiene challenges.

1.2 Background of the Study

According to the Independent Development Trust (2020), "the North West Province of South Africa was created after the 1994 democratic elections from the merger of Bophuthatswana (one of the former Bantustans or black homelands) and the western parts of the former Transvaal regions". The province is predominantly rural and comprises four districts, namely, Bojanala Platinum, Dr Kenneth Kaunda, Dr Ruth Mompati, and Ngaka Modiri Molema. The Department of Rural Development and Land Reform (2016) notes that most South African rural communities remain socio-spatially and economically marginalised due to colonial and apartheid legacies. The

three main district municipalities in North West, Ngaka Modiri Molema, Bojanala Platinum and Dr Ruth Segomotsi Mompati are characterised by high levels of poverty and inequality, although De Ruth Segomotsi Mompati is endowed with high potential agricultural land. The high schools in Ngaka Modiri Molema District confront sanitation and hygiene challenges. Most still use pit toilets, and lack a regular supply of water. Moreover, most of the rural areas in the district municipality experience inadequate service delivery and resultant backlogs (Department of Rural Development and Land Reform, 2016).

The Department of Water Affairs and Forestry (2002) identifies three periods in the history of basic health and sanitation in South African schools, namely, pre-1994 (the apartheid era); 1994-2001, marked by the adoption and implementation of new sanitation policies; and 2001-2008, which focused on the eradication of the bucket system. The sanitation challenges confronted by South African high schools are compounded by the growing number of learners. The manner in which schools plan, source and manage their sanitation operations process impacts supply chain visibility and maturity, which is becoming increasingly important. It is against this backdrop that this study employs the SCOR model to examine the challenges that affect the efficient and effective sanitation operations of high schools,

1.3 Problem statement

South African schools confront serious challenges in relation to supply chain sanitation and hygiene. School children spend most of their time in schools during which they may be exposed to improper sanitation. When it comes to a girl leaner menstruation journey, girls miss up to 4 consecutive days of school every month because of their periods, meaning that they miss 10%–20% of school time, which seriously impacts on their achievement. This is due to poor menstrual hygiene management caused by both lack of information, privacy, washing facilities, and sanitary pads. Across the basic education sector (primary, secondary and high schools) one in every five toilets are either locked or broken. Many schools lack toilet paper or sanitary pads for girls, with no bins provided for disposal of sanitary pads and no soap available for learners and teachers to wash their hands after using the toilet. In some schools, learners are still using pit toilets which are not safe for them to use. Leaners clean their own toilets, with no protective equipment such as mouth and nose masks and gloves, provided. The coronavirus known as Covid-19, which emerged

in 2019 and was declared a pandemic by the World Health Organisation has highlighted the need to urgently address the sanitation and hygiene situation in schools. The education authorities and schools themselves have a responsibility to ensure that learners and teachers' health and safety are protected. This calls for efficient supply chain operations. This study employs the SCOR model that embraces planning; sourcing; make; delivering; return and enable to examine challenges affecting the efficient and effective sanitation operations of high schools. Few studies have applied this model to high schools' sanitation and hygiene in South Africa. The study will thus assist schools and the Departments of Health and Basic Education in understanding how to implement SCOR in order to improve sanitation/hygiene processes and thus promote economic development.

1.4 Research objectives and questions

The study's objectives were to:

- Examine the challenges affecting high schools' efficient and effective supply chain sanitation operations;
- Establish how high schools develop an operations plan for integrated supply chain sanitation and hygiene;
- Evaluate how high schools' sourcing strategies facilitate improved service delivery;
- Establish how high schools' operations processes influence sanitation, hygiene and service delivery; and
- Ascertain how schools' waste management systems in relation to sanitation and hygiene influence the type of material; products and packaging systems.

Research questions:

- What challenges affect the efficient and effective supply chain sanitation operations of high schools?
- How do high schools develop an operations plan for their sanitation and hygiene?
- To what extent does a supply chain sourcing strategy facilitate continuous improvement of sanitation service delivery in high schools?
- How do agile operations management processes influence sanitation, hygiene and service delivery in high schools?

- How do waste management systems in relation to high schools' sanitation and hygiene influence the type of material, products and packaging systems?

1.5 Theoretical framework

Sekaran (2003:97) defines a theoretical framework as "the foundation on which the entire research project is based". It is a "logically developed, network of association among the variables deemed relevant to a situation and identified through processes of observations, literature survey and interviews" (Sekaran, 2003). This study adopted the SCOR model as its theoretical framework. According to the Supply Chain Council (2012), "the Supply Chain Operations Reference (SCOR) model was developed by the Supply Chain Council in 1996". Zhou, Benton, Schilling, and Milligan (2011:332) note that, "its focus is mainly on the SCM function from an operational process perspective and includes customer interactions, physical transactions, and market interactions". It "merged with APICS (formerly known as the American Production and Inventory Control Society) in 2014" (Edwards, 2018:60-221). Companies such as Intel were among the first to adopt the SCOR model (Zhou et al., 2011:332). This study uses the revised version 11.0 of SCOR to examine supply chain integration in relation to sanitation and hygiene.

1.6 Methodology

The research methodology refers to the tools employed by the researcher to solve a research problem. This study was a qualitative one that employed interviews and focus group discussions to gather data to respond to the research questions and fulfil the research objectives. Permission was obtained from the interviewees to record the interviews. The researcher transcribed the responses and NVivo was used for thematic analysis.

1.6.1 Research design

The "research design describes the nature and the pattern that the research intends to follow. It is the overall strategy chosen by the researcher to integrate the different components of the study in a coherent and logical way" (Creswell, 2021). A qualitative research design was appropriate for this study as the interviewees who were knowledgeable on water and sanitation issues pertaining to high schools provided rich data on the challenges confronting efficient and effective supply

chain basic health, sanitation and hygiene operations among high schools in Ngaka Modiri Molema District.

1.6.2 Target Population

Ngaka Modiri Molema District is one of four district municipalities in North West Province. It covers an area of approximately 28 114 km² and is home to around 961 960 people in 268 099 households. Ngaka Modiri Molema District has 42 high schools, excluding secondary and combined schools. The target population for this study was 13 of these schools. The researcher realised that adding more schools would not produce new data because the school participants were from the same district and were experiencing the same challenges, therefore the point of saturation was reached when the school participants the researcher interviewed were providing the same information on challenges such as a lack of water; vandalism, unavailability of sanitary pads; Covid-19, and planning and sourcing.

1.6.3 Sample size

The sample was 23 participants, including ten school heads; four deputy heads; seven members of school governing bodies (SGBs); one Deputy Director and one Supply Chain Administrator of PPP from the Ngaka Modiri Molema District Municipality. The participants were purposively selected based on their knowledge of supply chain basic health sanitation and hygiene in schools. Having examined the data collected, the researcher realised that adding more focus groups or considering more participants would not produce new data because the participants were from the same district and were experiencing the same challenges. The point of saturation was reached when the participants the researcher interviewed were providing the same information on sanitation challenges

1.6.4 Sampling strategy

“Sampling techniques provide a range of methods that enable the researcher to reduce the amount of data needed to be collected by considering only data from a subgroup rather than all possible cases or elements” (Saunders et al., 2020). Sampling techniques are divided into two categories known as probability sampling, which includes simple random, systematic, stratified, matched pairs, multi-stage and cluster sampling, where unit or people have a known chance of been selected

in the study. The other technique or design is non-probability sampling, which include convenience, purposive, expert, snowball, and quota sampling, where units or people do not have any probabilities attached to their being chosen as a sample subject. Non probability sampling was used in this study. This study employed purposive sampling based on the participants' ability to provide information on the challenges affecting high schools' efficient and effective supply chain sanitation operations.

1.6.5 Data collection methods

Semi-structured, face-to-face and telephonic interviews were conducted to collect data. Covid-19 protocols, including social distancing and the wearing of masks were observed during the face-to-face interviews. Telephonic interviews were held in cases where the interviewee was not available to meet face-to-face or was in isolation due to Covid-19 infection.

1.6.6 Data quality control

"Data quality control is concerned with the trustworthiness and credibility of the data that is accumulated; it evaluates the outcomes acquired as far as their similitude and checks if the outcomes might be for the most part relevant to the whole population" (Sekaran, 2003:66). Vosloo (2014) refers to data quality control as to how the researcher can ensure that the date gathering instruments used, measure what they are supposed to measure in a consistent manner: reliability and validity, respectively. Trustworthiness involves ensuring that the research procedures have been transparent, the research methods used are available for review and inspection and clear rational reasoning can be provided (DuPlooy, Davis and Bezuidenhout, 2014). Trustworthiness, is divided into dependability, credibility, transferability, and conformability (DuPlooy, Davis and Bezuidenhout, 2014). The fundamentals of trustworthiness that approve the methods and approach will be utilised as part of this study.

1.6.7 Overview of the dissertation

This study is presented in six chapters as follows:

Chapter 1: Introduction

This chapter introduces the study. It sets out the research problem, objectives and questions, and briefly discusses the theoretical framework and research methodology. The chapter concludes with an overview of the dissertation.

Chapter 2: Literature Review

Chapter 2 reviews the relevant literature on the challenges confronting efficient and effective SCM in basic health sanitation and hygiene and presents the study's theoretical framework. It discusses Water, Sanitation and Hygiene, known as WASH in light of Covid-19 as well as supply chain challenges during the pandemic. Finally, the chapter presents an in-depth discussion on the SCOR model's six primary management processes.

Chapter 3: Research Methodology

This chapter provides a detailed discussion on the research methodology, research design, and the sample size, as well as the sampling techniques, data collection, and data analysis, and the ethical considerations taken into account in conducting this study.

Chapter 4: Data Presentation

Chapter 4 presents the data generated during interviews and focus group discussions in relation to the study's research objectives and questions.

Chapter 5: Discussion of results

Chapter 5 discusses the findings in relation to each of the study's objectives and illustrates how these were achieved. It also highlights the study's contribution to knowledge.

Chapter 6: Recommendations and conclusion

The final chapter presents recommendations arising from the study's findings and suggestions for future research, as well as a conclusion.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews the relevant literature on the challenges confronting effective supply chain sanitation operations in high schools. In order to understand these challenges, it is necessary to examine the supply chain context, integration and supply chain reference operations. It is also important to elaborate on Water, Sanitation and Hygiene (WASH) initiatives. These concepts are considered together to derive principles to inform future research on basic health sanitation challenges. This study would not be complete without an examination of how the Covid-19 pandemic has affected efficient and effective supply chain sanitation operations in high schools. The pandemic has caused much fear and uncertainty among the education authorities, parents and learners, and support staff and educators at schools and has been marked by school closures, and phased re-opening, with the loss of teaching and learning time. This literature review thus considers Covid-19's impact on SCM in basic health, sanitation and hygiene.

2.2 The Nature of Supply Chain Management (SCM)

According to Lima-Junior and Carpinetti (2020:1), supply chain management (SCM) is crucial for any organisation that aspires to profitability and overall growth. Lima-Junior and Carpinetti (2020:1) add that it plays a key role in establishing and maintaining partnerships with suppliers and customers to improve products and processes. Wright (2016) argues that not only does SCM improve products and processes; it also aims to maximise value in the supply chain and thus enhances organisations' competitiveness via improved effectiveness and efficiency. Janvier-James (2012) highlights the need for competitive advantage in a globalised market amidst changing customer demands. Lima-Junior and Carpinetti (2020:1) note that effective SCM enables "reduction of inventory, improvement on the use of resource and a greater customer satisfaction". This section considers the various definitions of SCM in order to assess the challenges affecting efficient and effective sanitation operations in high schools.

2.2.1 Defining Supply Chain Management

The literature offers several definitions of the concept of SCM (Lima-Junior and Carpinetti, 2020:1). Weyers (2017:18) defines SCM as "the management of information, processes, goods,

and funds from the earliest supplier to the ultimate customer including disposal". Du Toit and Vlok (2014) describe the "supply chain as the network of organisations that are involved through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate customer". Ivanov (2020) notes that supply chains are the "backbone of economies and society, and largely interact with nature". For Felea and Albastroiu (2013:77), a supply chain comprises "life cycle processes comprising physical, information, financial, and knowledge flows whose purpose is to satisfy end-user requirements with products and services from multiple linked suppliers". The authors add that its "processes … cover a broad range of activities including sourcing, manufacturing, transporting, and selling physical products and services" (Felea and Albastroiu, 2013). Du Toit and Vlok (2014) produced material on SCM to enable up-and-coming researchers to gain knowledge and understanding of this field. Croxton, Garcia-Dastugue, Lambert and Rogers (2001:13) developed a framework to provide SCM instructors with useful material for their courses, presenting opportunities for further development of the field, and Janvier-James, (2012) proposed definitions of supply chains and SCM as well as theoretical, practical and measurement analysis.

Table 2.1: Different views on supply chain management

Authors	Views
Du Toit and Vlok (2013)	View a supply chain as a "network of organisations that are involved through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate customer".
Ivanov (2020)	Regard a supply chain as the "backbone of economies and society, and largely interact with nature".
Lima-Junior and Carpinetti (2020)	Describe supply chains as a critical subject for any organisation seeking global growth and profitability and note that they play a key role in establishing and maintaining partnerships with suppliers and customers and working together to improve products and processes.
Wright (2016)	Asserts that a supply chain not only improves products and processes, but also aims to maximise "value in the supply chain and allow a company to compete via enhanced effectiveness and efficiency".
Janvier-James (2012)	Notes that supply chains are important in improving an organisation's competitiveness in the global marketplace and in responding to changing customer demands,

Source: Compiled by the researcher from the literature review

Du Toit and Vlok (2014) suggest that, despite the multiple definitions of the term SCM, it has not been well defined. They "identify this lack of coherence as one of the issues faced by anyone studying the topic of SCM" (Du Toit and Vlok, 2014).

2.2.2 Supply Chain Integration (SCI)

The previous section reviewed different definitions of SCM. This section discusses supply chain integration (SCI) which in the researcher's view is integrally connected to SCM. This is an important concept in this research which aimed to develop an SCI system that will assist high schools in confronting basic health sanitation challenges. Like SCM, there are many definitions of SCI. Some scholars associate it with a firm's performance (Mostert et al., 2017;1-16; Kumar et al., 2017:2; Subburaj et al., 2020:231). "Over the years, manufacturing firms have focused on developing strategies that would bring about the much desired level of change and operational performance in the organisation" (Kumar, Chibuzo, Garza-Reyes, Kumari, Rocha-Lona, and Lopez-Torres, 2017:2). Mostert et al. (2017:4-16) "found several factors that significantly influence the relationship between SC partners, and ultimately concluded that high levels of relational intensity and interdependence in relationships are vital to effective integration". Kumar et al. (2017:2) observe that formulating "strategies along with integrating internal functions, suppliers and customers in a business relationship is the proper model for achieving competitive advantage". Many firms have adopted SCI to improve firm performance through closer relationships along the supply chain (Kumar et al., 2017:2).

Subburaj, Sriram and Mehrolia (2020:231) state that, "SCI is about cooperation, collaboration and coordination among various players of the supply chain, which upgrades an organisation's performance." Mostert, Niemand and Koetze (2017:1-16) regard it as a "concept that focuses on achieving the improved synchronisation of processes and the enhanced exchange of high-quality information throughout the supply chain (SC), in order to improve both SC and operational performance". Supply chain integration refers to the integration of an organisation's activities and those of its customers, suppliers and other supply chain members (Sundram, Chandran and Bhatti, 2016:1448). According to Mostert et al. (2017:3-16), "SCI improves the efficiency and flexibility of logistics processes, the quality of outputs, and the visibility and quality of information throughout the firm".

However, Wright (2016) argues that SCI does not always improve performance, and that further research that employs improved methodologies is required on this concept. Mostert et al. (2017) take a different view and maintain that SCI enhances customer service levels, and reduces redundancies and operational costs. Pakurar, Haddad, Popp, Khan and Ola (2019:131) note that, "the intention of supply chain management is to eliminate communication barriers and remove redundancies throughout coordinating, monitoring and controlling processes in the organization." Finally, Sundram et al. 2016:1448) observe that although SCI is mainly associated with a firm's performance, it also "links a firm with its customers, suppliers and other channel members by integrating their relationships, activities, functions, processes and locations".

Sundram et al., (2016:1448) examined the benefits of and barriers to SCI optimisation in relation to two stages of SCI, namely, internal and external integration. Sundram et al. (2016) maintain that "Internal integration establishes close relationships between functions such as shipping and inventory or procuring and raw material management", while "external integration has two directions: forward integration for physical flow of deliveries between suppliers, manufacturers, and customers and backward coordination of information technologies and the flow of data from customers, to manufacturers, to suppliers" (Sundram et al., 2016). Together, they lead to improved performance and profitability and enable firms to leverage strategic relationships (Kumar et al., 2017:3). However, Mostert et al. (2017:4-16) state that a "lack of cooperation and alignment between business functions, and an absence of top managerial support stifle internal collaboration". They add that "inadequate internal integration management and functional silos in businesses are barriers to internal SCI" (Mostert et al., 2017:4-16). In the same vein, Kumar et al. (2017:3) remark that some "firms have faced major challenges in integrating their supply chains internally and with other supply chain partners, the barriers can actually be a major driver to improve performance as it tries to solve the challenges encountered in business environment by enhancing its linkages internally and externally".

2.3 Theoretical Framework

Sekaran (2003:97) states that the theoretical framework "is the foundation on which the entire research project is based". It is a "logically developed, network of association among the variables deemed relevant to a situation and identified through processes of observations, literature survey and interviews" (Sekaran, 2003). This study adopted the SCOR model as its theoretical framework. In order to shed light on the need to model supply chain sanitation challenges (Weyers, 2017), this section begins by tracing the history of the model.

The SCOR model was "developed by the Supply Chain Council (SCC) in 1996 and known as an independent, non-profit corporation" (Supply Chain Council, 2012). According to Zhou, Benton, Schilling and Milligan (2011:332), "its focus is mainly on the supply chain management function from an operational process perspective and includes customer interactions, physical transactions, and market interactions". Lima-Junior and Carpinetti (2020:4) suggest that its practice is "a unique way of configuration of a process or activity and categorises the practices as emerging, best practices, standard practices and declining practices". Edwards (2018:60-221) notes that the SCC "merged with APICS (formerly known as the American Production and Inventory Control Society) in 2014". Companies such as Intel were among the first to adopt the SCOR model (Zhou et al., 2011:332). The SCC, which has 69 voluntary member companies (Supply Chain Council, 2012), aims to "develop a standard supply chain process reference model enabling effective communication among the supply chain partners by using standard terminology to better communicate and learn the supply chain issues and use standard metrics to compare and measure their performances" (Supply Chain Council, 2012). "The SCOR model was proposed by the Supply Chain Council in order to link business processes, best practices, performance metrics, people, and technology into a unified structure" (Lima-Junior and Carpinetti, 2020:4).

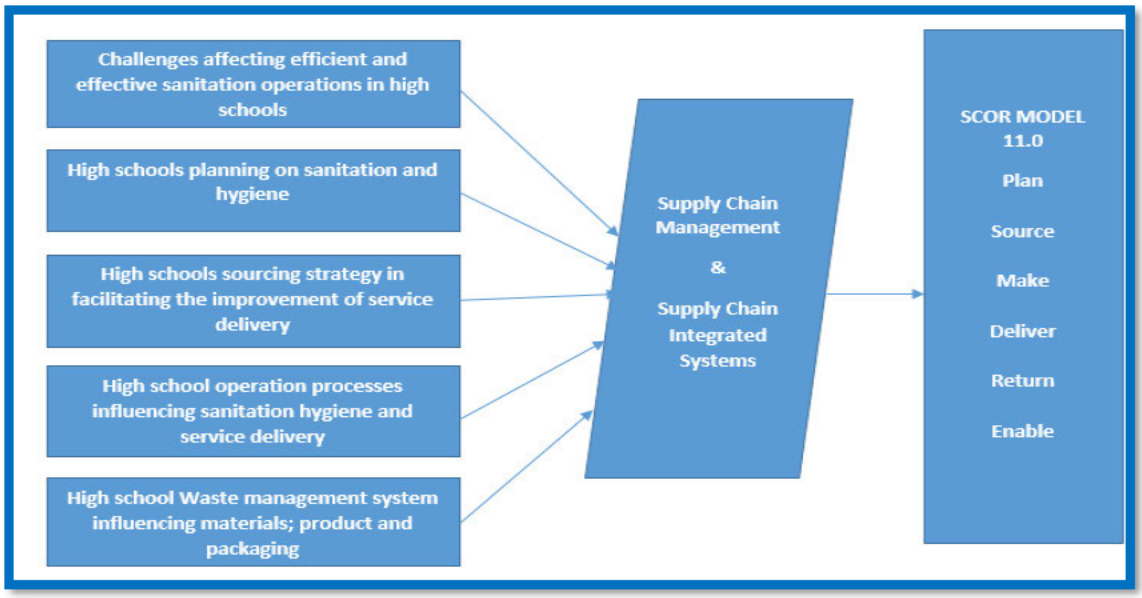
2.3.1 SCOR Containment

Numerous studies have focused on the SCOR model. According to Weyers (2017:55), it "integrates the well-known concepts of business process re-engineering, benchmarking and process measurement into a cross-functional framework which contains a standard descriptions of management processes; a framework of relationships among the standard processes; standard metrics to measure process performance; and management practices that produces best in-class-

performance". Lima-Junior and Carpinetti (2020:4) note that, the "SCOR model allows describing the way the processes interact along a supply chain and how they are set from a supplier's supplier to a customer's customer, which enables practitioners to identify the features that contribute to client satisfaction".

Kusrini, Rifai and Miranda (2019:2) describe the model as powerful tool for "evaluating, communicate supply chain management when taking a decision within the company, supplier, and customers". The authors add that it promotes SCM decision making (Kusrini et al., 2019:2). Weyers (2017:55) notes that "after modelling supply chain, the reference model gives the users of the model access to best practices and metrics aimed at quickly analysing and improving the supply chain."

Figure 2.1: Theoretical Framework



Source: Researcher – Adapted from the SCOR model in relation to the study's objectives

The theoretical framework above illustrates how the study's objectives were linked to the SCOR model as well as overall SCI. The study aimed to examine and establish the challenges affecting efficient and effective supply chain sanitation operations in high schools. These challenges were then modelled using SCOR and integrated through supply chain management to develop a framework.

2.4 Sanitation and Hygiene at high school level

This section discusses the sanitation challenges faced by schools and how some of these prevent learners from attending school, especially girls when they are menstruating. The concept of WASH is deployed to shed light on these challenges. Sibaya and Gumbo (2013:2283) state that "although sanitation delivery in South Africa has increased sharply, the knowledge, attitude and practices remain as major challenges facing our communities at large". They add that, the fact that infrastructure is in place, does not mean that people will utilise it the way it should be used at all times (Sibaya and Gumbo, 2013:2283). The Covid-19 pandemic poses new challenges to schools' basic health sanitation that are discussed in the following section. Table 2.2 below sets out different scholars' views on WASH.

Table 2.2: Perspectives on Water, Sanitation and Hygiene (WASH)

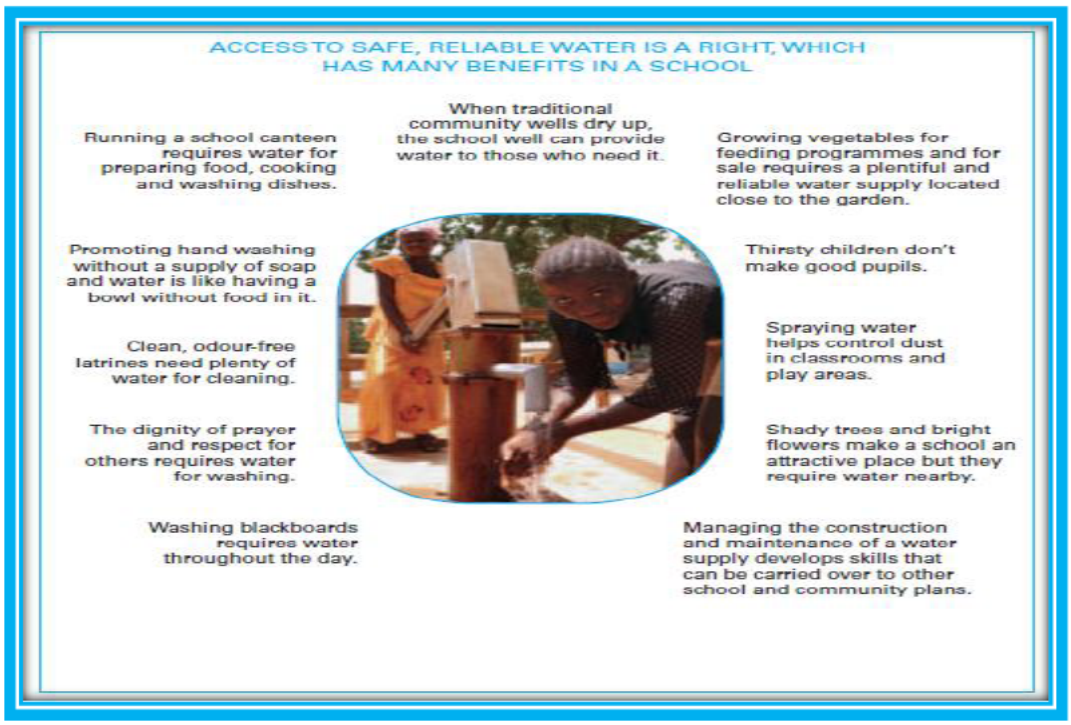
Authors	Perspectives on WASH
Department of Water and Sanitation (2016)	Notes that South Africa's "National Water Act (No. 36 of 1998) [aims] … to provide for fundamental reform of the law relating to water resources; to repeal certain laws and to provide other water resource matters in the country".
World Health Organisation (2012:1)	Defines positive WASH as "providing schools with safe drinking water, improved sanitation facilities and hygiene education that encourages the development of healthy behaviour for life".
Sumera (2020:50)	Examines "water and sanitation services as a requirement in schools. If these are not available … children are often exposed to unhygienic conditions that can make them sick and prevent them from attending school".
Nahar and Ahmed (2006:2)	Found that provision of hygiene and water and sanitation facilities resulted in increased school attendance among girls.
Ejelonu, Feng and Mckeon (2020:17)	Demonstrate that when a community has inadequate wastewater management and poor access to clean drinking water, sanitation deteriorates; and that education results in improved hygiene and sanitation.
Adams et al. (2009:14)	State that "children learn some of their most important hygiene skills at school, and for many this is where … they are introduced to hygiene practices that may not be promoted or possible in the home".
Taylor et al. (2020:9)	Proposed that schools and government work together to "look beyond taps and toilets and consider complete water supply and sanitation system needs for delivering water to users, and removing and safely disposing of, or reusing, excreta and wastewater".

Source: Compiled by the researcher from the literature review

2.4.1 Water: Water is one of the main sources of life, and everyone has the right to have access to sufficient water. According to the Department of Water and Sanitation (2016), "the Water Services Act was followed by the introduction of the National Water Act (No. 36 of 1998), which has the purpose to provide for fundamental reform of the law relating to water resources; to repeal certain laws and to provide other water resource matters in the country". The National Water Act regulates South Africa's water resources (Department of Water Sanitation, 2016). The World Health Organisation (2006) emphasises that, "safe drinking water, sanitation and good hygiene are fundamental to health, survival, growth and development".

World Health Organisation, (2012:1) adds that "one way of achieving positive WASH is by providing schools with safe drinking water, improved sanitation facilities and hygiene education that encourages the development of healthy behaviour for life". Dery, Bisung, Dickin and Dyer (2020:5) maintain that insufficient "access to water has impacts on public health and the mental, physical, and spiritual well-being of individuals and households". Not only households, but schools must have access to sufficient treated, safely stored drinking water for the school community. However, Tayler and Maruyama (2020:3) observe that rural schools lack ready access to water, rendering it difficult to plan affordable WASH schemes. Snel, Ganguly and Shordt (2002) comment that "schools' focus on sanitation stems from the fact that children have a right to basic facilities such as school toilets, safe drinking water, clean surroundings and information on hygiene" and that if these facilities are available, "children come to school and enjoy learning." Figure 2.2 below illustrates the benefits of access to a safe, reliable water supply in schools.

Figure 2.2: An integrated approach to WASH in schools



Source: Mooijman (2012)

2.4.2 Sanitation: According to Sumera (2020:50), "Water and sanitation services are a requirement in schools. If these are not available children are often exposed to unhygienic conditions that can make them sick and prevent them from attending school". Adams, Bartram, Chartier and Sims (2009:5) observe that, "high schools particularly in rural areas are often the most affected due to lack of sanitation facilities or have facilities that are inadequate in both quality and quantity". To achieve effective sanitation, schools require safe drinking water, quality sanitation facilities and education on hygiene to healthy behaviour for life (Mooijman, 2012:1). Reed and Show (2008:3) argue that the "lack of adequate sanitation is the major reason why many children, particularly girls, fail to attend school". Nahar and Ahmed (2006:2) add that 30% of girls stay away from school when they are menstruating, while the Department of Health notes that this phenomenon is particularly evident in disadvantaged communities or those that lack access to resources (Department of Health, 2017:21). Nahar and Ahmed (2006:2) highlight that evidence shows that girls' attendance increases when hygiene, and water and sanitation facilities are available through WASH related awareness, and teachers establishing sanitation clubs at school (Javeed 2020:51). Ejelonu, Feng and Mckeon (2020:17) state that sanitation can deteriorate when a community has inadequate wastewater management and poor access to clean drinking water.

Table 2.3: Norms and standards for school sanitation infrastructure

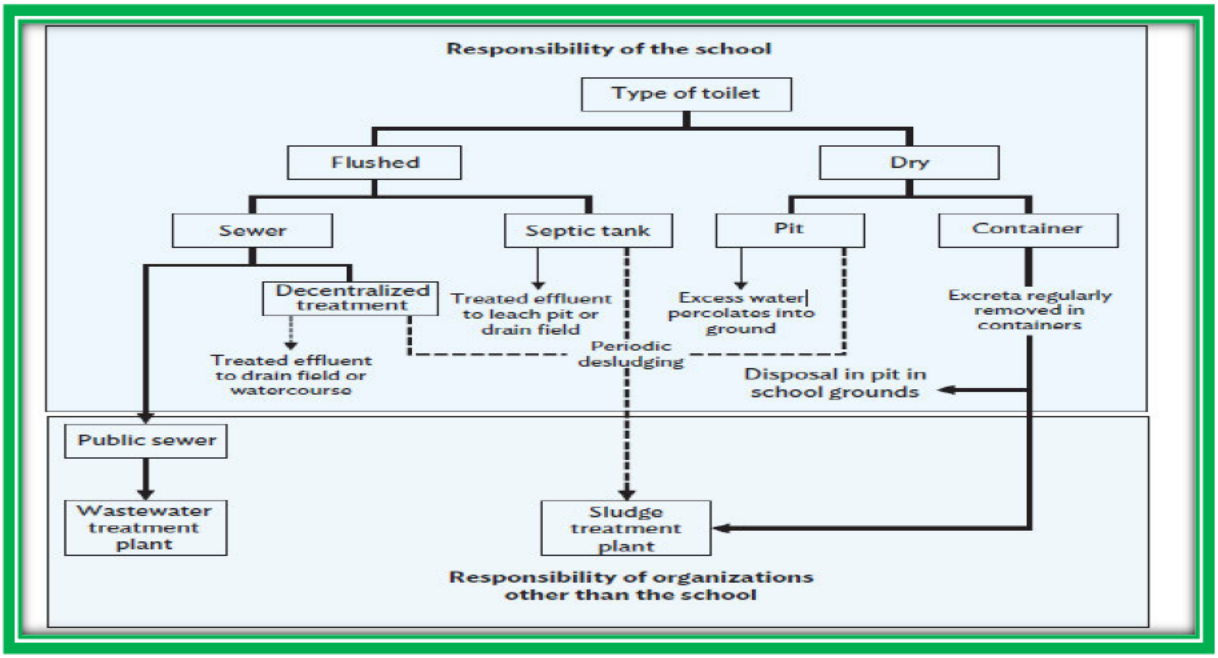
	Requirements	Acceptable options
Water (supply)	Schools must have sufficient water of good quality which complies with drinking water standards for drinking, personal hygiene and food preparation Availability of water at all times with convenient access	Municipal reticulation network Rainwater harvesting Mobile tankers Boreholes Local reservoirs and dams
Sanitation facility	All schools must have sufficient sanitation facilities They must be: Easily accessible Provide privacy and security Promote health and hygiene Comply with all relevant laws Be maintained in good working order Provide separate facilities for teachers, girls and boys	Water borne sanitation Small bore sewer reticulation Septic or Conservancy tank system Ventilated Improved Pit latrines (VIPs) compositing toilets NB: Unimproved pit latrines and bucket latrines are not acceptable

Source: Louton et al. (2015)

The Department of Education (2019:117) and the President of South Africa Mr Cyril Ramaphosa launched the Sanitation Appropriate for Education (SAFE) campaign that harnesses donations from the private sector to provide learners with adequate sanitation. UNICEF, Anglo American, Unilever and the Nelson Mandela Foundation are amongst the institutions that support this campaign (Department of Education, 2019:117). According to Amadi, Yakubi, Iro, Azuamah and Ukah (2020:413), schools should adopt "norms and standards for the school sanitation infrastructure'. Amadi et al. (2020:2140 add that a lack of proper sanitation is one of the factors that cause absenteeism and school dropout, while improved sanitation enhances learning and increases school attendance, particularly among girls.

"Although safe sanitation systems start from well-designed, appropriate toilet facilities, provision must be included for the removal, transport, treatment, and reuse or disposal of excreta" (Taylor and Maruyama, 2020:27). Figure 2.3 below sets out options for containment, removal, and treatment of excreta and wastewater, distinguishing between different types of toilets. "Solid connectors indicate activities that occur continuously or at short intervals, typically less than a week. Connectors shown with dashed lines indicate activities that are required at infrequent intervals" (Taylor et al., 2020:27).

Figure 2.3: Overview of sanitation options



Source: Taylor et al. (2020)

According to Taylor et al. (2020:9), a "school water supply system may become nonoperational if the design of WASH facilities focuses only on water outlets, in the form of taps and connections to toilet boilers, without attention to the systems required to deliver water to those outlets." Taylor et al. (2020:9) propose that schools and the government work together to "look beyond taps and toilets and consider complete water supply and sanitation system needs for delivering water to users, and removing and safely disposing of, or reusing, excreta and wastewater".

2.4.3 Hygiene: According to Snel et al. (2002:48), "hygiene also means using enough water". The Department of Health (2017) notes that, washing hands, particularly with soap at appropriate times, can reduce diarrheal diseases by 35% to 45%, and respiratory infections by 23%. Many studies in the field of hygiene highlight the importance of hygiene education. The Department of Health's (2017:13) National Hand Hygiene Behaviour Change Strategy 2016-2017 notes that, "one of the seven priority bottlenecks identified for South Africa is that education is the key driver". Snel et al. (2002:18) add that "school sanitation and hygiene education depend on a process of capacity; enhancement of teachers; education administrators and community members".

Adams et al. (2009:14) assert that most children acquire knowledge and learn about the importance 2tof sanitation and hygiene skills more quickly at school than at home. Ejelonu et al. (2020) emphasise the importance of hygiene education at schools through better sanitation. However, Nahar and Ahmed (2006:2) observe that most hygiene education packages exclude menstrual hygiene.

Table 2.4: Essential steps in managing WASH standards in schools at the national, district and local levels

Step	National level	District level	Local levels (School and Community)
1	Review existing national policies and ensure a national policy framework supportive of improved conditions in schools.	Raise awareness of water, sanitation and hygiene in schools among key stakeholders at the district level.	**Mobilise support from teachers, schoolchildren, families and other local stakeholders to achieve and sustain a healthy school environment.**
2	Ensure that appropriate national bodies exist for setting and monitoring standards.	Ensure that an appropriate body or service exists at the district level for overseeing compliance with standards. Try to incorporate all entities and organizations working in the district on WASH in Schools.	**Create an appropriate body to oversee the implementation of standards in the school.**
3	Review national standards and add to them if needed. Establish an effective regulatory framework that encourages and supports compliance.	Ensure that district-level guidance and support for compliance reflects the national regulatory framework. Use appropriate guidelines where standards do not exist.	**Define a set of targets, policies and procedures for implementing national standards and/or guidelines in a way that reflects local conditions. Define how targets, policies and procedures will be applied.**
4	Provide expertise and resources for assessment and planning at the national level.	Provide expertise and resources for assessment and planning at the district level.	**Assess existing conditions; consult local stakeholders including staff and local community; and plan improvements and new developments.**
5		Provide locally-appropriate plans and specialist input for new structures and improvements to existing structures.	**Plan improvements or new developments required, with specialist technical input if necessary.**
6	Promote, provide and/or facilitate funding for national programmes.	Advocate for the allocation of funding for planned improvements and new developments.	**Guarantee funding for planned improvements and new developments.**
7	Monitor developments at the national level and promote consistent application of standards in all districts.	Ensure oversight of improvements and new developments to confirm the consistent application of appropriate standards	**Oversee implementation of planned improvements and new developments.**

		in all schools.	
8	Ensure that water, sanitation and hygiene components are adequately reflected in the education management information system (EMIS) at the national level.	Monitor ongoing conditions in all schools and promote remedial action where required.	**Monitor ongoing conditions and ensure remedial action where required.**
9	**Provide training and information materials appropriate to a range of school settings. Ensure appropriate curriculum for training.**	**Provide appropriate training and information to teachers, school directors and extension agents.**	**Provide advice and training to staff, schoolchildren and parents.**

Source: Mooijman (2012)

According to Sibaya and Gumbo (2013:2283), UNICEF has made material on school sanitation and hygiene available to encourage learners to become active agents in school communities.

2.4.4 Operations and Maintenance: Sullivan, Pugh, Melendez and Hunt (2010:2.1) define operations and maintenance (O&M) as the "decisions and actions regarding the control and upkeep of property and equipment". Mungani and Visser (2013:4) define maintenance as "a collection of actions executed on an asset with the aim of retaining an asset in, or restoring it to, a specified condition".

Figure 2.4: Key Elements of Operations and Maintenance (O & M)

Source: Louton et al. (2015)

UNICEF (2011:3) highlights the importance of maintenance of water and sanitation facilities, noting that, "badly maintained sanitation facilities often cause an even bigger health risk". Many public South African schools confront challenges in this regard (UNICEF, 2011). Planning and budgeting are important in maintaining a safe and healthy environment for learners (UNICEF, 2011). The types of maintenance include predictive; preventative and reactive measures. According to Seyr and Mukulus (2019:11), preventative maintenance is "planned ahead before the occurrence of a fault or failure". This "can return a (degrading) component to an 'as-good-as-new' state or lower the degradation by a fixed amount; hence it is planned to be conducted in a fixed time interval" (Seyr and Mukulus, 2019:11). Table 2.5 below illustrates the different types of maintenance.

Table 2.5: Types of Maintenance

TYPES OF MAINTENANCE	
PLANNED MAINTENANCE (PREVENTATIVE)	
Statutory Maintenance:	**This refers to continuous/regular maintenance that must occur for upkeep of infrastructure.**
Preventative Maintenance:	**This refers to the implementation of processes such as inspections to detect and prevent deterioration of infrastructure.**
Scheduled Maintenance:	**This is another form of preventative maintenance where maintenance is scheduled, usually as prescribed by the manufacturer of the asset.**
Condition-based Maintenance:	**This refers to the restoration of an asset that has significantly deteriorated to its required condition.**
Backlog Maintenance:	**Refers to maintenance that should have been carried out but has been postponed or cancelled due to factors such as lack of funding.**
UNPLANNED MAINTENANCE (REACTIVE)	
Breakdown Maintenance:	**This refers to unplanned and reactive maintenance necessitated by unforeseen events. Normal breakdowns are to be addressed within 5 working days. Breakdowns that severely impact operations, such as a blocked sewage pipe, are seen as emergency breakdowns and must be attended to within a day. Fatal breakdowns, which pose a threat to surrounding assets, could result in the loss of a resource and/or pose a danger to the lives of people, should be attended to within 3 hours. Burst water pipes or exposed electrical wiring systems are examples of fatal breakdowns.**
Incident maintenance:	**This type of maintenance is necessitated by damage to infrastructure due to incidents such as a natural disaster, vandalism, forced entry or acts of violence. The degree of damage determines the timeframe within which it must be addressed.**
OTHER MAINTENANCE	
Replacement:	**This type of maintenance involves demolishing an old asset and replacing it with a new asset that has similar functionality.**
Repairs:	**These are repair projects aimed at renewing, replacing or mending old or damaged parts. The Department distinguishes between minor repairs (<R500 000) and major repairs (>500 000).**
Other types of maintenance also include rehabilitation, renovation and minor new works.	

Source: Equal Education (2018)

According to Equal Education (2018:48), a balance should be struck between planned and unplanned maintenance. The former is proactive and can thus be scheduled in advance, while the latter is more reactive and responds to unforeseen events. Furthermore, maintenance plans should be updated annually and approved by the SGB and should include weekly, monthly, and annual inspection checklists aimed at ensuring that preventative maintenance takes place (Equal Education, 2018:49).

2.5 Coronavirus – Covid-19

This section covers WASH and SCM in light of the Covid-19 pandemic.

According to Toquero (2020:1), few studies "have been done so far in relation to Covid-19 from the medical field and other fields related to health sciences". Toquero (2020:1) adds that, "insufficient research has been conducted in relation to how Covid-19 affected the educational system".

2.5.1 Definition of the Coronavirus (Covid-19)

According to Toquero (2020:1), Covid-19, which emerged in Wuhan, China in 2019 (Toquero, 2020:1; Zar, Dawa, Fischer and Rodriguez, 2020:2; Manderson and Levine, 2020:368), refers to "coronavirus infection … (also) referred to as the 2019 novel coronavirus or '2019-nCoV' … (that) is linked to Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV)" which can be fatal. The World Health Organisation and the United Nations Children's Fund (2020) note that it is highly infectious, while Rowan and Laffey (2020:1) describe Covid-19 as a "highly infectious agent that causes fatal respiratory illnesses, which is of great global public health concern". At the time this study was conducted, vaccination programmes were being rolled out across the world, including South Africa. The table below shows Covid-19 infections across the African continent as at July 2020.

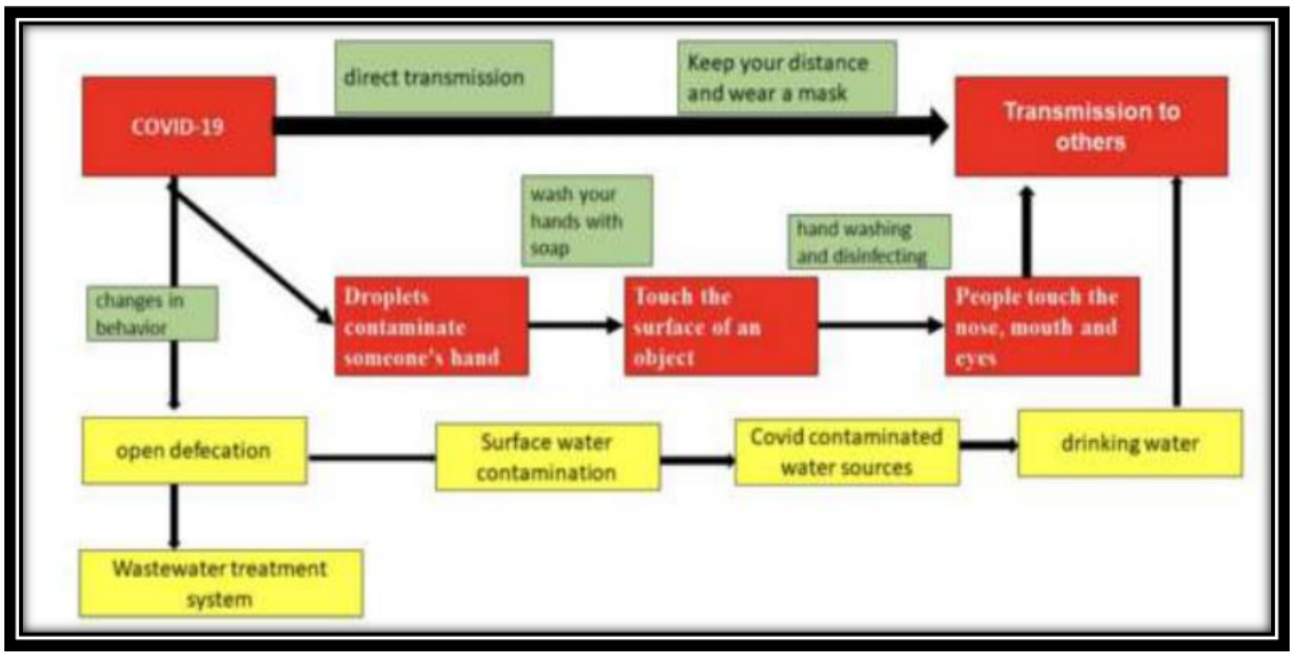
Table 2.6: Covid-19 cases and deaths top 10 as at July 2020

Reporting Country/Territory/Area	Total confirmed* cases	Total confirmed* new cases	Total deaths	Total new deaths
Africa				
South Africa	364 328	13 449	5 033	**85**
Nigeria	36 663	556	789	**11**
Ghana	27 667	607	148	**3**
Algeria	23 084	535	1 078	**10**
Cameroon	16 157	0	373	**0**
Côte d'Ivoire	14 119	423	92	**5**
Kenya	13 353	603	234	**9**
Ethiopia	10 207	704	170	**3**
Senegal	8 810	141	167	**4**
Democratic Republic of the Congo	**8 402**	**153**	**193**	**1**

Source: World Health Organisation (2020)

The World Health Organisation and United Nations Children's Fund (2020), state that "people who contact this virus most of the time will experience mild to moderate symptoms and recover without special treatment". It is transmitted by droplets generated when an infected person coughs or sneezes close to another person or when a person touches a contaminated surface and then touches their face (World Health Organisation and United Nations Children's Fund 2020). Zar et al. (2020:3) note that, "public health interventions including hand hygiene, social distancing, universal wearing of masks, identification and isolation of infected people and tracing of contacts are effective to contain transmission and mitigate the epidemic".

Figure 2.5: Covid-19 transmission patterns related to hygiene and sanitation



Source: Purnama, and Susanna (2020)

2.5.2 Water, Sanitation and Hygiene in light of Covid-19

The National Business Initiative (2020) states that "WASH compliance means access to clean water and appropriate sanitation, as well the ability to implement proper cleaning and disinfection measures". It adds that that "South Africa's inadequate water infrastructure means that for many of the country's most vulnerable citizens, these measures for preventing contagion are unavailable" (National Business Initiative, 2020). The on-going Covid-19 pandemic places learners and teachers in many schools in a vulnerable situation. According to Toquero (2020:1), Covid-19 had "affected higher educational institutions not just in Wuhan, China where the virus originated but all educational institutions in 188 countries as of April 06, 2020". The same is true of the basic education sector. Curtis, Dreibelbis, Sidibe, Cardosi, Sara, Bonell, Mwambuli, Moulik, White and Aunger (2020) state that "safely managed water, sanitation, and hygiene (WASH) services are an essential part of preventing and protecting human health during infectious disease outbreaks, including the current Covid-19 pandemic". Zar et al. (2020:4) observe that "re-opening of schools in the context of Covid-19 is complex and only half of schools globally have access to water and soap for hand washing". Overcrowding, which is mainly experienced in public schools, may enhance disease transmission (Zar et al., 2020:4). Curtis et al. (2020) assert that, "good WASH and waste management practices, that are consistently applied, serve as barriers to human-to

human transmission of the Covid-19 virus in homes, communities, health care facilities, schools, and other public spaces".

According to Corburn, Vlahov, Mberu, Riley, Caiaffa, Rashid, Ko, Patel, Jukur, Martínez-Herrera, Jayasinghe, Agarwal, Nguendo-Yongsi, Weru, Ouma, Edmundo, Oni and Ayad (2020), schools, service providers, and other stakeholders must be engaged and supported during a coordinated Covid-19 response. Many South African schools provide essential nutrition to learners and closing those institutions may deny them their only consistent meals (Corburn et al., (2020). Furthermore, Zar et al. (2020:4) observe that "closure of schools (is) directly affecting child learning, child mental health and the ability of parents to work". With regard to re- opening schools, Zar et al. (2020:4) indicate that "investments to improve basic sanitation facilities, use of masks, environmental controls, operational changes (such as smaller classroom sizes, social distancing in classes), screening of staff and students for symptoms and exclusion of high-risk staff from the workplace will be required".

2.5.3 Supply Chain Sanitation and Personal Protective Equipment (PPE) – Covid-19

One of this study's objectives was to examine the challenges affecting efficient and effective supply chain sanitation operations in high schools. It is important to discuss how Covid-19 will impact SCM in schools. According to Ivanov (2020), "Supply chains (SC) are a backbone of economies and society, and largely interact with nature". Ivanov (2020) adds that "interactions in these SC ecosystems are very complex and triggered by mutual interrelations and feedbacks between SCs, nature, society, and the economy". Du Toit and Volk (2014) note that SC processes involve "physical information, financial and knowledge flows whose purpose is to satisfy the end user requirements with products and services from multiple linked suppliers".

According to Ivanov (2020), SCs "experienced an unprecedented series of shocks caused by the Covid-19 virus outbreak and global pandemic, with significant negatively effects on the society", but also on the efficiency of operations and SCM (Queiroz, Ivanov, Dolgui and Wamba, 2020). The table below sets out the SC categories and components that need to be considered to build resilience during the Covid-19 pandemic

Table 2.7: Supply Chain Categories and Components

Category	Components
Systems	Structures, resources, capacities, interactions (response, coordination)
Process	Distribution, transportation, procurement, production, resource allocation, flexibility
Control	Inventory control, sourcing control, manufacturing control, resilience as KPI in optimisation models
Recovery	Manufacturing production, human labour, transportation network, suppliers, production flexibility

Source: Queiroz et al. (2020)

According to Ivanov (2020), "for some SCs, demand has drastically increased and supply was not able to cope with that situation (e.g., face masks, hand sanitizer, disinfecting spray)". Ranney, Griffeth and Jha (2020:2) note that, before the Covid-19 pandemic, "China produced almost half the world's face masks". However, as the infection spread across China, its exports came to a halt (Ranney et al., 2020:2). These caused the entire world to face shortages of PPE and sanitation supplies. Rowan and Laffey (2020:1) point to worldwide "concern regarding the shortage in supply chain of critical personal and protective equipment (PPE)". Wiley and Sons (2020:1) comment that, "The failures that we are facing underline the need to increase the focus on supply chain issues" (Wiley and Sons, 2020:1). Hollander and Carr (2020) note that Covid-19 has caused disruptions to supply chains and stock markets. Leroux and Dramowski (2020) observe that in South Africa, "where the Covid 19 epidemic is still developing, healthcare facilities have a short window of opportunity to improve PPE supply chains, train staff on prudent PPE use, and devise plans to track and manage the inevitable increases in PPE demand". Ketchen Jr. and Craighead (2020:5) maintain that "challenges became magnified during the Covid-19 pandemic because stay-at home orders forced large and small firms alike to rely more heavily on online distribution". For Ivanov (2020), the "Covid-19 pandemic shows that in cases of extraordinary events, SC resistance to disruption … must be considered at the scale of survivability or viability to avoid SC and market collapses and secure the provision of goods and services".

Table 2.8: Views on Supply chain sanitation and PPE challenges in light of Covid-19

Authors	Views on SC Sanitation and PPE in light of Covid-19
Toquero (2020:1)	Refers to Covid-19 as the 2019 novel coronavirus or '2019-nCoV' which "is linked to Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV)" that can be fatal.
Rowan and Laffey (2020:1)	Describe Covid 19 as a "highly infectious agent that causes fatal respiratory illnesses, which is of great global public health concern".
Toquero (2020:1); Zar, Dawa, Fischer and Rodriguez (2020:2); Manderson and Levine (2020:368)	Note that Covid-19 emerged in Wuhan, China in 2019.
Ivanov (2020)	Shows that supply chains' "demand has drastically increased and supply was not able to cope with that situation (e.g., face masks, hand sanitizer, disinfecting spray)".
Leroux and Dramowski (2020)	Indicate that the "current pandemic has challenged PPE supply chains globally and necessitated rapid review of the scientific evidence for PPE use and re-use".
Wiley and Sons (2020)	Demonstrate that factory "shutdowns and bans on travel and PPE exports … have put significant strain on PPE supply chains."
Ranney et al. (2020)	State that, prior to the pandemic, "China produced approximately half the world's face masks. However, as the infection spread across China, their exports came to a halt which caused a major disruption on supply chain management".
Queiroz et al. (2020)	State that "SCs should provide an adequate flow of medicament and other products such as Sanitation and PPE to avoid materials shortage".

Source: Compiled by the researcher from the literature review

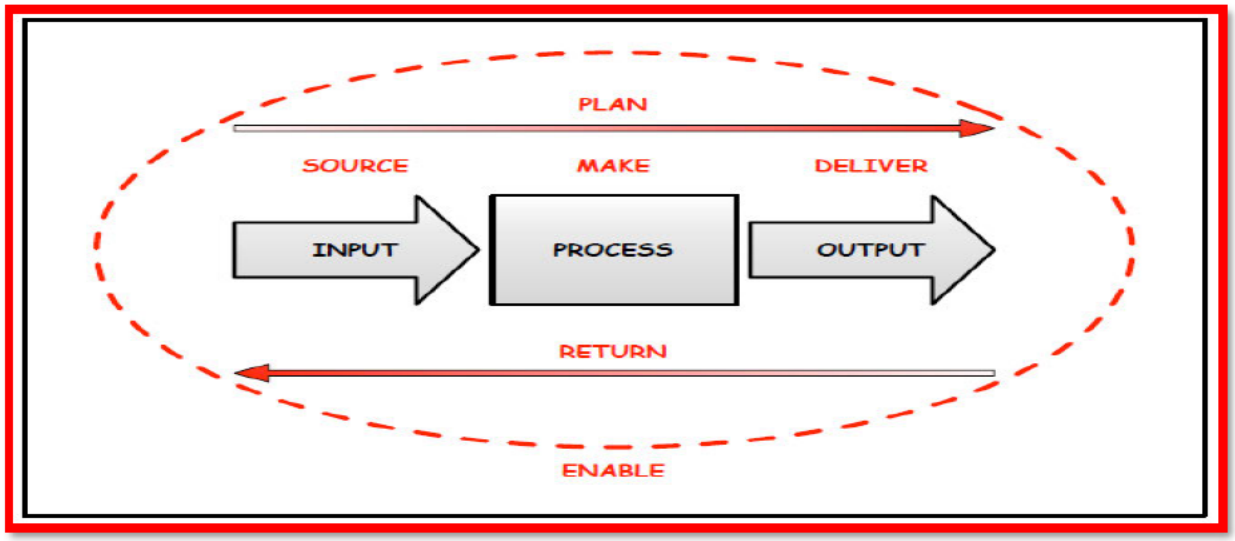
Leroux and Dramowski (2020), indicate that the "current pandemic has challenged PPE supply chains globally and necessitated rapid review of the scientific evidence for PPE use and re-use". The shortage of PPE has caused its re-use in Covid-19 critical care settings; this should be avoided due to the increased risk of infection (Leroux and Dramowski, 2020). Wiley and Sons (2020) note that the "most significant challenge (is) … to ensure that critical PPE products are sourced and allocated to frontline health workers and other responders in affected countries, especially those most vulnerable to the spread of the coronavirus. These PPE production items often requires imports of raw materials such as cotton fiber, polyester, and polyamide produced by different manufacturers around the world processed by protective clothing manufacturers for sale to end users" (Wiley and Sons, 2020). Factory shutdowns and bans on travel and PPE exports have put

significant pressure on PPE supply chains (Wiley and Sons, 2020). While several studies have focused on supply chain PPE challenges in the healthcare sector, there have been few on how these challenges play out in schools. This study hence examined the challenges affecting efficient and effective supply chain sanitation operations in high schools and evaluated how schools' sourcing strategy impacts service delivery.

2.6 Supply Chain Operation Reference (SCOR)

The SCOR model takes a process approach to modelling supply chain challenges. Its purpose is to define process architecture in a manner that aligns with key business functions and goals (Kusrini, Rifai, and Miranda, 2019:1). This section considers its six primary management processes in discussing how schools plan, source, make, deliver, return and enable in relation to sanitation and hygiene.

Figure 2.6: Illustration of the SCOR definitions overlaid on a simplified value creation chain



Source: Edwards (2018)

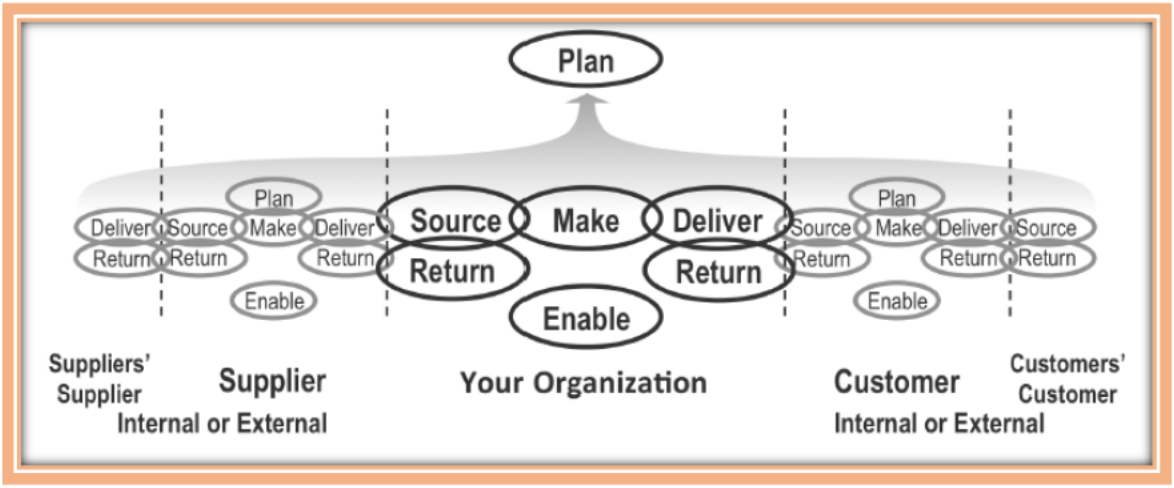
Kusrini, Rifai, and Miranda (2019:1) describe SCOR as the link to the overall "business process, performance metrics, practices, and people skills into the integrated structure" and as an effective model for SCM decision making. Zhou et al. (2011:332) note that its main focus is the "supply chain management function from an operational process perspective" and that it "includes customer interactions, physical transactions and market interactions". This study determined and

analysed the schools' operational processes in sanitation and hygiene. Edwards (2018:60) found that "SCOR can be used to determine accurately the changes that need to be made to strategy and processes within the supply chain, to achieve optimum performance and efficiencies". The Supply Chain Council (2012) confirms that "a performance attribute is a grouping of metrics used to express a strategy".

2.6.1 Six Primary Management Processes of SCOR

According to the Supply Chain Council (2012), "the processes section in SCOR provides a set of pre-defined descriptions for activities most companies perform to execute effectively their supply chains". According to Kusrini1, Rifai1, and Miranda (2019:2), the "scope of SCOR describes the business activities that can be linked to each other with all phases of satisfying customer demand".

Figure 2.7: Illustration of the SCOR Model and the Six Primary Management Processes



Source: Supply Chain Council (2012)

2.6.1.1 Plan: According to the Supply Chain Council (2012), "the plan process describes the activities associated with developing plans to operate the supply chain". Hence, this study posed the question: "how do high schools develop operations plans for their sanitation and hygiene?" Jeseviciute-Ufartience (2014:117) defines planning as one of an organisation's "management functions and the core function of organisation management". According to Edwards (2018:65), planning is "a macro view of all the supply resources to enable an understanding of the capacity needed to deliver a given product or service from the total supply chain system to the end

customer". This study modelled basic health sanitation and hygiene in high schools using the SCOR elements. Zhou et al. (2011:333) maintain that planning utilises information from external and internal operations to balance aggregate demand and supply. In terms of this model, Zhou et al. (2011:333) suggest that the capacity "to run 'simulated' full stream/demand balancing for 'what-if' scenarios is important for supply chain planning. There is not much said on the plan process and Covid-19 impact by researchers". SiJeseviciute-Ufartience (2014:117) points out that the planning process determines "the objectives of the organisation, examination of the environment and forecasting mostly changes and development of policies, procedures and necessary plans to help achieve the objectives in view of the changing environment". The Covid-19 pandemic represents a dramatically changing environment, suggesting the need to review, alter and develop policies, procedures and necessary plans. It requires schools to change or update their policies and procedures, including the number of learners in class rooms, sanitation policies and procedures, ensuring that hygiene PPE is available, etc.

2.6.1.2 Source: The source process describes ordering and receipt of goods and services (Supply Chain Council, 2012). According to Zhou et al. (2011:334), "sourcing practice connects manufacturers with suppliers and is critical for manufacturing firms". Building long-term, sustainable supplier-buyer relationships and decreasing the supplier base are sound sourcing practices (Zhou et al., 2011:334). Several research studies focus on strategic sourcing and Total Cost of Ownership (TCO). According to Ayoyi and Odungu (2015:2), "strategic sourcing involves taking a strategic approach to selection of suppliers, an approach that is more aligned with the organisation's competitive strategy". Miszczak (2014:8) defines TCO as "an estimate of total costs of goods, services or construction over the whole of their life. It is a combination of the purchase price plus all other costs incurred." Zhou et al. (2011:334) suggest that the key role of suppliers in a supply chain is assured through long-term sustainable relationships. There is a paucity of research on the source process and Covid-19's impact. The most recent studies focus on procurement or sourcing of PPE for health workers and other facilities such as schools. Sourcing PPE has been a challenge because of Covid-19's impact on SCM. According to Queiroz et al. (2020), SCs "worldwide have experienced an unprecedented series of shocks caused by the Covid-19 virus outbreak and global pandemic, with major negative effects on the society, but also on the efficiency of operations and supply chain management". Almost half of the world's face masks were

produced by China. However, as infections increased and spread quickly across their nation, Chinese exports came to a halt (Ranney et al., 2020:2). These PPE "items often require imports of raw materials such as cotton fiber, polyester, and polyamide produced by different manufacturers around the world processed by protective clothing manufacturers for sale to end users" (Wiley and Sons, 2020). Sourcing processes to procure goods and services for hygiene and sanitation to meet planned or actual demand end up not being met and put pressure on the entire system. Hence, this study posed the question: "to what extent does the supply chain sourcing strategy facilitate the continuous improvement of sanitation service delivery in high schools?"

2.6.1.3 Make: According to the Supply Chain Council (2012), "the make process describes the activities associated with the conversation of materials or creation of the content for services". Zhou et al. (2011:333) note that this process "includes the practices that efficiently transform raw materials into finished goods to meet supply chain demand in a timely manner". Edwards (2018:66) describes the make process as focused "on the value creation within all elements of the supply chain system". Edwards (2018:66) suggests that "this function include measures concerning the manufacturing process, testing of products, quality control, packaging, stock control and fulfilment". Many recent studies have examined PPE shortages during the Covid-19 pandemic as manufacturers struggle to obtain raw material, most of which is imported. Factory shutdowns and bans on travel and PPE exports have put significant strain on PPE supply chains (Wiley and Sons, 2020). Hence, this study posed the question: "How do agile operations management processes influence sanitation, hygiene and service delivery in high schools?"

***2*.6.1.4 Deliver:** According to the Supply Chain Council (2012), "delivery processes describe the activities associated with the creation, maintenance and order fulfillment of customer orders". In similar vein, Edwards (2018:66) states that the "delivery process considers if the finished products (i.e. output of the supply chain system**)** have been transported and distributed to the right end customer". According to Kusrini et al. (2019:5) delivery, "means that supplier always delivers with the right quantity, and never run out of stock. Good communication is key to this process (Kusrini et al., 2019: 5). Rural areas often have poor roads and challenges may be experienced in delivering sanitation/PPE and hygiene products to schools on time and with the right quality, negatively impacting service delivery. Hence the study posed the question: "how do high schools' operations

processes influence sanitation, hygiene and service delivery?" Queiroz et al. (2020) suggest "that logistics and SCs play an essential role in coordinating and integrating the multiple members' activities including manufacturers, transportation, hospitals, government". In terms of Covid-19, the literature notes that SCs should ensure an adequate flow of medicaments and other products such sanitation and PPE to avoid materials shortages (Queiroz et al., 2020).

2.6.1.5 Return: The return process describes the activities associated with the reverse flow of goods. Mostert et al. (2017:2-16) state that "product returns represent an increasing significant responsibility for retailers, because of factors such as levels of product returns and return process complexity and regulations regarding the proper disposal of waste created by these returns". Edwards (2018:66) adds that this "process is primarily concerned with ongoing maintenance, warranty, lifecycle/end of product life issues alongside the return of surplus, obsolete or expired product or assets". In terms of Covid-19, many suppliers find themselves running out of stock due to high demand for products by customers as well as the pandemic's impact on import and export of products or raw materials. The global shortage of PPE (Rowan and Laffey, 2020:1) means that there is no guarantee that customers (schools and other organisations) will get replacement orders on time should there be defects in PPE and sanitation products or even waste management due to ongoing challenges confronting SCM. This will pose high risks to learners and staff and could force schools to close. The return process is critical in the time of the pandemic. Hence, the study aimed "to ascertain how waste management systems in relation to schools' sanitation and hygiene influence the type of material, products and packaging systems".

2.6.1.6 Enable: According to the Supply Chain Council (2012), the "enable processes describe the associated with the management of the supply chain". Edwards (2018:67) describes this process "as a support that includes the management of practices of protocols, performance management and reporting, data management, resource management, facilities management, governance and risk and overall contracts management and compliance". According to Edwards (2018:67), "five categories at the core of the Enable process are identified: reliability, responsiveness, agility, cost and asset management". In the context of modelling the basic health and sanitation SC, the category of cost is an internal challenge. The six primary management processes of SCOR are the main focus of this study. The five categories of the enable process are

not covered extensively as schools' policies, governance and procedures, including contract reviews will change or be updated in response to the Covid-19 pandemic.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the research methodology used to conduct the study. The research methodology "refers to the theory of how research should be undertaken" (Saunders et al., 2020). A qualitative research methodology was employed for the study This chapter covers the research design, the target population; sampling, data collection methods, data analysis and ethical considerations.

3.2 Research design

The research design describes the "nature and the pattern that the research intends to follow" (Creswell, 2021). It is the overall strategy to integrate the different components of the study (Creswell, 2021). The most common research designs are the qualitative; quantitative and mixed methods (Creswell, 2021). According to Saunders et al. (2020) "mixed methods research may be conducted sequentially or concurrently and involves more than one phase of data collection and analysis". A qualitative research design was selected for this study that aimed to understand the challenges affecting the efficient and effective supply chain sanitation and hygiene operations of high schools. Saunders et al. (2020) note that the selection of a research philosophy depends on the research questions that the researcher intends to answer. Research philosophies include positivism, realism, interpretivism and pragmatism. The positivist approach is associated with quantitative studies, while interpretivism is a common qualitative approach. Interpretivism was adopted for this study because the researcher relied on the views of the interviewees based on their experiences of supply chain basic health sanitation.

3.2.1 Deductive and Inductive Approach

Researchers generally review the literature on their topic in order to identify theories and ideas that they will test when analysing the data. According to Saunders et al. (2020) "a deductive approach will require the researcher to identify a clear theoretical position when drafting the research question that researcher will then test". Edwards (2018) notes that this approach "examines and test theories" and that the "results is typically generalized". Other researchers

explore data to develop theories that they subsequently relate to the literature. This inductive approach was used in this study, gaining insight from the interviewees.

A qualitative method was employed to establish how the SCOR supply chain elements processes influence sanitation and hygiene in Ngaka Modiri Molema high schools in North West Province. The interviews produced qualitative data that describe the challenges affecting efficient and effective sanitation and hygiene operations in these schools. They yielded different, multiple perspectives that enabled an in-depth understanding of SCM and an integrated sanitation supply chain system in high schools. Thematic analysis was used to analyse the qualitative data.

3.3 Type of design

There are three types of research design, namely descriptive, explanatory, and exploratory.

3.3.1 Descriptive Research Design

According to Saunders et al. (2020), "The object of descriptive research is to gain an accurate profile of events, persons or situations". Descriptive studies answer questions that start with how; what and who. A descriptive design was employed in this study to learn about and understand a specific problem.

3.3.2 Explanatory Research Design

According to Saunders et al. (2020), "studies that establish causal relationships between variables may be named explanatory research". Rahi (2017:2) states that an explanatory research design enables the "researcher to explain a problem or a situation with the aim of identifying issues and key variables related to the phenomenon". The emphasis is on "studying a situation or a problem in order to explain the relationships between variables" (Saunders et al., 2020). Edwards (2018: 91) notes that an explanatory research design aims "to answer questions, define the line in real life situations that are typically too complex for alternative experimental analysis".

3.3.3 Exploratory Research Design

According to Saunders et al. (2020) an exploratory study is "a valuable means to ask open questions to discover what is happening and gain insights about a topic of interest. It is particularly

useful if you wish to clarify your understanding of a problem, such as if you are unsure of the precise nature of the problem" (Saunders et al., 2020).

In qualitative research, researchers "use the literature in a manner consistent with the assumption of learning from the participant, not prescribing the questions that need to be answered from the researcher's viewpoint" (Creswell, 2021). An exploratory study calls for qualitative research (Saunders et al., 2020). According to Sekaran (2020), "exploratory research is usually performed when not much information is known about the subject being studied", inferring that little research has been conducted on the topic. Saunders et al. (2020) note that, "There are a number of ways to conduct exploratory research, these include a search of the literature; interviewing 'experts' in the subject; conducting in-depth individual interviews or conducting focus group interviews". An exploratory design was appropriate to analyse the supply chain sanitation challenges experienced in high schools.

3.4 Nature of the study

Qualitative research is often associated with "an interpretive philosophy because researchers need to make sense of the subjective and socially constructed meanings expressed by those who take part in research about the phenomenon being studied" (Saunders et al., 2020). It is a very broad term that "embraces research methodologies that deal with phenomena by analyzing experiences, behaviours and relations without the use of statistics and mathematics and the processing of numerical data" (Basias and Pollalis, 2018). In qualitative research, meaning is derived from words rather than numbers. Since words may have multiple as well as unclear meanings, it is necessary to explore and clarify these (Saunders et al., 2020). "Qualitative research might provide benefits such as: (a) supporting the researcher to understand the nature and complexity of the phenomenon being considered, (b) enabling research in relative new areas of research and (c) supporting the investigation of a phenomenon in its natural environment" (Basias and Pollalis, 2018).

This study employed a qualitative research design to gather qualitative data from the participants with regard to supply chain basic health sanitation among high schools in Ngaka Modiri Molema District Municipality in North West Province.

3.5 Sampling design

Sekaran (2020) defines a sample as a subset of the population. It comprises of some members selected from it. The sample for this study was selected from heads and deputy heads of schools, members of SGBs and District Managers and administrators of PPE during Covid-19. The total population based on 13 schools, including the Deputy District Director and Supply Chain Administrator of PPE from the Department of Basic Education was 23.

3.5.1 Sampling strategies

"Sampling techniques provide a range of methods that enable the researcher to reduce the amount of data needed to be collected by considering only data from a subgroup rather than all possible cases or elements" (Saunders et al., 2020). The two major sampling designs are probability sampling and non-probability sampling. According to Sekaran (2020), "when elements in the population have a known chance of being chosen as a subject in the sample, the researcher resorts to a probability sampling design". It includes simple; random; stratified; cluster and systematic sampling**.** In non-probability sampling, "elements in the population do not have any probabilities attached to their being chosen as sample subjects" (Sekaran, 2020). Since the study employed a qualitative approach, probability sampling was used. It includes stratified, simple, and systematic sampling. Non-probability sampling techniques are known as convenience; purposive and self-selection, etc. (Saunders, 2020). The stratified technique was employed for this study.

3.6 Target population

North West Province is predominantly rural. It is divided into four districts, namely, Bojanala Platinum; Dr Kenneth Kaunda; Dr Ruth Mompati, and Ngaka Modiri Molema Districts. Ngaka Modiri Molema District, which was the focus of this study, includes five local municipalities, namely, Ditsobotla; Mahikeng; Ramotshere; Ratloung and Tswaing. Thirteen high schools were selected, with all five local municipalities covered. The target population was 23, made up of ten heads of schools; four deputy heads of schools; seven SGB members; one Deputy Director and one Supply Chain Administrator of PPP from Ngaka Modiri Molema District Municipality. Having examined the data collected, the researcher realised that adding more focus groups or considering more participants would not produce new data because the participants were from the same district and were experiencing the same challenges. The point of saturation was reached when

the participants the researcher interviewed were providing the same information on sanitation challenges. The responsibilities of participants are deemed important for example Heads and deputy heads of schools were selected because they are in charge of overall school activities, while SGB members are responsible for the schools' overall maintenance plan and budget. The Deputy Director is responsible for the overall operations and strategic plans of schools and the Supply Chain Administrator was charged with administration of PPE during Covid-19. The 13 schools were chosen because they are all under Ngaka Modiri Molema District, the same district that the researcher was interested in. The researcher realised that adding more schools would not produce new data because the school participants were from the same district and were experiencing the same challenges, therefore the point of saturation was reached

3.7 Unit of analysis

A unit of analysis is the site or place that the researcher chooses to conduct research, including data collection. Saunders et al. (2020) note that the researcher can select to utilise an organisation in which the researcher has been employed or is currently employed as the researcher's case. The unit of analysis for this study was high schools in North West Province in the district municipality of Ngaka Modiri Molema, which includes the towns of Mahikeng, Lichtenburg and Zeerust. This Province was selected because the researcher was born in this district and is thus familiar with the challenges confronting it. The researcher also believes in a say that goes "Charity begins at home."

3.8 Sample size

Sekaran (2020) defines sampling as "the process of selecting a sufficient number of elements from the population, so that a study of the sample and an understanding of its properties or characteristics would generalize such properties or characteristics to the population elements". For the purpose of this study, 13 high schools were selected, with a target sample of 23, comprising ten heads of schools; four deputy heads of schools; seven SGB members; one Deputy Director and one Supply Chain Administrator of PPE from Ngaka Modiri Molema District Municipality.

Table 3.1: Sample Size for a Given Population Size: Based on 13 schools

Capacity	No. of Interviewees
- Head of School	10
- Deputy Head of School	4
- SGB member	7
- District Manager	1
- Administrator of PPE in schools during Covid-19	1
Total	**23**

Source: Researcher (2021)

3.9 Data Collection

Data can be obtained from primary or secondary sources (Sekaran, 2020). There are four main sources of data, namely, the individual; focus group; panels; and unobtrusive methods (Sekaran, 2020). Data collection instruments include interviews (structured or unstructured interview; questionnaire; face-to-face; telephonic); observation; document analysis and unobtrusive methods. Semi-structured; face-to-face and telephonic interviews were conducted for this study using the interview guide-. The researcher asked the open ended question that called for details and cannot be answered in one or two words.

Data was collected during Covid 19 pandemic and all Covid-19 protocols were observed during face-to-face interviews and telephonic interviews were held when the interviewee was not available to meet, or was in isolation due to Covid-19.

3.9.1 Interviews and Focus Groups

Sekaran (2020) states that "one method of collecting data is to interview participants to obtain information on the issues of interest interviews could be unstructured or structured and conducted either face to face or by telephone or online". Interviews enable participants to explain themselves using their own words. They are free to their express themselves and their answers are not influenced by the interviewer. The researcher conducted semi-structured interviews with heads and deputy heads of schools; SGB members the District Director and Administrator of PPE to collect data on the challenges affecting high schools' efficient and effective supply chain sanitation operations. Semi-structured focus group discussions, which involve bringing a group of participants together, were held to ascertain how schools plan and source their operations processes

that influence sanitation and hygiene as well as service delivery. The interviews were recorded using an audio device. According to Sekaran (2020), "permission to record the interview should be obtained before the Voice Capture System (VCS) is activated". The heads of schools are represented in this study as (P). In some instances, the head of school was interviewed together with the SGB member, which is represented by (F).

3.10 Data analysis

The NVivo software package was used to sort the collected data into categories and locate the subsets of the data according to specified criteria. The researcher employed thematic analysis, which "is defined as data analysis structure that allows the researcher to focus on identifiable themes within a case and utilise these themes to arrange and present the case" (Rule and John, 2011:123). The following steps were followed:

3.10.1 Six-Phase Thematic Analysis

Phase 1: Familiarising with the collected data

The researcher read and gained a deeper understanding of the data collected from interviewees. The researcher transcribed the data by listening to the recorded discussions. This was transferred to a Word document by listening to the recording and typing manually to the word. The researcher relied mostly on the NVivo software for coding

Phase 2: Generating initial codes

The study's objectives were used to generate codes in order to collate the data and organise it in such a way that it matched the codes.

Phase 3: Searching for themes

Data was gathered into possible themes.

Phase 4: Reviewing themes

The themes were reviewed and checked to ensure that they related to the coded data as well as the entire dataset. A process of categorising followed, showing all the themes that were selected from the raw data into NVivo.

Phase 5: Defining and naming themes

The themes were repeatedly refined to generate clear explanations and names. This is the most important step considered by the researcher.

Phase 6: Producing the report

The data was analysed by the researcher in relation to the research objectives and questions and the literature in order to produce a comprehensive, well-thought out report by utilising NVivo software.

3.10.2 Data Quality Control

Reliability is defined as the dependability or a positive relationship between two or more parties that has trust and predictability. In statistical terms, it is viewed as a repeated measure which can have indicators which yield similar results (Vosloo 2014). Qualitative research is trustworthy when it accurately represents the experiences of the study participants. Vosloo (2014) emphasise that the goal of qualitative research is to accurately represent the study participants' experience. Validation of trustworthiness therefore becomes key of the data when discussing elements of dependability, credibility, and confirmability of the study.

Vosloo (2014) refers to Data quality control as to how the researcher can ensure that the date gathering instruments used, measure what they are supposed to measure in a consistent manner; reliability and validity, respectively. Trustworthiness ensures that the research procedures have been transparent, the research methods used are available for review and inspection and clear rational reasoning can be provided (DuPlooy, Davis and Bezuidenhout, 2014). Trustworthiness, is divided into dependability, credibility, transferability, and conformability (DuPlooy, Davis and Bezuidenhout, 2014).

This section discusses in detail how the control quality of the data was collected. It is seen as the most important part of data collection due to high quality and decision being made on the basis of reliable and valid data. As discussed in previous chapters, trustworthiness, is divided into dependability, credibility, transferability, and conformability (DuPlooy, Davis and Bezuidenhout, 2014). To ensure the trustworthiness of the data collected, the following measure we employed:

Credibility

To maintain credibility, the researcher followed the thematic method according to the six steps of thematic analysis. Recent literature was reviewed, and articles were sourced from credible journals with rigorous review processes. Triangulation, which was achieved by conducting in-depth

interviews and focus group discussions, added to the study's credibility. According to Baumgart, Craig and Tong (2021:539) " Strategies that can be used to enhance credibility include using purposive sampling to capture a wide range of perspectives and experiences, designing a question guide with relevant questions that promote introspective and indepth discussion, using a multidisciplinary research team during the research process, using a combination of qualitative methods (eg, interviews and focus groups), and collecting data until saturation to ensure comprehensive interpretations of the data". In order to make sure that clear, sufficient data was collected recording, taking notes and transcripts was done for the purpose of interpreting data correctly. The interviews were recorded using a device make sure what the participants said was clear. Notes were also taken as additional as an additional measure of collecting data from the participants. Data collected from the participants during the interview was then transcribed into readable data without losing the meaning in terms of the expression of words from the participants. It is also important to mention that, before the interview proceeded, the researcher requested permission to record the interviews.

Dependability

Dependability pertains to whether there is a coherent and transparent relationship between the methodology, methods, data, and findings (Baumgart, et al.,2021:539)".

The research is independent because the researcher applied the following protocols in terms of how to handle the interview process, the confidentiality process was followed, all the participants who participated in the interviews were guaranteed confidentiality. The informed consent letter was sent to the participants also informing them that the interview will be recorded, they may refuse to participate or withdraw from the study at any time with no negative consequence and that there will be no monetary gain from participating in the study.

Confirmability

To ensure confirmability in the study, the participants that were interviewed in the study were effective in evaluating the integrity and quality of the research because of their experience in the supply chain basic health sanitation. The results of the study were clearly stated and verified by the participants based on their perception and experience. There are many data collection and analysis methods used in the study which allows other researchers to evaluate the study. According

to (Baumgart, et al.,2021:539) “Researchers can enhance transparency by recording and transcribing data, using computer software during coding to create auditable documentation of the research process that can be reviewed by others. Audit trail was applied in ensuring that findings were sound and confirmed findings”.

Transferability

Transferability is described as “degree to which the findings are relevant to and have implications in other populations and settings (Baumgart, et al.,2021:539)”. For the rationale of the study the conclusion and data be easily transferable to other high schools including secondary schools. This is due to the similar health sanitation challenges experienced buy high schools in rural areas. It is imperative that “Researchers should provide sufficient details about the study setting and participant characteristics and compare findings to other studies conducted in different contexts or populations so that other researchers may judge whether the findings can be applicable to their own setting (Baumgart, et al.,2021:539)”,

3.10.3 Saturation strategy

Data and/or theory saturation

Data saturation relates to the degree to which data repeats itself during the course of data collection. Baumgart, et al., (2021:538) refers to saturation as “the sample size that is usually determined by the research question, methodology, methods, feasibility, and data or theoretical saturation (when no new relevant concepts are emerging in subsequent data collection)”. Guest, Namey and Chen, (2020) refers to saturation as “the point during data analysis at which incoming data points (interviews) produce little or no new useful information relative to the study objectives”. The study reached the point of saturation. The saturation strategy is explained later in the study.

3.11 Ethical considerations

Ethical approval was obtained from the University of KwaZulu-Natal’s Ethics Committee. A gate-keeper’s letter was obtained from the office of the North West Province Department of Education. All the interviewees received letters detailing what the research entailed and they signed informed

consent forms before interviewing commenced. They were also informed that participation was voluntary and that confidentiality was guaranteed.

3.12 Conclusion

This chapter discussed the research methodology employed to conduct this study. It covered the research design, philosophy and approach, the target population and sampling methods, the data collection tools and data analysis, trustworthiness, credibility, reliability and validity, and the ethical considerations taken into account. The following chapter presents the data collected by means of interviews and focus group discussions.

CHAPTER FOUR

DATA PRESENTATION

4.1 Introduction

This chapter presents and analyses the data gathered by means of interviews and focus group discussions in relation to the research objectives and questions presented in Chapter one and the literature review in Chapter two.

The research objectives were as follows:

- To examine the challenges affecting high schools' efficient and effective supply chain sanitation operations;
- To establish how high schools develop an operations plan for integrated supply chain sanitation and hygiene;
- To evaluate how high schools' sourcing strategy facilitates improved service delivery;
- To establish how high schools' operations processes influence sanitation, hygiene and service delivery; and
- To ascertain how schools' waste management systems in relation to sanitation and hygiene influence the type of material; products and packaging systems.

4.2 Overview: basic health sanitation in Ngaka Modiri Molema District high schools

Basic sanitation and hygiene are essential to human health. Millions of people around the world die due to infections transmitted as a result of poor basic sanitation and hygiene. Supply chains play a major role in all organisations. This study of basic health and sanitation employs the SCOR model, a popular tool that is used to evaluate and make rapid improvements to supply chain processes. Its six management processes are Plan; Source; Make; Deliver; Return and Enable (Supply Chain Council, 2012).

Figure 4.1: North West Ngaka Modiri Molema locality Map

Source: Municipalities (2021)

North West Province is largely rural. According to the Department of Rural Development and Land Reform (2016), most South African rural communities remain socio-spatially and economically marginalised due to colonial and apartheid legacies. The high schools in Ngaka Modiri Molema District that were the focus of this study confront major challenges in relation to basic sanitation and hygiene. Most still use pit toilets and there is a lack of water.

4.3 Biographical Information of Participants

Table 4.1: Profile of the participants

Participants	Gender	Age Group	Highest Qualification	Racial Group	Home Language	Length of Employment	Position held	Date and Time of Interview
Focus Group 1	Male	42-49 years	Degree	African	Setswana	10 years and above	Head of school	
	Female	50 years and above	Matric	African	Setswana	6-9 years	SGB	19.10.2020 08h00
Focus Group 2	Male	50 years and above	Degree	African	Setswana	3-5 years	Head of school	
	Female	42-49 years	Matric	African	Setswana	3-5 years	SGB	19.10.2020 09h30
Focus Group 3	Male	50 years and above	Honours	African	Sepedi	10 years and above	Head of school	
	Female	42-49 years	Non-Matric	African	Setswana	6-9 years	SGB	20.10.2020 08h00
Focus Group 4	Male	42-49 years	Post graduate	African	Setswana	10 years and above	Head of school	
	Female	34-41 Years	Matric	African	Setswana	3-5 Years	SGB	20.10.2020 09h30
Focus Group 5	Male	50 years and above	Degree	African	Setswana	10 years and above	Head of school	
	Male	50 years and above	Non-Matric	African	Setswana	6-9 years	SGB	20.10.2020 11h30
Focus Group 6	Female	51 years and above	Degree	African	Setswana	10 years and above	Deputy Head of school	
	Female	34-41 Years	Matric	African	Setswana	3-5 Years	SGB	21.10.2020 08h00
Focus Group 7	Female	42-49 years	Diploma	African	Setswana	10 years and above	Head of school	
	Male	42-49 years	Diploma	African	Setswana	10 years and above	Deputy Head of school	21.10.2020 09h30
Focus Group 8	Male	50 years and above	Degree	African	Setswana	10 years and above	Head of school	
	Male	50 years and above	Matric	African	Setswana	6-9 years	SGB	22.10.2020 08h00
Participant 1	Female	42-49 years	Post graduate	African	Setswana	10 years and above	Head of school	22.10.2020 14h00
Participant 2	Male	50 years and above	Post graduate	Asian	English	10 years and above	Deputy Head of school	23.10.2020 08h00
Participant 3	Male	50 years and above	Degree	African	Setswana	10 years and above	Head of school	23.10.2020 09h30
Participant 4	Male	42-49 years	Post graduate	African	Setswana	10 years and above	Head of school	27.10.2020 08h00
Participant 5	Male	50 years and above	Degree	African	Setswana	10 years and above	Deputy Head of school	27.10.2020 08h00
Participant 6	Male	50 years and above	Post graduate	African	Setswana	10 years and above	Deputy Director	26.10.2020 09h00
Participant 7	Male	50 years and above	Degree	African	Setswana	10 years and above	PPE Administrator	26.10.2020 10h00

4.4 Analysis of themes

NVivo version 12 was used to perform thematic analysis of the primary data gathered by means of in-depth interviews and focus group discussions. The steps/phases in thematic analysis were discussed in the previous chapter, where the researcher read and gained a deeper understanding of the data collected from interviewees. The researcher then transcribed the data by listening to the recorded discussions. This was transferred to a Word document by listening to the recording and typing manually to the word.

Figure 4.2: Themes

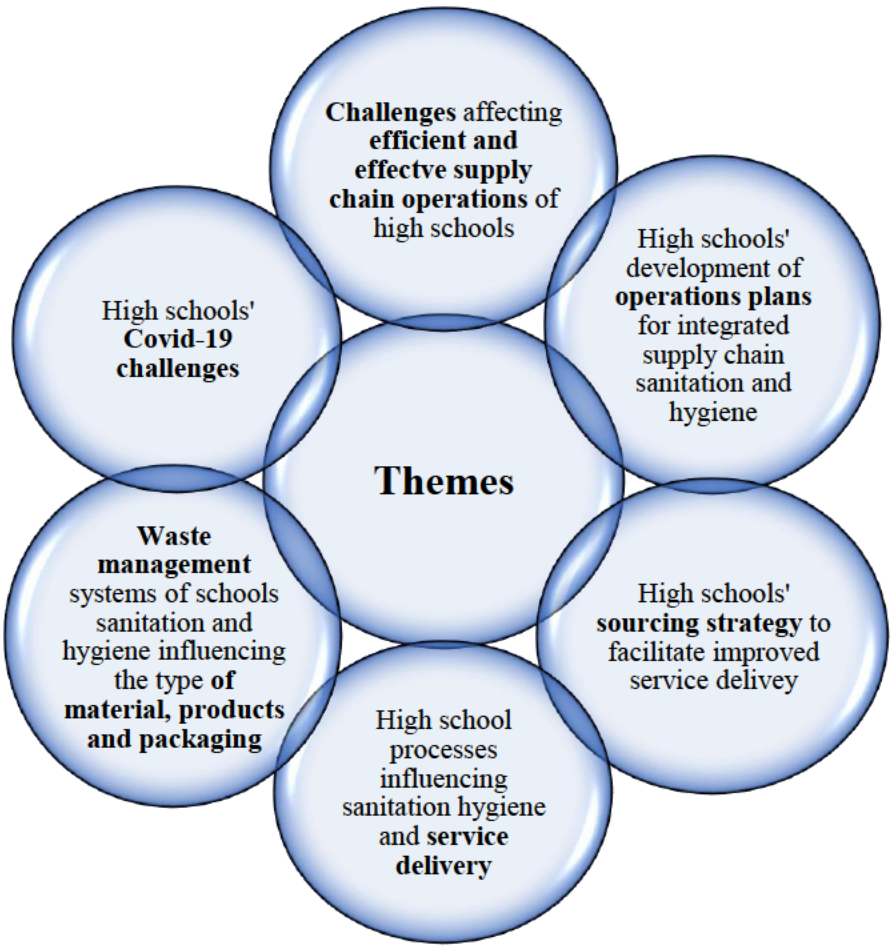
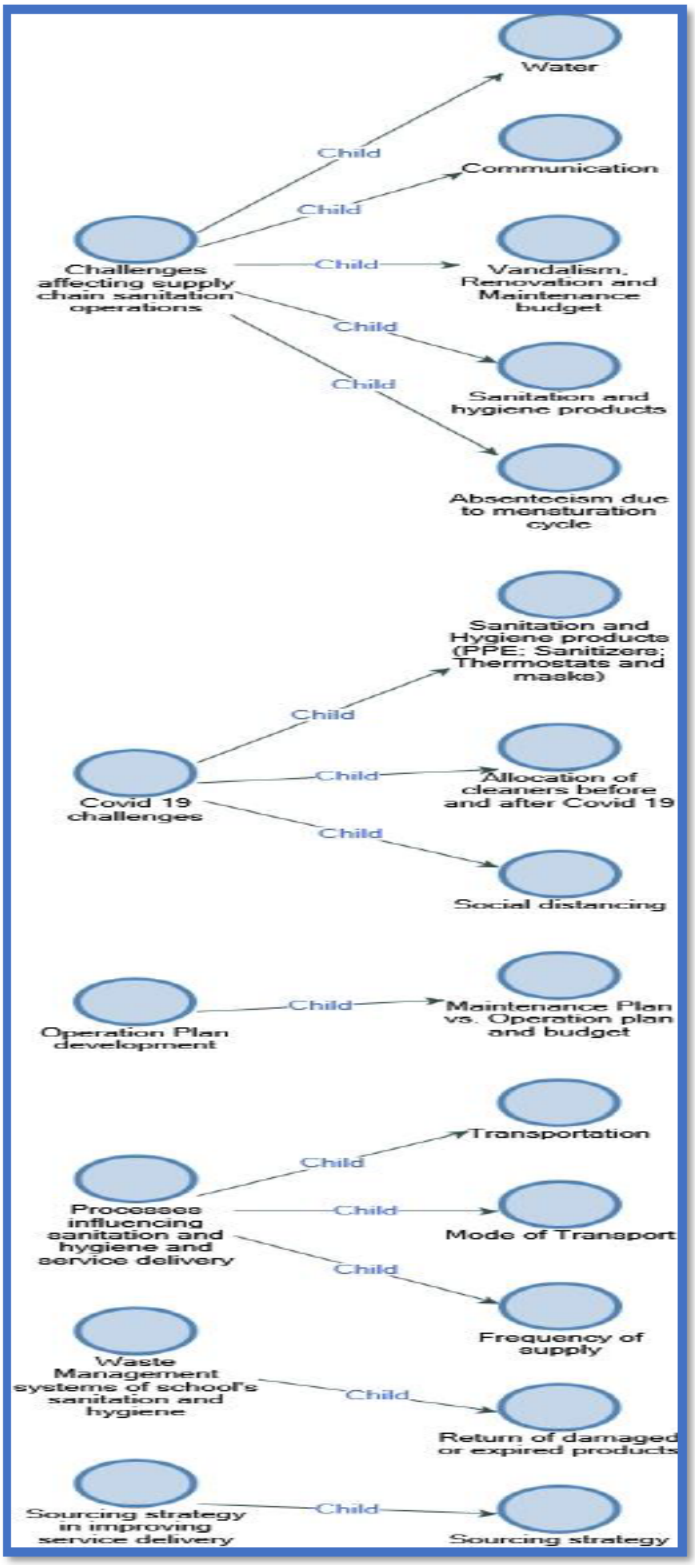


Figure 4.2 sets out the themes created from the NVivo software, five of which relate to the study's research objectives, with an additional theme on the Covid-19 challenges experienced by high schools. The themes are outlined and analysed in Figure 4.3 below.

Figure 4.3: Analysis of themes



Source: NVivo 12

Table 4.2: Theme 1: Challenges of Supply chain sanitation and hygiene per participant

Challenges affecting sanitation	P1	P2	P3	P4	P5	P6	P7	F1	F2	F3	F4	F5	F6	F7	F8
Sub –Theme and Code															
Water			X	X		X			X		X	X		X	X
Communication										X					X
Vandalism/Renovations and Maintenance budget				X	X						X	X			
Sanitation Hygiene Products		X		X						X	X			X	
Absenteeism due to menstruation cycle			X	X	X				X		X	X		X	

Source: Researcher (2021)

Q: *I would like to get your reactions to the challenges affecting supply chain sanitation and hygiene in your schools - tell me the story of sanitation at your school.*

Water

Almost all the participants identified a lack of water as a major challenge in the high schools. F8 stated that "*Our major challenge is water, we only received the borehole in 2015. This has been a problem throughout the history of this school. The ... borehole which only lasted five years ... dried in 2020*". Schools that rely on water piped from villages face even greater challenges. F4 said: "*We don't have borehole from school, we get supply from the village and it is piped ... We sometimes stay without water for five days in the village which in turn affects us. For example, last week ended without water and we decided to send learners home*". Participant 4 remarked: "*We are in the remote village areas. There is no water. We depend upon the water from the municipality. At some point the water will be cut. We have been struggling to get water*".

Some high schools that used JoJo tanks experienced issues with water pressure as well as a shortage of JoJo tanks due to the number of learners in the school. F2 stated that "*The challenge is the water from JoJo does not pressurize to the new toilet structure"*, while F5 added, *"As we speak, toilets don't flush. We bought a JoJo tank that we refill with water. We bought tanks and fill them with water from the JoJo. Learners have to use a bucket and draw water from the tanks and fill the toilet to flush".* F7 pointed to the shortage of JoJo tanks: "*You will find that it can last until break time. This is due to not having enough JoJos. The two JoJos of 15 000 litres are not enough for school. If the department can give us another JoJo of 15000 litres"*. P6 recounted that *"Currently … we have a recovery plan. … We asked DBE to assist, they gave us Rand Water from Gauteng, so that it gives us JoJo tanks. They supplied the school with urgency. They connected them and made a stand for them. The SGB had to fit tabs. Then their water became a challenge because the Municipality … could no longer assist anymore due to finances. Rand Water supplied via tankers where they would fill those JoJos. The contract ended up being terminated end of August due to … water being drawn from hydrants that was not included in the Memorandum of Understanding*".

Furthermore, some schools' boreholes have run dry, causing serious problems. F8 stated that "*The … borehole which only lasted five years … dried in 2020. The borehole installer only bored to 30 metres. The minimum should be at least 60 metres. This borehole did not even last five years. We are currently buying water. We are paying around R900 for 10000 litres and other tanks per refill. We refill once a week. Luckily, during Covid-19, learners come interchangeably. Imagine if all learners are in school, this means we now have to refill twice a week. There was a stage where I had to open the school gate for learners to go home and use toilets. Sometimes they would come back drunk*". P3 remarked: "*If temperatures are high, the borehole turns dry, and it also looks like the water pipes for school and the village meet somewhere. This causes a problem as the little we have, seems to be going to the village*".

Communication

Communication is key in every organisation and schools will not function well without proper communication among the stakeholders in the education system. The participants pointed to challenges in this regard. P4 stated that "*We have written letters to Department of Education, (but thus far) no one is doing anything*". F8 noted: "*I have been making numerous requests to the department*", while F3 said: "*The Department of Basic Education has been using the prioritisation system whereby they look to other schools that have similar problems; therefore, we do not get assistance on time. We have been making numerous requests, but nothing happened*".

The poor communication between schools and the DBE needs to be addressed as a matter of urgency.

Vandalism, and Renovation and Maintenance budget

Vandalism, and insufficient funds for renovation and maintenance were mentioned a number of times. P4 and P5 stated that "*Because of vandalism and learners breaking toilets, the upper structure has not been working for a long time; we cannot be even able to utilise the 10% from the Section 21 because it is not enough*". F4 commented: "*(There are) enough toilets; they only need renovation; the only challenges are vandalism. The major challenge is water".* F5 also emphasised that *"The toilets need overall maintenance. We also need extra toilets as the learner numbers have increased".* P5 noted that, *"The toilets that are closed and not working, requires more budget".*

Q: Are there hygiene products in the toilets like toilet paper; soap?

Sanitation and Hygiene Products

Water and sanitation services are a requirement in schools as, if they are not available, children are exposed to unhygienic conditions that can make them sick and prevent them from attending school. P4 stated that "*Before Covid we did not have many products for learners, but now we were able to buy a cleaning chemical; since Covid the school is able to buy chemicals. We have the stand where we mix water and soap so that they can wash hands. In terms of toilet paper, they*

come with their own". F4 also noted that "*Before Covid we did not supply learners with any hygiene products. But after Covid DBE supplies 25 litres X 5 of sanitizers, (but) as we speak only a little is left".* However, F5 said: *"There is no soap and toilet rolls in the toilets before and after Covid. We rely mostly on improvisation. There will be a time when we see that there is a need for toilet paper; we will then have options like sourcing funding or raising funding at school to procure them."* Some participants painted a more hopeful picture. F7 mentioned that *"We have hygiene products, we have water and soap next to the toilets, since we have a challenge of basins. In terms of toilet paper, we have a big box where we place the pieces of toilet roll and give the learners as they go in the toilet".* P2 proclaimed: "*The school does have the hygiene products; we can go see after the interview*".

Thus, the Covid-19 pandemic has brought about some changes in schools when it comes to sanitation and hygiene products, as many of these schools did not have these products prior to Covid-19.

Q: *Do girls experience challenges during menstruation?*

Sanitary pads availability?
Sanitary bins?

Absenteeism due to menstruation and disposal of sanitary pads

One in four girl children do not attend school when they are menstruating, while some attend school, but do not have sanitary pads. These challenges were raised by many participants. P4 stated that "*We rely upon donations. Normally when they experience their periods most of them don't come to school, I sometimes issue the permission slip to go home especially when there is no help to offer. The reason must also be stated. We only received donations last year 2019 around August. That is a very serious challenge".* F2 remarked: *"The department used to assist before, it was only once, but that service no longer happens. We realized that most students are very shy. According to Administrator Assistant: learners do come and request and the schools are experiencing shortages. We used to also get donations from churches".* F4 and F7 agreed: *"We do not have sanitary pads. There is a group in the village who used to assist but not anymore. We really need the sanitary pads to assist our learners*". P3 supported F2's statement: *"Last year (2019) the department was providing quarterly until December. Since 2020 we have not seen any*

supply. We really need them for our girl children. We have also experienced high absenteeism. In terms of sanitary bins, we do not have bins in the toilets. To tell the honest truth, I am not sure how they dispose of sanitary pads, and we have not experienced any blockages so far". P5 commented: "*We have … bins in the toilets, (but) the learners steal these bins. They girls also do not throw the pads in the bins and throw them on the floor. Others throw them in the toilets; we have experienced blockages*." F5 agreed that there is a serious challenge when it come to the disposal of sanitary pads: "*We have a challenge with sanitary pads for girl learners. We bought the … bins, but this was not sustainable, especially disposing of them. We were then forced to dispose them in the old pit toilets again. The challenge comes … when those pit toilets get full; they overflow. We have tried chemicals, but they are not working".* P4 commented: "*In terms of the disposal bins, we have them in toilets but not in every toilet. Some don't throw sanitary pads in the bins. When we were cleaning the toilets, let me give a worse scenario, there are two or three times where we found underwear covered in blood and thrown next to the toilet hidden by the learner. … as a teacher, you ask yourself what happened to that child; did the child report and how did she cope the whole day in class? These are very serious challenges*".

Most of the participants stated that their high schools rely on donations and that if these are not forthcoming, they sit with a serious challenge. Only one, F5, stated that, "*There was Sanitary Dignity Project by DBE. We were one of the schools which was selected to benefit from this project. Due to shortages and non-availability of sanitary pads, absenteeism was too high. Funds were made available for the (budget); the school will then be required to appoint the supplier in writing. The supplier will then commit to sustain supply in schools. Unfortunately, after Covid it has stopped. The learners were very excited when this programme started*". The researcher asked a follow-up question: "*What could be the reason for stopping the supply*?". F5 responded: "*The DBE is not forth coming. I don't know what the reason could be, not sure if it is us schools perhaps, we were not running the programme well, I don't know".* A further question was asked: *"Is this sanitary pad budget you are talking about, the one that DBE allocates to schools?". F5 responded: "No is not, so a dedicated amount will be in the school account only for sanitary pads. Then the school will have to administer that budget and supply invoices and all to the DBE. Unfortunately, all has stopped".* The last follow-up question was "*Who were you using as a supplier*?". F5 stated that "*We were using Shoprite Zeerust. We will go collect and then distribute to learners, learners*

in turn will sign the register. Some learners don't come due to being shy. All girl children were identified to make sure that all received sanitary pads".

The pain of not having access to sanitary pads should not be experienced in school. A girl child's dreams of becoming someone are stolen by unavailability of sanitary pads. Furthermore, disposal of sanitary pads is a serious issue confronting these high schools.

Table 4.3: Theme 2: Operations Plan

Operation plan development	P1	P2	P3	P4	P5	P6	P7	F1	F2	F3	F4	F5	F6	F7	
Sub –Theme and Code															
Maintenance Vs. Operations and budget		X	X		X	X			X		X	X		X	X

Source: Researcher (2021)

Q: *Does the school have an operations plan?*
Can you tell me about the school plan for sanitation and hygiene and what is included in the plan?

Maintenance and Operation plan development and Budget

Most of the participants from the high schools stated they do not have an operations plan, but a maintenance plan. A few did have such a plan. F8 stated: "*We do have the plan, which we sit down as SGB and draft and then during the annual meeting we review on an annual basis. There are some projects that cover more than a year".* F2 and F4 commented: *"We don't have an operational plan; it is important that we have it".* F5 advised that *"We had an operational plan when these toilets were built. It started in 2004 but stopped and it's been a long time".* F7 said that the school has a "*constant maintenance plan. We receive money twice a year. We do not say it's for the year. Part of the budget is related to transport. Every three months, we report to the department letting them know how we are going to run it in the next three months".* P3, P5 concurred with F7's statement that, *"In our school we rely on the maintenance plan. We were discussing the needs, also looking at the allocation of the budget. From Section 21 we are required to use 10%".* Finally, P2 noted that, *"The school has the maintenance plan. We have a school budget, which is for the*

cleaning materials. The department has a budget allocation for us. We plan this budget, e.g., transport; cleaning materials; consumables. etc.".

Thus, most of the schools do not develop an operations plan, but a maintenance plan that is budgeted in line with their allocation from the DBE. Hence the statement by P6 (the Deputy Director): "*The schools do not have it. It is broad (and) is created by us. It is district based, has activities and is costed in terms of budget. They have plans like maintenance plan."*

The DBE representative stated that, although schools are not involved in the operations plan, the department has the responsibility to at least engage them in the processes.

Table 4.4: Theme 3: Sourcing Strategy

Sourcing strategies facilitating improves service delivery	P1	P2	P3	P4	P5	P6	P7	F1	F2	F3	F4	F5	F6	F7	F8
Sub –Theme and Code															
Sourcing strategy				X			X		X			X		X	X

Source: Researcher (2021)

Q: *How does the school source sanitation and hygiene products such as soap, toilet paper, masks and sanitizers?*
Does the school have a sourcing strategy in place that it should follow?

A sourcing strategy is regarded as a powerful tool that guides organisations in supply chains. Without such a strategy, wrong decisions may be made in selecting a supplier during the bidding process. P4 stated that, "*We got a company that we are working with in Mahikeng. From my knowledge, most of schools are using that company. It is a supplier of chemicals. We have a relationship with them. They are able to assist us on credit. We don't have a contract with them; they are only our preferred supply. They are local".* F8, F2, F5 and F7 also noted that, *"For all our hygiene products, we are using a supplier of chemicals, even if we don't have money. We don't*

have a contract … the supplier … is a black company. The supplier delivers the products. When it is urgent, we use our own transport". In terms of sourcing PPE, especially during Covid-19, P7 stated that, "*We are able to go into the system and source according to where the services are required and target those suppliers who are local in the area. PPE was procured by head office; we were not directly involved as a district. We were only receiving and signing delivery notes and checking. From there we called the coordinators in the sub-district to collect and then principals will be called according to their clusters to come and collect. I am answering for them: they are using three base quotations. There is no contract".* P7 added that, "*One challenge is that we do not have big companies/firms in Mahikeng. So, our small suppliers were forced go and buy from the big guys. Another challenge (is that), local suppliers' pricing will not be the same as when the supplier is located in Gauteng. Markup was added as these suppliers needed to profit".*

These responses show that although these high schools do not have a contracted suppler, there is a common preferred supplier and due to their relationship with this supplier, they are able to buy on credit.

Sourcing from a sole supplier is sometimes not good for customers, in this case schools. In the event that the supplier goes into liquidation, the schools will not know where to buy from as relationships have not been established with other suppliers.

Table 4.5: Theme 4: Service Delivery

Processes influencing sanitation	P1	P2	P3	P4	P5	P6	P7	F1	F2	F3	F4	F5	F6	F7	F8
Sub –Theme and Code															
Transportation			X						X			X			
Mode of Transport			X							X		X			
Frequency of supply									X			X			

Source: Researcher (2021)

Q: *How are sanitation and hygiene products delivered to the school?*
What mode of transport is used in delivering these hygiene products?
How frequently does the supplier deliver/supply the hygiene products?

Transportation

P4 stated that, *"In most cases supplier is the one that delivers".* F2 noted that, "*The supplier will deliver, or the school will go collect themselves".* According to F5, F7 and P3 *"The supplier delivers to school".*

Mode of Transport

P2 remarked that, *"In terms of the mode of transport, I think they should be able to use the correct mode".* P5 stated that, *"We use the middle man who delivers for us, he uses his transport".* F3 commented: *"We go and buy products ourselves"* and P3 and F5 both stated that, *"They use a van suitable for hygiene products".*

Thus, some schools rely on the supplier to deliver hygiene products, while others fetch them themselves. It also seems that schools do not know if the supplier is using the correct mode of transport.

Frequency of supply

F8 stated that, *"In terms of frequency, when things are normal, we buy in bulk and per semester".* P4 and P3 advised that, "*Our frequency is per term*". F2 noted that, "*We buy once per semester as we buy in bulk. Sometimes it happens that we buy twice in a semester*". F5 recounted that *"We top up as and when."*

Table 4.6: Theme 5: Waste Management

Waste management of schools	P1	P2	P3	P4	P5	P6	P7	F1	F2	F3	F4	F5	F6	F7	F8
Sub –Theme and Code															
Waste management process: Disposal	X	X	X		X			X	X	X	X	X	X	X	X
Return of damaged or expired products					X			X	X	X	X	X			

Source: Researcher (2021)

Q: *What type of waste management processes does the school have in place?*
Do girl learners have bins in their toilets for disposal of sanitary pads?
How does the school return hygiene products it is not satisfied with or those that have expired to the supplier or manufacturer?

Waste management - Disposal

The participants were in overall agreement on the waste management process, especially the method that high schools use to dispose of rubbish. F1, F3, F5, F6, F7, P1, and P3 stated that "*In terms of rubbish and sanitary pads, because the school is located in the village, we burn the rubbish in a hole in the back yard of the school every morning".* P4 stated that, *"There is a big truck that drives in the villages and they come and collect. They sometimes don't come for some time. It can be about two months. If they take long, we burn it in a hole."* The discussion on this issue also revealed that some of the high schools still use pit toilets. F2 explained: "*Because we have pit toilets, we use chemicals to kill or lessen excreta."* F8 stated that, **"***We have a company from Miga; it comes and drains. They will instruct us to buy a certain product that we put in the toilets, then in four to five days they come and drain".* F4 responded: "*We put them in the plastic and dispose in the pit toilets*". Not all the schools were based in villages. P2, from one of these schools, said, *"Every day the dustbin is cleaned, and we have the plastic bags ready kept at the corner and collected by the truck. If the rubbish piles up, we call them".* P5 stated: *"We put then in black municipal plastic bags and burn them in the hole behind the yard. Paper*

is separated from the other rubbish and someone collects and sells for recycling, same as tins".

Most schools use a hole at the back of the school yard to burn waste; however, P6 commented: "*I am not sure because a hole is a thing of the past. I have not noticed. Most schools use chemicals and most have septic tanks. In terms of villages, the municipalities collect refuse for free. School fall under wards, so municipalities do collect".*

Some participants stated that the municipal truck passes via the village but in most cases it takes a long time to come and pick up. There appeared to be poor communication between schools and the municipality.

Return of damaged or expired products

Most of the participants said their schools had never experienced damaged or expired products. F1 and F4 stated that, *"We do check the products before we accept and receive them*". F2 and F5 mentioned that, *"Since I came here as a principal, we have never experienced such".* F3 noted: *"We have a relationship with them and return when issues are experienced".* P5 recounted that, *"We once returned the sanitizer which was 50% effective and this is not according to standard. Another issue was the floor polish that created dust. We returned it and received the correct ones".*

Thus, schools check products on arrival and during usage.

Table 4.7: Theme 6: Covid-19 challenges

Covid 19 challenges	P1	P2	P3	P4	P5	P6	P7	F1	F2	F3	F4	F5	F6	F7	F8
Sub –Theme and Code															
Sanitation and Hygiene products (PPE)		X		X	X	X	X				X				X
Allocation of cleaners before Covid 19	X							X	X						X
Social Distancing				X				X						X	

Source: Researcher (2021)

Q: *I would like to know about challenges during Covid-19 in your school, especially since the school re-opened during Covid 19.*

Sanitation and Hygiene products (PPE; sanitizers; thermometers and masks)

According to the World Health Organisation and United Nations Children's Fund (2020) Covid-19 emerged in Wuhan, China in 2019 and spread across the world. The participants identified a number of challenges that confronted their schools during the pandemic. P7 stated that, **"***The challenge was delivery and pressure of Covid-19. Other challenges were that service providers were not supplying correct materials*". P6 observed that, "*Water and sanitation are the challenges we experienced and others were curriculum based. We are constantly supplying the sanitizers, delivery is per district and then we take them to sub-district. Those who buy for themselves are the ones who choose to do so. As a district director, there is no school that will be allowed to operate without water and sanitizers*". P5 and F8 advised that, "*The school was not ready during the opening under Covid-19, we had to pay from our own pockets*". In similar vein, P4 reported: "*We did not open for a week because the school was not ready. The school received masks. In terms of the sanitizers we collect them at the sub-district and also top up for ourselves".* P2 stated that, *"From the school side we bought some. For the masks we waited for a day. Sanitizers we also buy. If there is a shortage, we know what to do*". According to F4, *"With regard to PPE we wait for them till they tell us to come and collect. We also check with the sub-district. Sometimes they tell us that sanitizer is not available. Masks are enough; there are no issues."*

Allocation of cleaners before and after Covid-19

F1 stated that, *"The department allocated us two cleaners during Covid. They are paid by the department and the contract is for 10 months".* F2, P1 and F8 concurred with this statement. Their schools received one cleaner each and they noted that, *"allocation of cleaners depends on the total number of learners."*

Social distancing

F7 stated that, "*When the school opened, we were well prepared. The only challenge we had was the social distance in classes. The other challenges were learner attendance, till today some learners have not returned*". F1 said '*It's a challenge especially during lunch breaks, and mostly they do it under supervision."* P4 added that *"Social distancing is very difficult; before Covid we would have 40 to 50 learners. During Covid we moved them into a hall and there is space."*

Schools struggled during the first reopening under Covid-19. Some opened on time, and many did not due to unavailability of sanitation and hygiene products.

4.5 Conclusion

The data gathered from the participants reveals the significant challenges impacting high schools' efficient and effective supply chain sanitation operations. These include those in relation to water; the unavailability of sanitary pads; planning and sourcing; and last, but not least, the Covid-19 pandemic that remains a serious challenge. Schools' sometimes lack the ability to take the necessary precautions to prevent learners and staff from being infected. The majority of the participants were of the view that assistance is unlikely to be forthcoming as longstanding issues have never been resolved. For example, some schools still use pit toilets. The participants indicated that, without support from the top, it becomes difficult to achieve effective supply chain basic health sanitation operations.

CHAPTER FIVE

DISCUSSION OF RESULTS

5.1 Introduction

This study aimed to model the supply chain basic health sanitation challenges in the Ngaka Modiri Molema District in North West Province. The previous chapter presented and analysed the data gathered during in-depth interviews and focus group discussions. This chapter discusses the findings in relation to each of the study's objectives and illustrates how these were achieved. It also highlights the study's contribution to knowledge.

To recap, the objectives were:

- To examine the challenges affecting high schools' efficient and effective supply chain sanitation operations;
- To establish how high schools develop an operations plan for integrated supply chain sanitation and hygiene;
- To evaluate how high schools' sourcing strategy facilitates improved service delivery;
- To establish how high schools' operations processes influence sanitation, hygiene and service delivery; and
- To ascertain how schools' waste management systems in relation to sanitation and hygiene influence the type of material; products and packaging systems.

5.2 Overview of Research Objectives

5.2.1 Objective One

To examine the challenges affecting high schools' efficient and effective supply chain sanitation operations.

The first objective of this study was to examine the challenges affecting high schools' efficient and effective supply chain sanitation operations. The findings in this regard offer opportunities to develop strategies to overcome these challenges, such as high schools adopting the SCOR model in their processes as well as SCI. According to Lima-Junior and Carpinetti (2020:1), "supply chain management (SCM) has become a critical subject for any organisation seeking global growth and

profitability". Lima-Junior and Carpinetti, (2020:1) highlight the need to establish partnerships with suppliers and customers and to work "together to improve products and processes". Furthermore, "Supply chain integration (SCI) is now being adopted by many firms that were striving to improve firm performance with closer relationships being built among other links in the supply chain" (Kumar et al., 2017:2). Mostert, Niemand and Koetze (2017:1-16) describe SCI as a "concept that focuses on achieving the improved synchronisation of processes and the enhanced exchange of high-quality information throughout the supply chain (SC), in order to improve both SC and operational performance".

The participants identified various challenges, including water shortages, vandalism, and absenteeism. The scarcity of water results in many sanitation problems. When there is no water, learners are forced to return home, negatively impacting their studies. A lack of water also means that flushing toilets no longer operate, which forces the schools to open pit toilets that were no longer in use. Furthermore, some schools resort to buying water, drawing on the maintenance budget that was not meant for this purpose. Finally, learners and staff are not able to practice proper hygiene routines like washing hands, which is of grave concern during the Covid-19 pandemic.

It was also noted that many girl learners are absent during menstruation. One in every four girl children miss school due to menstruation and not having access to sanitary pads. It was noted that, "*Not every child comes from a family that is well off. Most of our children in school come from a poor background. You give them a packet of sanitary pads expecting that packet to last a month. But it ends up being using by the whole family and finishes quicker".* It is imperative that the DBE source and deliver sanitary pads to all high schools. It could also delegate this responsibility to high schools. It is also incumbent upon teachers to monitor and ensure that all girl children that require sanitary pads receive them at all times. It was also found that there is poor communication between high schools and the department to mitigate supply chain basic health sanitation challenges. Some participants noted that their schools had been trying for years to communicate the challenges to a higher level to no avail.

5.2.2 Objective Two

To establish how high schools develop an operations plan for integrated supply chain sanitation and hygiene.

This objective sought to establish how high schools develop an operations plan for integrated supply chain sanitation and hygiene.

The participants reported that high schools are only responsible for the development of a maintenance plan. Mungani and Visser (2013:4) define maintenance as "a collection of actions executed on an asset with the aim of retaining an asset in, or restoring it to, a specified condition". The Northwest Department of Education Deputy Director stated that the operations plan is developed by the department. Sullivan, Pugh, Melendez and Hunt (2010:2.1) define operations and maintenance (O&M) as the "decisions and actions regarding the control and upkeep of property and equipment". The participants stated that the maintenance plan is linked to the budget allocation from the DBE. They are required to use only 10% of the budget for this purpose. Planning and budgeting are important in maintaining a safe and healthy environment for learners (UNICEF, 2011) The participants added that the 10% allocation is not sufficient as they are sometimes forced to use it for other urgent matters that were not part of the plan. Another example is buying on credit and paying the service provider once the budget allocation is made available. The participants also stated that, although they do not develop operations plans, they have small project plans, like buying chalk and stationery replenishment.

5.2.3 Objective Three

To evaluate how high schools' sourcing strategy facilitates improved service delivery.

The objective sought to evaluate how high schools' sourcing strategy facilitates improved service delivery. According to Zhou et al. (2011:334), "sourcing practice connects manufacturers with suppliers and is critical for manufacturing firms. further discovery established that long-term supplier–buyer relationship and reducing the supplier base are good sourcing practices" (Zhou et al., (2011:334). In explaining further, the source process describes ordering and receipt of goods and services (Supply Chain Council, 2012). Areas of concern included the availability of sanitation and hygiene products. For example, while there are many suppliers, they don't all have all the required items. This results in schools buying from the one that has everything they need even

when they adopt a three base quotation approach. The preferred supplier used by the schools also offers credit. Monopoly suppliers pose a risk because they might inflate their prices as they know their customers depend on them. The DBE should thus engage in supplier development. Another participant highlighted that Mahikeng and other parts of the district do not have many manufacturing firms and that firms that used to exist have closed.

5.2.4 Objective Four

To establish how high schools' operations processes influence sanitation, hygiene and service delivery.

The fourth objective was to establish how high schools' operations processes influence sanitation, hygiene and service delivery**.** According to the Supply Chain Council (2012), "delivery processes describe the activities associated with the creation, maintenance and order fulfillment of customer orders". Furthermore, Sibaya and Gumbo (2013:2283) state that "although sanitation delivery in South Africa has increased sharply, the knowledge, attitude and practices remain as major challenges facing our communities at large". The participants noted that this was not a major issue as they have a relationship with a single supplier. They also stated that if products are needed urgently, they use their own transport instead of waiting for the supplier to deliver. However, the participant from the DBE stated that suppliers selected to provide PPE ended up procuring from major suppliers in Johannesburg. This increased logistical costs as the small Mahikeng suppliers had to add a markup. "Logistics is a crucial function in an organisation and in any existing supply chain it functions as the link of all supply chain partners from the point of manufacturing of products to the point of consumption and reverse logistics where a need arises" (Gwala, 2019).

5.2.5 Objective Five

To ascertain how the schools' waste management systems in relation to sanitation and hygiene influence the type of material; products and packaging systems.

The final objective was to ascertain how the schools' waste management systems in relation to sanitation and hygiene influence the type of material; products and packaging. In terms of the returns process which forms part of the waste management process, Mostert et al. (2017:2-16) state that "product returns represent an increasing significant responsibility for retailers, because of factors such as levels of product returns and return process complexity and regulations regarding

the proper disposal of waste created by these returns". The participants had different views on this issue. It was evident that waste management is a challenge for some high schools, especially those located in villages that burn their waste in a hole in their back yard. Some high schools' waste is removed by municipal trucks, but the participants reported that this service was not reliable, forcing schools to burn their waste. The DBE representative was not aware of schools burning waste and stated that they should utilise the truck that passes through the village. This points to a lack of communication between schools and the department.

Edwards (2018:66) notes that this process is primarily concerned with ongoing maintenance, warranty, lifecycle/end of product life issues alongside the return of surplus, obsolete or expired products or assets.

5.3 Saturation

For qualitative interview studies, "approximately 20 participants from each population of interest may be adequate to reach saturation (Baumgart, et al.,2021:538)", furthermore "focus group studies with 3 to 5 groups14 with approximately 6 to 8 participants per group are recommended to achieve saturation and manage group dynamics (Baumgart, et al.,2021:538)",

Having examined the data collected, the researcher realised that adding more focus groups or considering more participants would not produce new data because the participants were from the same district and were experiencing the same challenges. The point of saturation was reached when the participants the researcher interviewed were providing the same information on challenges such as a lack of water; vandalism, unavailability of sanitary pads; Covid-19, and planning and sourcing. The same high schools are from the same district and municipalities

5.4 Contribution to knowledge

High schools make significant contributions to society by educating the future workforce. In order to promote academic achievement, they need to provide a safe and healthy environment. Schools thus need to identify efficient and effective ways to address supply chain basic health sanitation challenges. This study contributes to the body of knowledge in this field by examining and modelling these challenges and making recommendations on how best to overcome them. It will assist high schools and the DBE to manage and control these challenges, and develop and refine

policies. The study also lays the foundation for future research on ways in which other high schools including secondary and combined schools, and those that cater for learners with disabilities, in other districts can address additional challenges with regard to supply chain basic health sanitation.

CHAPTER SIX

RECOMMENDATIONS AND CONCLUSION

This study has shown that high schools in Ngaka Modiri Molema District, North West Province confront complex supply chain basic health sanitation issues that are also experienced in other parts of South Africa. The data generated by in-depth interviews and focus group discussions identified a lack of water, poor communication, insufficient funding, challenges relating to maintenance and waste management, and a lack of hygiene products as among the challenges that undermine high schools' ability to provide a safe and healthy environment in which learners can excel.

The findings suggest that poor communication between high schools and the DBE is at the root of many of these challenges. "Information sharing" is an important strategy to achieve effective supply chains. The data point to the need for an effective information sharing system that would promote transparency and the free flow of information. It would also enable a comprehensive high school data base to be developed. For example, a communication application (App) could be established for the department and schools. The App can also be linked to the Department of Water and Sanitation for a prompt response in relation to water and sanitation issues. The lack of water was raised as a major concern by the participants. Water is a basic human need and without it, high schools will not be able to function to the best of their ability or produce good results. Given the Covid-19 pandemic, it is imperative that schools have a reliable supply of water.

In order to address the challenges identified by this study, it is recommended that the DBE adopt the SCOR model and apply its six primary management processes.

According to the Supply Chain Council (2012), "the processes section in SCOR provides a set of pre-defined descriptions for activities most companies perform to execute effectively their supply chains" Kusrini1, Rifai1, and Miranda (2019:1) note that the scope of SCOR describes the business activities that can be linked to each other in order to satisfy customer demand.

First component - Plan: the study found that the DBE, rather than high schools, is responsible for development of the operations plan. The participants stated that schools are responsible for the maintenance plan and that they could only utilise 10% of their budget for maintenance. It is imperative that the department shares the content of the operations plan with high schools for alignment and transparency. For example, sanitary pads are a crucial need for girl children in high school. It is the DBE's responsibility to plan for a sufficient and regular supply of sanitary pads to high schools.

Second component - Source: The majority of the participants reported that the high schools do not have a sourcing strategy and use a single supplier of sanitation and hygiene products. Asked why this is the case, they responded that some suppliers are not able to supply all the school's needs and that some also supply poor quality products. The participants stated that they use three base quotations to select a supplier. The fact that a single supplier has a monopoly and that it offers credit, which enables schools to pay when they receive their budget allocation, poses the risk of price inflation. Furthermore, should the company go into liquidation, there will be no-one to supply the schools' needs. In order to address these issues, the DBE should work with SMMEs to grow and sustain their businesses. It should also train high school staff on sourcing strategies and equip them to better manage their budgets.

Third component - Make: This element was not originally part of the study, but arose during data collection in relation to procurement of PPE during Covid-19. Ngaka Modiri Molema District does not have a large manufacturing base and suppliers of PPE sourced it from major suppliers in Gauteng, thus incurring high transportation costs and a mark-up on the goods. The DBE should work with SMMEs to encourage local production of PPE.

Fourth component - Deliver: The majority of the participants did not raise major concerns with regard to the delivery of products to their premises. Some stated that the single supplier delivers the products and that schools sometimes collect using their own transport. It was noted that the supplier and the schools use a bakkie to transport goods. However, some sanitation and hygiene products are hazardous in nature and if not packaged and delivered correctly with the right mode of transport, could cause illness or even death. The DBE and schools should ensure that such

materials are properly packaged and transported under the right conditions with the recommended mode of transport. The proposed SCOR model involves more than one supplier and all suppliers should comply with correct delivery protocols.

Fifth component - Return: The study sought to ascertain how schools' waste management systems in relation to sanitation and hygiene influence the type of material; products and packaging. The participants had mixed views on this issue. It was evident that waste management is a challenge for high schools, especially those located in villages, the majority of whom burn their waste in a hole in their back yard. While some schools are serviced by waste management trucks, this service is unreliable, and they also resort to burning their waste.

The participant from the DBE stated that the department was not aware of the practice of burning waste. This calls for better communication between it and schools to understand why the latter are resorting to this method. It also requires the department to engage with the local authorities to ensure a more efficient waste management system. With regard to material; products and packaging systems, schools have the responsibility to check every delivery before signing for it, especially during the Covid-19 pandemic.

Sixth component - Enable: According to the Supply Chain Council (2012), the "enable process describes the associated with the management of the supply chain". Edwards (2018:67) describes this process as "a support that includes the management of practices of protocols performance management and reporting, data management, resource management, facilities management, governance and risk, and overall contracts management and compliance". It is imperative that the DBE and high schools monitor all contracts in place and review them annually if they run for more than a year.

Covid-19 challenges: This theme was added to the study due to its significant impact on schools. The majority of the participants stated that their schools were not ready when schools re-opened for the first time following the outbreak of Covid-19. Some used their own budget to buy PPE. Some received only 2 X 5 litres or 20 litres of sanitizer and had to buy more from their own budgets. The participant from the DBE stated that schools are supposed to collect sanitizer from

the sub-district when they run out. However, heads of schools noted that they were informed that the sub-district had no sanitizer. Once again, this points to a lack of communication between the parties.

Supply chain integration offers a solution to supply chain basic health sanitation challenges. Subburaj, Sriram and Mehrolia (2020:231) state that "SCI is about cooperation, collaboration and coordination among various players of the supply chain, which upgrades an organisation's performance." Mostert, Niemand and Koetze (2017:1-16) describe SCI as a "concept that focuses on achieving the improved synchronisation of processes and the enhanced exchange of high-quality information throughout the supply chain (SC), in order to improve both SC and operational performance". It is the extent to which all activities within an organisation and the activities of its suppliers, customers and other supply chain members are integrated (Sundram, Chandran and Bhatti, 2016:1448). Integration helps companies to overcome challenges in their supply chains and achieve their objectives (Marker, 2017).

Based on the study's findings, it is recommended that:

Firstly, the issue of water should be thoroughly addressed with the Departments of Water and Sanitation, and Public Works and Infrastructure. Both departments should revisit and review previous and current plans. Schools and the DBE should develop a communication App that will assist schools to communicate emergency sanitation issues to the department. The App can also be linked to the Departments of Water and Sanitation, and Public Works and Infrastructure.

Secondly sanitary pads should be available in all schools.

- The Sanitary Dignity Programme that falls under the DBE and the Department of Women, Youth and Persons with Disabilities focuses on Quintile 1 to 3 schools, mainly in rural areas and farming and informal settlements. The study found that some schools that used to benefit from the programme no longer receive sanitary pads, while some were not aware of the programme. It is therefore recommended that the DBE conduct a thorough investigation on the distribution of sanitary pads and implement the necessary measures to ensure that schools that qualify for this programme receive them.

- The reporting system among service providers, schools and the DBE in relation to the sanitary pads programme should be strengthened. Deliveries and receipt should be tracked in order to promote transparency.
- The DBE should liaise with local manufacturers to produce sanitary pads in North West Province.

Thirdly, in relation to waste management and disposal, it was found that most schools dispose of waste including sanitary pads by burning in the school yard. The DBE needs to ensure that the local municipality collects waste from schools. Where it is unable to collect, there should be early communication. Together with the local municipality, schools could reach agreements with service providers to collect waste and transport it to the landfill.

Fourthly, it was found that, while many schools were receiving PPE such as sanitizers from the sub-district, some were not. A clear communication strategy is required between the DBE, sub-districts and schools to ensure that schools receive sufficient PPE.

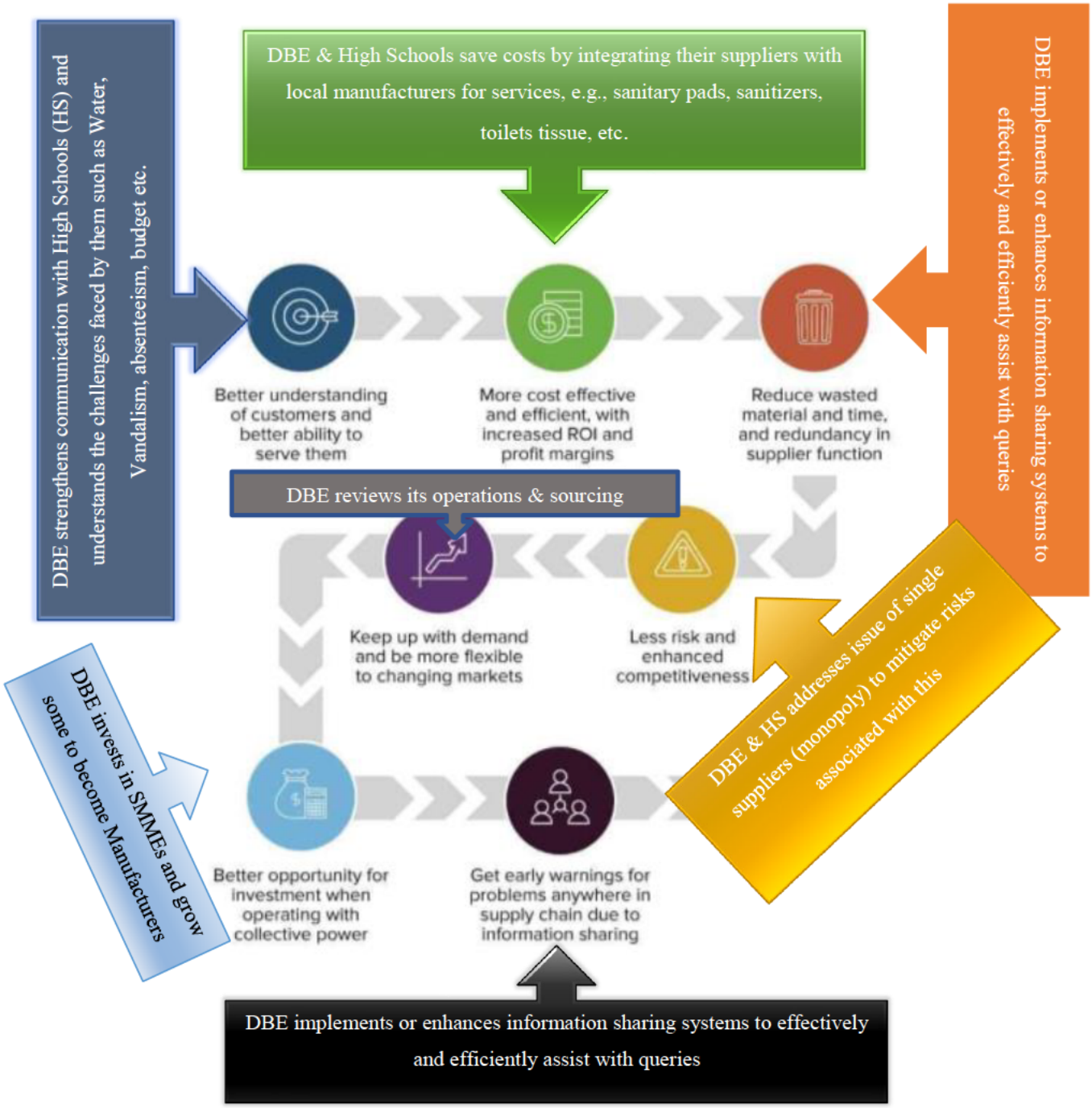
Fifthly, in line with the SCOR model (Plan; Source; Make; Deliver; Return and Enable), schools need to **Plan** ahead and not only rely on their budget. Schools need to come up with ways to raise funds. It was also found that most schools **Source** items such as cleaning material from one service provider, creating the risk of inflated prices and problems should the supply go into liquidation. It is recommended that the DBE encourage schools to build relationships with other suppliers. The department should build relationships with SMMEs that promote their growth and sustainability and should also train school staff to better manage their budgets.

In terms of **Make**, Ngaka Modiri Molema does not have a strong manufacturing base. It is therefore recommended that the DBE encourage and assist local SMMEs to produce goods such as sanitary pads. This will also positively impact the department's social responsibility / BBBEE performance.

Turning to **Deliver**y, schools must insist on the delivery of quality goods in the right quantity and on time, using the correct mode of transport.

Figure 6.1 below lists the benefits of SCI and illustrates how supply chain basic health sanitation is linked to each benefit.

Figure 6.1: Benefits of supply chain integration



Source: Marker (2017) and Researcher (2021)

6.1 Limitations and Delimitations of the Study

This study focused on a single district municipality, Ngaka Modiri Molema District in North West Province. This means that its findings cannot be generalized to all districts in this province or areas in other provinces affected by supply chain basic health sanitation challenges. Time was a major limitation, as interviews were conducted when schools were preparing for matric examinations. The Covid-19 pandemic also imposed serious constraints.

6.2 Conclusion

This research study focused on a number of unresolved health sanitation issues in South African high schools, especially those in rural areas. As a result, absenteeism, lack of water and proper sanitation facilities poses risks to learners' and teachers' health. Female learners are absent in school because schools are not providing sanitary pads which should be prioritized. Sanitary pads should be considered a basic human right that should be provided. If the schools do not have sanitary pads and female learners are not receiving those, a certain group at a certain period, this means those leaners should be staying at home. It is the responsibility of the school to make sure that there is no absenteeism of that nature based on unavailability of sanitary pads, and lack of water as they go hand in hand. Without water female leaner will not be able to practice proper hygiene during the menstruation period. Not only female learner will be affected, the entire school become affected when there are water problems. The supply chain basic health sanitation was modelled using the SCOR model. It is hoped that the study will assist high schools and the DBE to manage and control health sanitation challenges, and develop and refine policies. The study also lays the foundation for future research on ways in which other high schools in other districts can address additional challenges with regard to supply chain basic health sanitation.

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APPENDICES

Appendix A: Interview Guide

Date: _____

Name of School: _____

Person interviewed: _____

Capacity: _____

INTRODUCTION

The purpose of this study is to examine challenges affecting the efficient and effective supply chain sanitation operations of high schools. The participants included in this study are assured with anonymity and can stop this interview at any point without negative or undesirable consequences to themselves.

Section A: Biographical Data & Organizational Profile

- **Rank in the organization**

Head of School	SGB	District Manager	Administers of PPE	If Other: Specify

Moderator's Guide

Interviews

Interviews			
Participants Demographic Information	1	Age	
	2	Position	
	3	Race	
	4	Gender	
Date of Interview			
Time Allocation			

INTRODUCTIONS

Moderator

I will introduce myself and thank the participant for agreeing to come

Thank you for volunteering your time and coming to this interview. I am Remofilwe Tlhabudugwane; a Master's Degree Student in the School of Information Technology, Governance, and Discipline of Management studies - University of KwaZulu-Natal (UKZN).

For partial fulfilment of my programme I am required to conduct interviews for my dissertation. My research topic or title is: ***Modelling supply chain basic health sanitation challenges in district high schools: Northwest province.*** *I will moderate our discussion today.*

I will explain the Focus Group interview guidelines and tell how long the interview will last

We have the discussion scheduled for one hour today. During the group I want to get your reaction to the challenges affecting the efficient and effective supply chain sanitation operations of your high school. Before we continue, I would like to explain the definition of supply chain

Again, I am here just to facilitate the session today. You will not hurt my feelings or make me feel good with whatever opinions you might give. I am interested in hearing your point of view.

- *I am going to make every effort to keep the interview focused and within our time frame. If too much time is being spent on one question or topic, I may move the conversation along so we can cover all the questions.*

I will address the issue of confidentiality

- *I will do the voice recording of the discussion because I do not want to miss any comments. But I will only be using the first name today and there will not be any name attached to the comments on the final report. You may be assured complete confidentiality.*

Lay the ground rules

To facilitate the process, I will lay down a few in-depth interview rules

- *We are just two of us, so only one person is to speak at a time.*

- *Feel free to express your views. I want to learn from you here-your opinions, views, feelings, perceptions are important to me. I want each of you to tell me a story today! Don't always just say "I agree"! There is no right or wrong answer and I encourage you to "talk" to talk to me.*

- *You are responsible for the interview that is to take place during this session.*

- *My role is as to be a moderator not really interviewer, so I facilitate the interview not to create it. I urge you to ask me questions to clarify issues.*

- *You have signed the initial form confirming your participation in this session as well as your agreement to ensure that everything that is discussed in this venue remains confidential and private. Can I confirm that you are satisfied with this arrangement?*

- *I will take notes.*

Ice breaker: Participant introduction

On that note, please introduce yourselves-first name is fine. Please tell me which office you work in.

Discussion starter question

As mentioned earlier, the main topic of my theme is your challenges affecting the efficient and effective supply chain sanitation operations of your school.

To obtain consensus and before moving on with this exercise, it is important to explain that although this study does not mainly focus on COVID 19, it will however be covered during this session.

THEMES ON MODELLING SUPPLY CHAIN SANITATION AND HYGIENE to start with, the moderator will explain to the discussant what is meant by challenges of supply chain sanitation and hygiene using practical examples.

1. Challenges affecting the effective and efficient supply chain sanitation operations of school

I would like to get your reactions to the challenges affecting supply chain sanitation and hygiene in your schools ***A clear definition on what is meant by 'sanitation and hygiene challenges will be provided using practical examples.***

- *To begin with, can you tell me the story of sanitation at your school? If you have different kinds of toilet, what they are, when they were built, the issues or successes you have experienced with them, what is their status currently and other issues, things you have tried and so on.*
- *Tell me about your water source, its reliable or adequate and available at all time? etc.*
- *Can you tell me what are the challenges facing your school regarding sanitation and hygiene?*

    - *Are there enough toilets for both boys and girls?*
    - *Is there enough running water?*
    - *What do you do when there is no water available to flush or wash hands?*
    - *Do girls experience challenges during menstruation cycle?*
    - *Are the hygiene products in the toilets like toilet papers; soap?*
    - *Are your toilets clean, and who cleans them?*

2. How the high schools, develop an operation's plan for their integrated supply chain sanitation and hygiene

Let us now talk about how the school develop its operations plan, for its integrated supply chain sanitation and hygiene. But before we do that, let me explain to you what I mean by the integrated supply chain. ***A clear and brief explanation on what is meant by 'Supply chain integration will be given using practical examples.***

- *Can you tell how the school plan for their entire sanitation and hygiene and what is included in the plan?*
- *Does the plan include the clear scope of work?*
- *Does the school include bidders list in their plan?*
- *The locality of the supplier?*
- *Do they conclude on the contract terms (start and end date)?*
- *Does the plan include supplier premises visit- to know where they operate?*
- *Does the plan include the cost structure?*

3. How high schools' sourcing strategy facilitates the improvement of service delivery

- *How does school source their sanitation and hygiene products such as soaps toilet papers masks and sanitisers?*
- *Does the school have a sourcing strategy in place that the school developed and follows?*
- *Does the school have current supplier for sanitation and hygiene?*
- *In details, how do school prepare their bidders/ supplier list*
- *How do they conclude on contract terms start and end date?*
- *Are the supplier BBBEE compliant?*
- *what does the school consider – sourcing strategy to the point the supplier is appointed*

4. How the high schools' operations processes influence sanitation, hygiene and service delivery

- *How is the sanitation and hygiene product delivered to school?*
- *what mode of transport is it used in delivering these products?*
- *How frequent do the supplier deliver/ supply the products?*
- *Is there a time where a school miss delivery?*
- *If yes to the above questions what are the reasons?*

5. How the waste management systems of schools' sanitation and hygiene influence the type of material; products and packaging systems.

I would like to get your reactions on the waste management system of your school, how the school return or treat its products the ***moderator will explain what is meant by waste management system influencing the product and or packaging using practical examples.***

- *Tell me, what type of waste management processes does the school have in place,*
- *do learners particularly girls have bins in their toilets for pads disposals?*
- *if your school uses latrines how do then expose of excreta?*
- *how does the school return products of hygiene if not satisfied or expired back to the supplier or manufacturer?*

6. Full sanitation and hygiene facilities in place

I would like to know your knowledge on hygiene facilities in your school. ***An explanation will be given on what is meant by 'hygiene facilities using practical examples.***

- *Please tell me about your facilities in place, this can be number of toilets for boys and girls including staff. Do you think that they are enough and in good or bad conditions? Can we go see them?*

- *Is there a time when the hygiene products like soap and toilet papers are unavailable, if so what did you do, and any particular reason why that happens?*

7. Current Covid 19 Challenges at High Schools

I would like to know about challenges during Covid 19 in your school, especially since the school re- opened during Covid 19

- *Can you please tell me about the challenges the school is experiencing since and during Covid 19 and re-opening of schools? Does the school have enough PPE, Disinfectants and Sanitation/hygiene products?*

- *Does the school have supplier and or distributor of PPE and hygiene products during Covid 19?*

- *Does the school have enough water source especially for learners to wash hands frequently and for toilet use?*

- *Can you please share with me the process of learners entering the school yard and exiting of school yard? Do learners come wearing masks at all time, is their temperature checked before and after*

- *During Covid 19 can you please tell me who cleans the class rooms and toilets. Does the school have enough cleaning material and disinfectants products?*
- *During Covid 19 and re-opening of schools, how often does the school class rooms being sanitised.*

- *Do learners understand what Covid 19 is and do they practise social distancing*

CLOSING REMARKS

I will offer an opportunity for any short final comments' participants would like to make.

Thank you very much for your input today. Are there any last comments that you would like to make? The information you provided will help me write my dissertation and inform schools and department of education and Health of the outcome

End

Appendix B: Ethical Clearance

16 September 2020

Miss Remofilwe Virginia Tlhabudugwane (204011626)
School Of Man Info Tech &Gov
Westville Campus

Dear Miss Tlhabudugwane,

Protocol reference number: HSSREC/00001836/2020
Project title: Modelling supply chain basic health sanitation challenges in district high schools: North West province
Degree: Masters

Approval Notification – Expedited Application

This letter serves to notify you that your application received on 18 August 2020 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

This approval is valid until 16 September 2021.
To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

All research conducted during the COVID-19 period must adhere to the national and UKZN guidelines.

HSSREC is registered with the South African National Research Ethics Council (REC-040414-040).

Yours sincerely,

[redacted]

Professor Dipane Hlalele (Chair)

/dd

Appendix C: Informed Consent

UKZN HUMANITIES AND SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE (HSSREC)

APPLICATION FOR ETHICS APPROVAL

For research with human participants

Information Sheet and Consent to Participate in Research

Date:

Greetings,

My name is (Remofilwe Virginia Tlhabudugwane) from the School of Management, IT and Governance of the University of KwaZulu-Natal. Contact number: 066 440 7261 and email address: 204011626@stu.ukzn.ac.za.

You are being invited to consider participating in a study that involves research (**Modelling supply chain basic health sanitation challenges in district high schools: North west pprovince**). The aim and purpose of this research is to:

- to examine challenges affecting the efficient and effective supply chain sanitation operations of high schools;
- to establish how the high schools, develop an operation's plan for their integrated supply chain sanitation and hygiene;
- to evaluate how high schools' sourcing strategy facilitates the improvement of service delivery;
- to establish how the high schools' operations processes influence sanitation, hygiene and service delivery; and
- to ascertain how the waste management systems of schools' sanitation and hygiene influence the type of material; products and packaging systems.

The study is expected to include high schools in the North West Province particularly in Ngaka Modiri Molema. 34 participants will be selected: 16 Head of schools; 16 School Governing Body per member per school; 1 District Manager particularly in the Ngaka Modiri Molema.

We hope that the study will create the following benefits such as assisting in dealing with challenges of sanitation faced by high schools.

This study has been ethically reviewed and approved by the UKZN Humanities and Social Sciences Research Ethics Committee (approval number_____).

In the event of any problems or concerns/questions you may contact the researcher at (066 440 7261 or 204011626@stu.ukzn.ac.za) or the UKZN Humanities & Social Sciences Research Ethics Committee, contact details as follows:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION

Research Office, Westville Campus

Govan Mbeki Building

PrivateBagX54001

Durban 4000 KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557- Fax: 27 31 2604609

Email: HSSREC@ukzn.ac.za

Your participation in the study is voluntary and by participating, you are granting the researcher permission to use your responses. You may refuse to participate or withdraw from the study at any time with no negative consequence. There will be no monetary gain from participating in the study. Your anonymity will be maintained by the researcher and the School of Management, I.T. & Governance and your responses will not be used for any purposes outside of this study.

All data, both electronic and hard copy, will be securely stored during the study and archived for 5 years. After this time, all data will be destroyed.

If you have any questions or concerns about participating in the study, please contact me or my research supervisor at the numbers listed above.

Sincerely

Remofilwe Virginia Tlhabudugwane

CONSENT TO PARTICIPATE

I (Name_____) have been informed about the study entitled (**Modelling supply chain basic health sanitation challenges in district high schools: North west province**) by (Remofilwe Virginia Tlhabudugwane).

I understand the purpose and procedures of the study (**Modelling supply chain basic health sanitation challenges in district high schools: North west province**).

I have been given an opportunity to ask questions about the study and have had answers to my satisfaction.

I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without affecting any of the benefits that I usually am entitled to.

If I have any further questions/concerns or queries related to the study I understand that I may contact the researcher at (066 440 7261 or 204011626@stu.ukzn.ac.za) or provide details).
f I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researchers then I may contact:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION
Research Office, Westville Campus
Govan Mbeki Building
PrivateBagX54001
Durban
4000
KwaZulu-Natal, SOUTH AFRICA
Tel: 27 31 2604557 - Fax: 27 31 2604609
Email: HSSREC@ukzn.ac.za

Additional consent, where applicable

I hereby provide consent to:

Audio-record my interview / focus group discussion YES / NO

_____ _____

Signature of Participant **Date**

_____ _____

Signature of Witness **Date**
(Where applicable)

_____ _____

Signature of Translator **Date**
(Where applicable)

Appendix D: Editor's Letter

62 Ferguson Road
Glenwood
DURBAN 4001
Tel: 072 442 7896
Email: deanne.collins30@gmail.com
Income tax number: 0526066204

16 August 2021

This serves to confirm that I have edited the dissertation, "Modelling supply chain basic health sanitation challenges in district high schools: North West Province", by Remofilwe V. Tlhabudugwane, student number 204011626.

DISCLAIMER: The editor cannot be held responsible for any errors introduced due to changes being made to the document after the editing is complete.

Yours sincerely,

[redacted]

(Ms) Deanne Collins (MA)