

Demystifying the challenges of water, sanitation and hygiene in rural high schools

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ABSTRACT

Basic sanitation is an essential human need to preserve dignity as well as health. However, many South African schools confront challenges in providing a sufficient level of sanitation. This has been exacerbated by the global Covid-19 pandemic. This study employed the Supply Chain Operations Reference (SCOR) model to examine the challenges affecting efficient and effective sanitation supply chain operations in disadvantaged rural high schools. It also assessed the extent to which high schools engage in planning, sourcing and operations processes for integrated supply chain sanitation, hygiene and service delivery. An exploratory design was adopted and thematic analysis was employed 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, the study recommends supply chain integration, improved communication with suppliers and the adoption of the SCOR model to enhance the provision of basic sanitation and water.

Key words: Supply Chain; SCOR model; Water, Sanitation and Hygiene

Introduction

South African schools confront serious challenges in relation to sanitation and hygiene. Across the basic education sector (primary, secondary and high schools) one in every five toilets is either locked or broken. Many schools lack toilet paper and sanitary pads for girls, with no bins provided for the disposal of sanitary pads and no soap for learners and teachers to wash their hands after using the toilet. In some schools, learners clean their own toilets, with no personal protective equipment (PPE) such as mouth and nose masks and gloves provided. The targets set by the six Sustainable Development Goals (SDGs) on drinking water and sanitation called for the Department of Basic Education to improve levels of service (Fisher, Danquah, Seidu, Fechter, Saga and Bartram, 2020). A reliable supply of drinking water as well as safe management at the source and household level is included in these targets. However, many challenges prevent the achievement of these targets in the rural areas of low-and middle-income countries (LMICs), resulting in a substantive burden of disease. Against this background, this study aimed to establish the extent to which rural South African high schools engage in planning, sourcing and operations processes for integrated supply chain sanitation, hygiene and service delivery and the challenges that negatively impact their supply chain sanitation systems.

Background

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 Mompoti, 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 Mompoti are characterised by high levels of poverty and inequality, although Dr Ruth Segomotsi Mompoti 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. 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 processes impacts supply chain visibility and maturity, which is becoming increasingly important. It is against this backdrop that this study employed the SCOR model to examine the challenges that undermine efficient and effective sanitation operations in high schools during the Covid-19 pandemic. Sumera (2020:50) notes that “children are often exposed to unhygienic conditions that can make them sick and prevent them from attending school”. Ejelonu, Feng and Mckeen (2020:17) demonstrate that when a community has inadequate wastewater management and poor access to clean drinking water, sanitation deteriorates, negatively affecting the education system. Taylor and Maruyama (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”. However, Taylor and Maruyama (2020:3) observe that rural schools lack ready access to water, rendering it difficult to plan affordable water, sanitation and hygiene (WASH) schemes.

Research Problem and Objectives

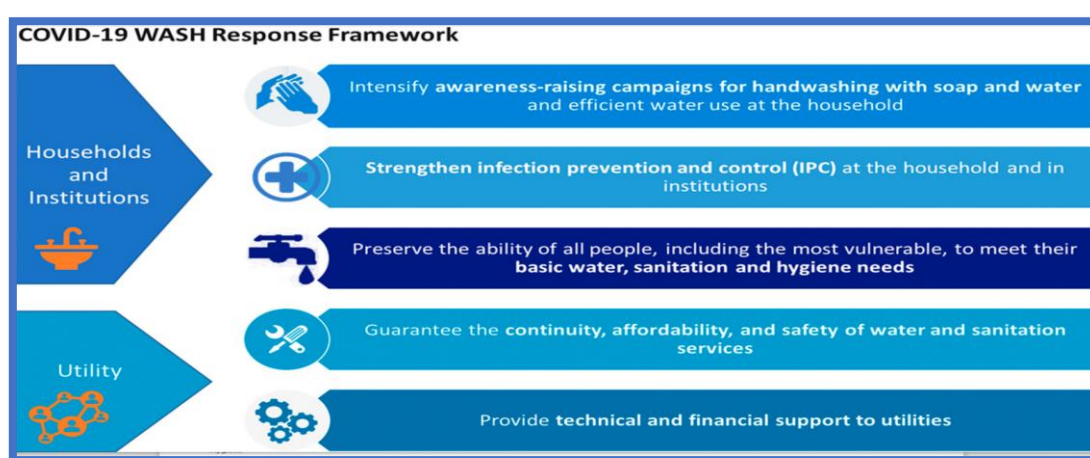
The coronavirus known as Covid-19, which was first identified in 2019 and was declared a pandemic by the World Health Organisation (WHO) highlighted the need to urgently address the sanitation and hygiene situation in schools. The education authorities and schools themselves have a responsibility to ensure that learners’ and teachers’ health and safety are protected. This calls for efficient supply chain operations and improved procurement systems. This study employed the SCOR model that encompasses planning; sourcing; making; delivering; returning and enabling to examine the challenges affecting high schools’ efficient and effective sanitation operations. Few studies have applied this model to sanitation and hygiene among high schools in South Africa. The study also aimed to establish the extent to which high schools engage in planning, sourcing and operations processes for integrated supply chain delivery and to make recommendations to assist schools and the Departments of Health and Basic Education to improve the delivery of sanitation and hygiene services.

Water, Sanitation and Hygiene in the time of Covid-19

Water, sanitation, and hygiene (WASH) practices emerged as a critical component in controlling and preventing the spread of Covid-19. Rural schools require adequate WASH

infrastructure to enable the practice of safe behaviours and strengthen resilience during a large-scale health crisis (Bauza, Sclar, Bisoyi, Majorin, Ghugey and Clasen, 2021). Covid-19 spread rapidly across the world and was declared a global pandemic by the WHO on March 11, 2020 (WHO, 2020). It is caused by the novel coronavirus SARS-CoV-2, which is primarily transmitted from person to person through inhalation of respiratory droplets/aerosols and contact with fomites contaminated with the virus (WHO, 2021). The WHO highlighted the importance of the safe management of human faeces and treatment of drinking water in its guidance on WASH and Covid-19 (WHO, 2020; Pandey, Verma, Verma, Mahanty, Dutta, Daverey and Arunachalam, 2020). A review of initiatives and interventions implemented by countries during the first months of the Covid-19 response identified WASH initiatives in 84 countries; these were categorised into those that aimed to secure WASH for all, and those that sought to provide technical and financial support to service providers.

Figure 1: Covid-19 WASH Response Framework



Source: WHO, 2020. Timeline: WHO's COVID-19 Response; Giné-Garriga, Delepiere, Ward, Alvarez-Sala, Alvarez-Murillo, Mariezcurrena, Sandberg, Saikia, Avello, Thakar, Ibrahim, Nouvellon, El Hattab, Hutton, and Jiménez (2021).

Beyond the risks associated with the collection of drinking water, sharing a sanitation facility with a few households or through public, pay-per-use facilities, may also serve as a transmission pathway for Covid-19 (Bauza, Sclar, Bisoyi, Majorin, Ghugey and Clasen, 2021; Caruso and Freeman, 2020; Parikh et al., 2020), especially in the absence of adequate water and soap for hygiene purposes. Given the recognition that handwashing is important to reduce transmission and the possible spread of the virus via feces, WASH access and practices are important to reduce the spread of Covid-19. Large cities confront risks due to population density, with many city residents in Africa and Asia living in slums and informal settlements (Lallal and Wahba, 2020; Cooper, 2020). Cramped living conditions and inadequate public services, especially with regard to waste management and sanitation, can exacerbate the spread of the virus (Stoler, Jepson and Wutich, 2020). Residents of informal settlements and densely populated rural areas frequently rely on communal toilets, where it is difficult to apply physical distancing and follow strict hygiene procedures (Parikh et al., 2020). As noted previously, improving water supply, hygiene and sanitation is a significant focus of the SDGs and the global health agenda (Maina, Tosas-Auguet, McKnight, Zosi, Kimemia and Mwaniki, 2019).

School Sanitation and Hygiene

The National Business Initiative (2020) notes that “WASH compliance means access to clean water and appropriate sanitation, as well as the ability to implement proper cleaning and disinfection measures”. It adds that “South Africa’s inadequate and dilapidated water infrastructure means that for many of the country’s most vulnerable citizens, these measures for preventing contagion are unavailable” (National Business Initiative, 2020). Toquero (2020:1) observes that “insufficient research has been conducted in relation to how Covid-19 affected the educational system”.

Figure 2: School Facilities



Source: Livingstone Tanzania Trust (2020) LTT’s Hand Washing Appeal and UNICEF (2021) “Hand washing is the cheapest and most effective way to curb the spread of coronavirus” – UNICEF.

The ongoing Covid-19 pandemic places learners and teachers in many schools in a vulnerable situation. Curtis et al. (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”. Research has shown that, globally, only 50% of schools have access to water and soap for hand washing (Zar et al., 2020:4). Overcrowding, which is mainly experienced in public schools, increases the possibility of disease transmission. While schools in many countries were closed for a period of time in response to the Covid-19 pandemic, many South African schools provide essential nutrition to learners and closing them might 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”. Zar et al. (2020:4) add that “investments to improve basic sanitation facilities (Curtis et al., 2020), 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”. Pupils in many rural districts in LMICs lack water and soap for handwashing. This calls for maintenance and repair as well as infrastructural and behavioural change, ideally integrated into broader quality improvement plans. Such schools also require support from the local authorities to ensure that girls have access to sanitary pads.

Theoretical framework

Kummer, Herold, Dobrovnik, Mikl and Schäfer (2020) note that organisational theories enable those within organisations to understand phenomena. Theories and models enable the understanding and prediction of phenomena in a particular field. This study adopted the revised version 11.0 of the SCOR model that was developed in 1996 by the Supply Chain Council as

its theoretical framework (Supply Chain Council, 2012). The model focuses on supply chain management (SCM) from an operational process perspective and includes customer interactions, physical transactions, and market interactions (Zhou, Benton, Schilling and Milligan, 2011:332). It traces the way the processes interact along a supply chain and how they progress from a supplier's supplier to a customer's customer, enabling practitioners to identify the features that contribute to client satisfaction (Lima-Junior and Carpinetti, 2020:4). Kusrini, Rifai and Miranda (2019:2) describe the SCOR as a powerful tool to evaluate and communicate SCM in order to improve relations between a company, and its suppliers and customers (Kusrini et al., 2019). Weyers (2017:55) notes that, after modelling the supply chain, the reference model enables users to apply best practices and metrics that promote sound analysis and supply chain improvements.

The dynamic capability (DC) theory was developed by Teece, Pisano and Shuen (1999) to help organisations to understand their employee and management capabilities in times of change and to enhance their adaptability for survival. The growing use of technology from the early 1990s, accompanied by climate change and an increase in diseases and disasters, radically altered the way in which organisations operate. Teece, Pisano and Shuen (1997: 515) noted that schools, which are important building blocks in confronting these challenges, are thus called upon to embrace adaptation and innovation. The Covid-19 pandemic, a disaster that could not have been predicted and has had devastating results, challenges the operational routine, structure, and survival of all enterprises (Faulkner, 2001).

The study drew on the collaborative planning theory employed by Nguyen et al. (2017) to investigate school stakeholders' attitudes and obstacles to their collaboration. It also employed the chaos theory that Faulkner (2001) and Ritchie (2008) used as a lens to understand disaster management in the tourism sector. The chaos theory was employed to address the complex nature of the pandemic's impact on schools, the collaborative planning theory in relation to turbulence in the school environment, and the dynamic capability theory to examine change dynamics in schools within the framework of the SCOR model.

Literature Review

Components of the SCOR Model

The Covid-19 pandemic has dramatically changed the environment in which organisations operate, calling for a review of policies, plans and procedures. Among other things, schools have had to reconsider the number of learners in classrooms, as well as their sanitation policies and procedures, and ensure that PPE is available. Planning is the first component of the SCOR model, and it involves a macro view of all resources required to enable improved utilisation of capacity to deliver a given product or service along the supply chain system to the end customer (Edwards, 2018:65). Planning for WASH involves developing plans to ensure that schools have a seamless supply chain to deliver water, sanitation and hygiene services. The second component of this model is procurement with proper oversight by the public authorities. The global supply chain has been disrupted by the Covid-19 pandemic, negatively impacting procurement, operations and logistics (Wiley and Sons, 2020; Queiroz et al., 2020; Ranney et al., 2020).

The third component of the SCOR model describes the activities associated with the conversion of materials or the creation of content for services. Heizer, Render and Munson (2021:36) define operations management (the making process) as "the set of activities that creates value in the form of goods or services by transforming inputs into outputs". In the context of this study, it is the critical process of adding value to WASH for the seamless functioning of

schools. In the time of Covid-19, it involves transforming scarce raw materials into goods and services to meet demand in a timely manner. The make process focuses on value creation within all elements of the supply chain system including the manufacturing process, testing products, quality control, packaging, stock control and fulfilment (Edwards, 2018; Ranney et al., 2020). Recent studies have noted that PPE shortages during the pandemic resulted from operations' inefficiency due to disruptions caused by shortages of imported raw materials. Factory shutdowns and bans on travel and PPE exports exerted significant strain on PPE supply chains (Wiley and Sons, 2020).

The fourth SCOR process is delivery, which describes the activities associated with the creation, maintenance and fulfilment of customer orders (Supply Chain Council, 2012), transportation, warehousing and distribution to the right end customer. According to Kusrini et al. (2019:5) delivery, "means that [the] supplier always delivers with the right quantity, quality and price and never run[s] out of stock". Rural areas often have poor roads and challenges may be experienced in delivering sanitation/PPE and hygiene products to schools on time in the right quality, negatively impacting service delivery. Queiroz et al. (2020) suggest "that logistics and supply chains play an essential role in coordinating and integrating the multiple members' activities including manufacturers, transportation, hospitals, and government". In terms of Covid-19, supply chains should ensure an adequate flow of medicines and other products such as sanitation and PPE to avoid materials shortages (Queiroz et al., 2020).

The return process is the fifth component that describes the activities associated with the reverse flow of goods. Many rural schools lack proper waste management plans, especially with regard to used PPE and sanitary pads. 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 (Zar et al., 2020). This poses high risks to learners and staff and could force schools to close.

The enable process is the final SCOR component that is associated with the management of the supply chain and focuses on dimensions such as reliability, responsiveness, agility, and cost and asset management (Heizer, Render and Munson, 2021). Edwards (2018) describes this process "as a support to the management of practices of protocol's performance management and reporting data, resource, facilities, governance and risk and overall contract management and compliance (Edwards, 2018; Curtis et al., 2020). In the context of modelling the basic health and sanitation supply chain, the cost is an internal challenge. The six primary management processes of SCOR were the main focus of this study.

Supply Chain Management Under Covid-19

Supply chain management is crucial for any organisation that aspires to profitability and overall growth. It establishes seamless processes and develops sound partnerships with suppliers and customers. Supply chain management aims to maximise value and thus enhances competitiveness via improved effectiveness and efficiency (Wright, 2016; Mostert et al., 2017) for better utilisation of resources (Heizer, Render and Munson, 2021) and greater customer satisfaction (Lima-Junior and Carpinetti, 2020). In the context of schools, SCM involves the management of operations information, value-adding processes, procurement and budgeting along the supply chain from upstream and midstream subsidiary suppliers to the ultimate customer (schools), including disposal of waste. A supply chain is a network of organisations with upstream and downstream linkages that engage in different processes and activities that produce value in the form of products and services for the ultimate customer (Du Toit and Vlok, 2013; Weyers, 2017). Ivanov (2020) notes that supply chains are the backbone of

economies and society. Supply chain management is associated with government performance (Subburaj et al., 2020) to properly plan operations, procure supplies, localize the production of goods and services, distribute them to urban and rural citizens and manage the disposal of waste using performance processes, reporting data, resources, facilities, governance and risk management and overall contract management and compliance (Heizer, Render and Munson, 2021) to prevent corrupt activities. Kumar, Chibuzo, Garza-Reyes, Kumari, Rocha-Lona, and Lopez-Torres (2017) and Mostert et al. (2017) identified several factors that significantly influence the relationship between supply chain partners, and concluded that high levels of interdependence are vital for effective integration of systems.

Subburaj, Sriram and Mehrolia (2020:231) highlighted that supply chain integration is embedded in cooperation, coordination and collaboration among various members of the supply chain. Mostert, Niemand and Koetze (2017:1-16) noted the need for synchronized processes and the exchange of high-quality information. Supply chain integration (SCI) enhances procurement processes and promotes flexible logistics. It enhances the quality of outputs from suppliers, and the visibility, transparency and quality of information for improved delivery of goods and services.

While safe sanitation systems start from well-designed, appropriate toilet facilities, provision must be made for the removal, transport, treatment, and reuse or disposal of excreta (Taylor and Maruyama, 2020:27). According to Amadi, Yakubi, Iro, Azuamah and Ukah (2020:413), schools should adopt norms and standards for sanitation infrastructure to avoid absenteeism and school dropout, and to enhance learning and increase school attendance, particularly among girls. Ivanov (2020), notes that 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” (le Roux and Dramowski, 2020). Ejelonu, Feng and Mckeen (2020:17) state that sanitation can deteriorate when a community has inadequate wastewater management and poor access to clean drinking water. 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). 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.

Research Methodology

Research design

The research methodology “refers to the theory of how research should be undertaken” (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 (Creswell, 2021; Saunders et al., 2020). An exploratory study calls for qualitative research (Saunders et al., 2020). Exploratory research is usually undertaken when not much is known about the subject under study, inferring that little research has been conducted on the topic (Sekaran, 2020; Saunders et al., 2020). A qualitative approach was used for the study. Qualitative research is an umbrella term that encompasses a family of approaches based on inductive reasoning that aims to gain an in-depth understanding of participants’ points of view. Data is gathered in the participants’ natural settings by means of interviews (Creswell and Poth, 2018; Denzin and Lincoln, 2018).

Research Paradigm and Philosophy

Ontology, which refers to “the nature of our beliefs about reality” (Bryman, 2021: 349), provides the foundation for a study. The ontological question for this study was: “What can be known about the reality that exists in high schools in relation to water, sanitation and hygiene?” (Bryman, 2021: 349). Interpretivism rejects the view that a single understanding of reality exists independent of one’s senses and states that the truth can be universally known. Interpretivism believes that multiple realities exist (Guba and Lincoln, 2005: 204). The aim of interpretive research is to discover and unpack ‘real truths’ that exist about knowledge, in the case of this study, in the context of water, sanitation and hygiene in high schools (Saunders, Lewis, and Thornhill, 2019: 108). Interpretivism was adopted for this study (Saunders et al., 2020) because the researchers sought to understand the participants’ views on the basic sanitation supply chain based on their experiences. “An interpretive philosophy [is] a very broad term that embraces research methodologies that deal with phenomena by analyzing [participants’] experiences, behaviours and relations” (Basias and Pollalis, 2018). Researchers generally review the literature on the topic in order to identify theories and ideas to better analyse the data.

The study also drew on constructivism which holds that knowledge is constructed rather than received from an objective world or external reality (Lowenthal and Muth, 2008). In the context of this study, schools actively construct knowledge of WASH and reality is determined by their experiences. In relation to the Covid-19 pandemic, they use their previous knowledge of WASH as a foundation to address the new dimensions introduced by the pandemic.

Finally, an inductive approach was adopted to support the exploratory strategy to understand the impact of the Covid-19 pandemic on supply chain processes in relation to sanitation and hygiene among high schools in Ngaka Modiri Molema, North West Province.

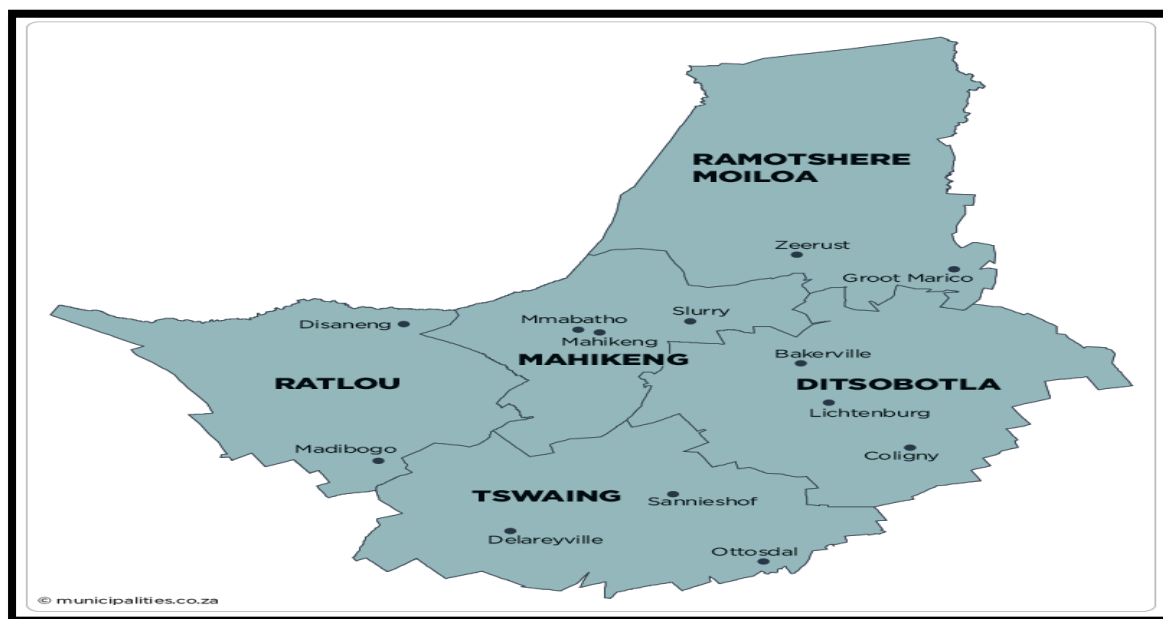
Sampling strategies

Probability sampling, in which the elements of the population have a known chance of being chosen for the sample (Sekaran, 2020), as well as stratified sampling, were used to select the sample for this study (Saunders et al., 2020). The unit of analysis was high schools in North West Province in the district municipality of Ngaka Modiri Molema, which includes the towns of Mahikeng, Lichtenburg and Zeerust. A total population of 13 high schools was selected, with a target sample of 23, comprising ten heads of schools; four deputy heads; seven School Governing Body (SGB) members; a Deputy Director and a Supply Chain Administrator of PPE in Ngaka Modiri Molema District Municipality. 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 schools’ overall operations and strategic plans, while the Supply Chain Administrator was charged with the administration of PPE during the pandemic.

North West Province 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; Ratlouw and Tswaing. Thirteen high schools were selected, with all five local municipalities covered. Ethical approval was obtained from the University of KwaZulu-Natal’s Ethics Committee and a gatekeeper’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 the

interviews commenced. They were also informed that participation was voluntary and that confidentiality was guaranteed.

Figure 3: North West Ngaka Modiri Molema locality Map



Source: Municipalities (2021)

Data Collection and Analysis

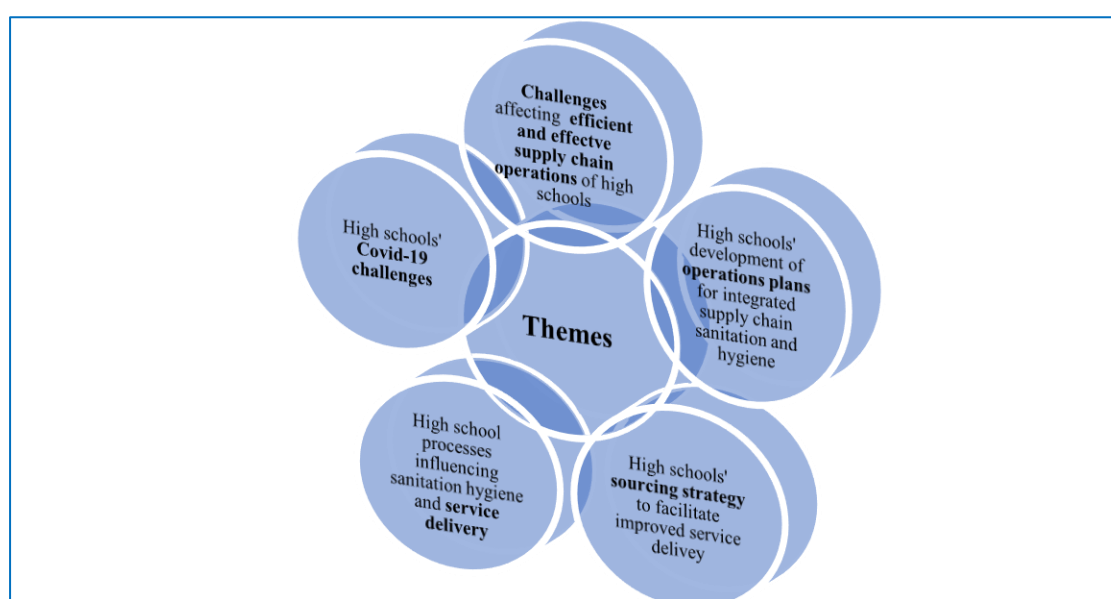
All Covid-19 protocols were observed during the face-to-face interviews and telephonic interviews were held when the interviewee was not available to meet, or was in isolation due to Covid-19. Semi-structured interviews were conducted with heads and deputy heads of schools; SGB members the District Director and Administrator of PPE to collect data on the challenges affecting high schools' efficient and effective sanitation supply chain operations. Semi-structured focus group discussions, which involve bringing a group of respondents 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 the school was interviewed together with the SGB member, which is represented by (F).

Saturation: For qualitative 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 groups of 14 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 researchers concluded 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 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 NVivo software package was used to sort the collected data into categories and identify the subsets according to specified criteria. The researchers 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). It is also useful for summarising the key features of a large data set, as it provides a well-structured approach to handling data, helping to produce a clear and organised final report (Stahl and King, 2020). The following steps were followed:

The *first phase* was familiarising ourselves with the data by reading and re-reading the transcripts. The responses were aligned with the themes from the literature review. The initial codes were generated during the *second phase*. The *third phase* involved searching for themes produced by NVivo software. Figure 4 below sets out the themes.

Figure 4: Themes



Four of the themes relate to the study’s research objectives, with an additional theme on challenges that emerged in high schools as a result of the Covid-19 pandemic.

During the *fourth phase*, 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 in NVivo. The *fifth phase* was defining and naming themes, which were repeatedly refined to generate clear explanations and names. The *sixth phase* was producing the report, which involved analysing the data in relation to the research objectives and the literature review in order to produce a comprehensive, well-thought-out report.

Findings

The *first objective* was to examine the challenges affecting efficient and effective sanitation supply chain operations in high schools.

Theme 1 revealed numerous challenges, including a lack of water, communication, a renovations and maintenance budget, and sanitation and hygiene products; as well as vandalism and female learners' absenteeism during their menstrual cycle.

The *first challenge* was the lack of water. F8 stated that *"The major challenge is water that dried up in 2020 from the borehole erected in the last five years – 2015"*. Schools that rely on water piped from villages face even greater challenges. Participants noted that *"schools don't have sufficient boreholes and water supply comes from the village through a pipe system. The scanty water supply led to learners staying at home with no water for five days in the village. Sometimes the municipality operates water-shedding"*. The shortage of JoJo tanks also creates problems. A participant added that, *"the water from JoJo does not pressurize to the new toilet structure"*. F5 added that *"the toilets don't flush; learners have to use a bucket and drain water from the tanks and fill the toilet to flush"*. The high temperatures tend to dry up the boreholes.

The *second challenge* was poor communication among stakeholders in the education system. Participants bemoaned that *"the Department of Basic Education has been using the priority rule system in scrutinizing the submitted schools' challenges and problems [causing long] waiting times"*. Thirdly, vandalism results in the destruction of school infrastructure: *"Vandalism and learners breaking toilets, and the toilets that are closed [call for a larger] renovation and maintenance budget"*. The *fourth challenge* related to the need for improved water and sanitation services in response to the Covid-19 pandemic. Participants confirmed that *"they are now able to buy a cleaning chemical since ... Covid-19 pandemic coupled with stands with water and soap for washing hands. ... learners bring their toilet papers although the schools provide hygiene products during Covid-19"*. However, F5 argued that *"there are no soap and toilet rolls in the toilets before and after Covid-19 [or] basins"*. This suggests that the pandemic brought about some changes in schools when it comes to sanitation and hygiene products, as many did not have access to such products prior to it.

The *fifth challenge* revolves around absenteeism due to menstruation and the disposal of sanitary pads. One in four girl children does not attend school when they are menstruating, while some attend school without sanitary pads. Participants noted *"a dearth of sanitary pads (as a result the school experienced high absenteeism)"*. It was noted that *"Not every child comes from a family that is well off. Most of our children in school come from poor backgrounds. You give them a packet of sanitary pads expecting that packet to last a month. But it ends up being used by the whole family and finishes quicker"*. F5 raised the problem of disposal of sanitary pads *"when those pit toilets [are] fully overloaded and disposal bins are either fully utilized or displaced in other toilets"*. 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. F5 stated that *"there was Sanitary Dignity Project [with] DBE providing pads alternatives [and] making funds available ... to procure sanitary pads from service providers. The supplier ... committed to sustaining a supply in schools, [but] schools encountered [a] dwindling supply stream after Covid-19 started abating"*.

These challenges could be addressed by high schools adopting the SCOR model in their processes as well as supply chain integration (SCI). Dilapidating infrastructure and the shortage of working boreholes and JoJo tanks created water shortages prior to and during the Covid-19 pandemic in rural schools. This disrupts teaching and learning, with learners sent home when no water is available as they are unable to practice basic hygiene like washing hands. A lack of water also means that flush toilets no longer operate, which forces schools to open pit toilets

that had been abandoned. Most schools are unable to buy water. It was also noted that many girl learners are absent during menstruation.

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). Schools receive limited budget allocations for maintenance and private sector donations dried up to the hard financial times caused by the Covid-19 pandemic. Mostert, Niemand and Koetze (2017:1-16) describe SCI as a synchronised process to share high-quality information across the supply chain. It was also found that there is poor communication between high schools and the department to mitigate sanitation supply chain challenges. Some participants noted that their schools had been trying for years to communicate the challenges to a higher level to no avail.

The *second objective* was to establish the extent to which high schools engage in planning, sourcing and operations processes for integrated sanitation supply chain delivery.

Theme 2 revealed that operations and maintenance plans exist in the high schools, with participants stating that “*the plan is formulated and drafted with [the] school governing board (SGB) and further reviewed in the annual meeting*”. Focus groups 2, 4, 5 and 7 concurred that “*there are operational plans and [a] maintenance plan*” while participants 2, 3, and 5 noted that “*the schools have the maintenance plan, school budget for the cleaning materials, transport; cleaning materials; consumables as allocated by the department*”. The DBE asserted that, although schools are not involved in the operations plan, the department has the responsibility to at least engage them in the process.

Theme 3 focused on the sourcing and procurement of sanitation and hygiene products such as soap, toilet paper, wipes, masks and sanitizers.

Without a sound sourcing strategy, wrong decisions may be made in selecting a supplier during the bidding process. Participants stated that “*most of the schools are using the same company as a supplier of chemicals since it ... assists schools with credit. However, there is no contract with the supplier; only our preferred local supplier*”. Focus groups 8, 2, 5, 7 and 8 noted that the “*supplier of chemicals is a black company with reliable delivery of products except in an urgent situation when schools use our own transport*”. In terms of sourcing PPE, especially during Covid-19, “*schools are able to link into the system and source from local suppliers in the area. PPE was procured by the head office without the direct involvement of a district except for signing delivery notes for correct products, correct quality and quantity and correct location. The supply chain policy is confined to three base quotations without a contract*”. P7 stated that, “*there are small suppliers in Mahikeng who procure from large suppliers located in Gauteng where local suppliers’ pricing impacts the schools’ budget considering an exorbitant markup*”. These responses show that although these high schools do not have a contracted supplier, there is a commonly preferred supplier that offers credit. Sourcing from a sole supplier contravenes effective supply chain practices and can result in poor supply chain performance and a lack of agility and customer responsiveness.

Theme 4 focused on service delivery, including reliable delivery of sanitation and hygiene products and an efficient mode and frequency of transportation. According to F5, F7, P5 and P3, “*the supplier delivers to school and sometimes schools use the middle man with [a] van*

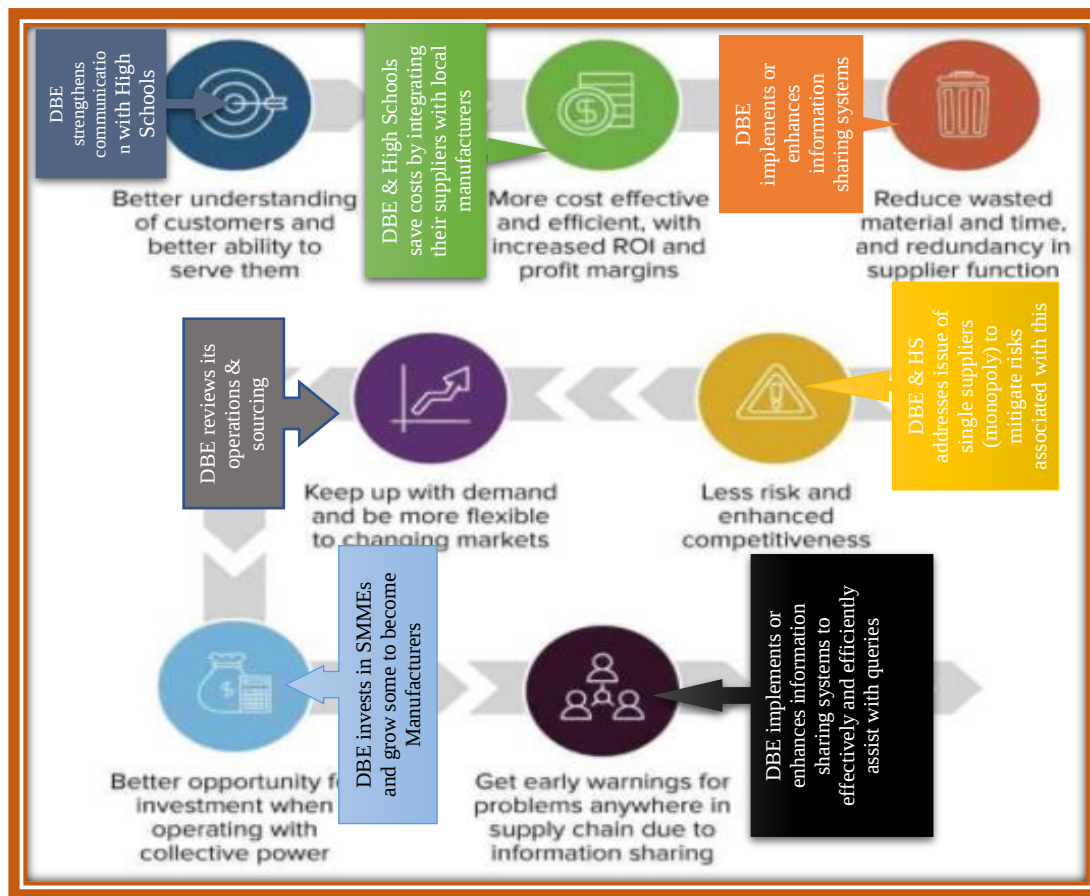
suitable for delivering hygiene products". It also seemed that schools did not know if the supplier was using the correct mode of transport. F8 stated that *"In terms of frequency, when things are normal, we buy in bulk and per semester"*. P4 and P3 advised, *"Our frequency is per term"*. F2 noted, *"We buy once per semester as we buy in bulk. Sometimes it happens that we buy twice in a semester"*. F5 remarked that *"We top up as and when."*

The participants reported that high schools are only responsible for the development of a maintenance plan linked to the budget allocation from the DBE. They buy on credit and pay the service provider once the budget allocation is made available. The preferred supplier used by the schools 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 and establish a long-term supplier-buyer relationship for sound sourcing practices. The operations process influences sanitation, hygiene and service delivery and procuring from major suppliers in Johannesburg increases logistical costs as the small Mahikeng suppliers 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).

Theme 5 on the challenges that emerged due to Covid-19 raised concerns around PPE including sanitizers and masks, thermometers; cleaning schedules; and social distancing.

Sanitation and hygiene products are highly recommended by the WHO and the United Nations Children's Fund (2020) to prevent the spread of Covid-19. The participants identified a number of challenges that confronted their schools during the pandemic especially the shortage of water. It was also noted that *"delivery by service providers is district-based descending to sub-districts since no school [is] allowed to operate without water and sanitizers. The pressure of Covid-19 compels the schools to exhaust their limited budget from irregular delivery and supply of sanitizer, masks and PPEs. Crowdfunding from teachers mitigates the ... shortages and waiting times to procure additional masks, sanitizers and other supplies such as PPE"*.

Scheduling of cleaners before and after Covid-19 *"depends on the total number of learners."* The participants noted that *"the department allocated two cleaners during Covid-19, with payment ... by the department over the contractual agreement of 10 months"*. Social distancing was initially a challenge when schools reopened. Participants alluded to *"overcrowded classrooms and poor attendance since some learners have not yet returned. The major challenge emanates during lunch breaks with minimum or no supervision"*. P4 added that, *"Social distancing was very difficult where learners had to be moved into a hall for sufficient space until the block system of alternative days or weeks attendance by group ameliorated the challenges."* Schools struggled during the first reopening under Covid-19. Some opened on time, but many did not due to the unavailability of sanitation and hygiene products.

Figure 5: Benefits of supply chain integration

Source: Marker (2017) and Researchers (2021)

Data Quality Control

Data quality control confirms that the data gathered, and instruments utilised are acceptable and relevant to achieve the set goals in a consistent manner (Rubin, 2009). Qualitative research considers people's views, experiences and attitudes using various sources of information or data to understand social behaviour (Yin, 2011). "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, 2016:66). Trustworthiness, dependability, credibility, transferability, and reproducibility, were employed to ensure the trustworthiness of this qualitative study. As noted by Lincoln and Guba (1981, p. 35), credibility is used to evaluate trustworthiness (Saunders et al., 2019, p. 6). It involves using purposive sampling to "capture a wide range of perspectives and experiences, designing a question guide with relevant questions that promote introspective and in-depth discussion, using a combination of qualitative instruments (interviews and focus groups), and collecting data until saturation to ensure comprehensive interpretations of the data" (Baumgart, Craig and Tong, 2021:539). To ensure credibility, the recent literature was reviewed, and articles were sourced from credible scholarly journals with a rigorous review process. Dependability concerns consistency and

reliability in terms of the study's repeatability in different contexts using the same research methods with similar participants. Triangulation involves the use of a range of sources. It was achieved by conducting in-depth interviews and focus group discussions. In terms of transferability, the interviews and focus group discussions were recorded and transcribed by the researchers and the data was analysed using NVivo. The conclusions are easily transferable to other high schools. The study also achieved conformability by ensuring that the findings reflect the data gathered from the study informants/participants in order to address the research objectives.

Discussion of Findings

The study found that high schools in Ngaka Modiri Molema District, North West Province confront complex sanitation supply chain 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, and promote transparency and the free flow of information. 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. According to the Supply Chain Council (2012), "the processes section in SCOR provides a set of predefined descriptions for activities most companies perform to execute effectively their supply chains" Kusrini, Rifai, and Miranda (2019:1) note that the SCOR model describes the business activities that can be linked to each other in order to satisfy customer demand. The DBE is solely responsible for the development of the *operations plan* while schools are responsible for the maintenance plan and 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.

It is the DBE's responsibility to plan for a sufficient and regular supply of sanitary pads for girl learners in high schools. The high schools do not have a *sourcing strategy* and use a single supplier of sanitation and hygiene products. 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. In order to address these issues, the DBE should work with SMMEs to grow and sustain their businesses and train high school staff on sourcing strategies for better management of their budgets. The *operations process (make)* arose during data collection in relation to the 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 markup on the goods. The DBE should work with SMMEs to encourage local production of PPE. A single *supplier delivers* the products and sometimes schools collect using their own transport. 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 the correct delivery protocols. It

was evident that waste management (*return*) 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. The department should engage with the local authorities to ensure a more efficient waste management system. According to the Supply Chain Council (2012), the “*enable* process is associated with the management of the supply chain”. Edwards (2018:67) describes this process “as a support to the management of practices of protocol’s performance management and reporting”. 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.

Implications of the Findings

The Covid-19 pandemic has had a significant impact on schools. The majority of 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 argued 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 sanitation supply chain challenges. Subburaj, Sriram and Mehroliia (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 ... 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).

The Departments of Water and Sanitation, and Public Works and Infrastructure 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. 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. 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. A clear communication strategy is required between the DBE, sub-districts and schools to ensure that schools receive sufficient PPE. The DBE should liaise with local manufacturers to produce sanitary pads in North West Province. It was found that most schools dispose of waste including sanitary pads by burning them in the schoolyard. The DBE needs to ensure that the local municipality collects waste from schools. Together with the local municipality, schools could reach agreements with service providers to collect waste and transport it to the landfill.

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. They 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. The DBE should encourage schools to build relationships with many vendors and suppliers. It should also build relationships with SMMEs that promote their growth and sustainability and train school staff to better manage their budgets. In terms of *Make*, Ngaka Modiri Molema does not have a strong manufacturing base and the DBE should encourage and assist local SMMEs to produce goods such as sanitary pads. Turning to *Delivery*, schools must insist on the delivery of quality goods in the right quantity and on time, using the correct mode of transport.

Contribution of the Study

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 sanitation supply chain 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 developing 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 the sanitation supply chain.

Conclusion

The data gathered from the participants reveals the significant challenges impacting high schools' sanitation supply chain 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 which 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 not 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 sanitation supply chain operations. Future studies should examine the reconstruction and development of schools' infrastructure, and waste management in the context of the circular economy.

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