European Journal of Logistics, Purchasing and Supply Chain Management
Vol.7 No.2, pp.35-56, April 2019
Published by European Centre for Research Training and Development UK (www.eajournals.org)

THE IMPACT OF LIQUID PETROLEUM GAS (LPG) SUPPLY-CHAIN CHALLENGES ON RURAL HEALTHCARE SERVICE DELIVERY IN ZIMBABWE.

Gladys Makhanda
Mancosa Graduate School of Business,
16 Samora Machel St, Durban Central,
Durban, 4001, SOUTH AFRICA
Email: ir@mancosa.co.za

O. Pwaka
Mancosa Graduate School of Business,
16 Samora Machel St, Durban Central,
Durban, 4001, SOUTH AFRICA
Email: ir@mancosa.co.za

ABSTRACT: *Rural hospitals in Zimbabwe have consistently faced energy challenges, especially in powering machines which are critical in hospital operations. This issue is exacerbated by the erratic electricity supply from the national grid. This study was therefore initiated with the aim of establishing the extent of LP Gas (LPG) use in rural hospitals. Key areas of the study were to ascertain the major benefits and challenges accrued from the use of LPG in rural settings as alternative energy sources and the possible strategies to enhance the effectiveness of using LPG in vaccine programmes in rural hospitals. The research processes adopted a mixed methods philosophy and the population was composed of 320 individuals, which comprised nurses, laboratory staff, pharmaceutical department and maintenance staff, from provincial hospitals, private LPG suppliers, as well as non-governmental organisations (NGOs) involved in the purchase and supply of LPG.*

KEYWORDS: alternate energy sources; rural hospitals; supply-chain.

INTRODUCTION

The research focuses on the impact of Liquid Petroleum Gas (LPG) supply-chain challenges on rural healthcare service delivery in Zimbabwe. The topic was selected owing to the growing importance and use of LPG in hospitals in developing countries like Zimbabwe as it offers such advantages as being inexpensive and safe to use, and the ability to be used in rural settings where electricity is a challenge, among others. However, LPG unavailability and shortages continue to be experienced in Zimbabwe and this is one of the reasons why the proposed study seeks to establish the supply-chain challenges leading to these shortages and the possible strategies that can be used to manage these challenges.

Background of the study

There has been an increase in the demand for energy worldwide. This increase has often been met through electricity, particularly in the developing nations. However, the demand for electricity and energy has been difficult to meet, especially given the rapid growth in the populations of these countries as well as the high levels of poverty which make electricity unaffordable. Three billion people on a global scale are still using traditional fuels such as coal, dung, charcoal and wood for cooking. Most of the people without access to reliable energy sources are concentrated in Africa, as shown in Figure 1.1.

ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

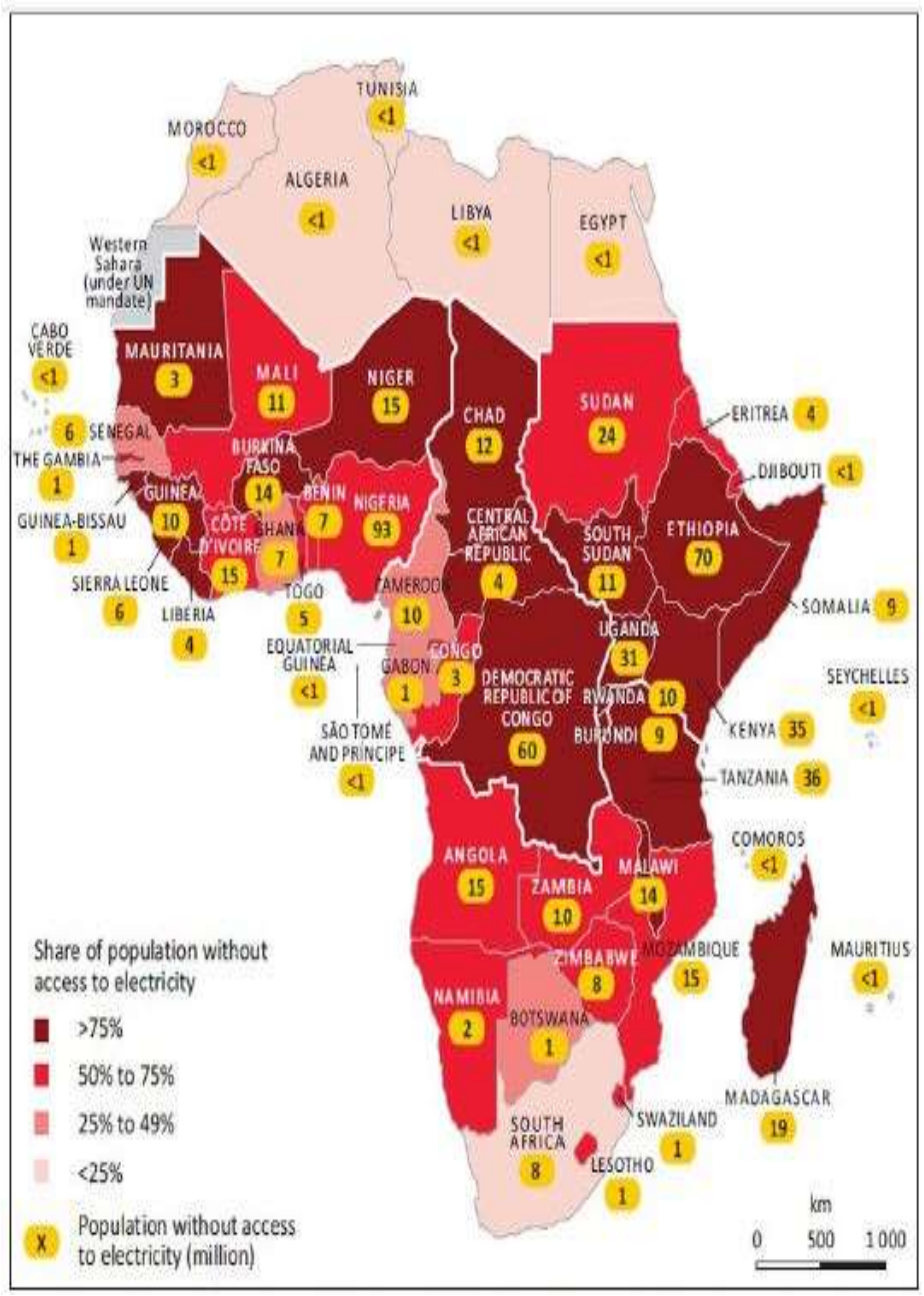

Figure 1.1 Access to electricity in Africa

Source: (Avila, Carvallo, Shaw & Kammen, 2017)

The map above in Figure 1.1 shows the levels of access to electricity in Africa, which shows that most Africans remain in areas where electricity is inaccessible or in short supply. Because of the poverty and rapid growth in populations, most African households, particularly those in the rural areas, continue to depend on traditional fuels which are unreliable and environmentally damaging. Osoro (2015) states that there are various petroleum products which can be used to meet the energy demands of African communities. These sources can be used for various purposes in the home and in industries such as cooking, heating and lighting (Osoro, 2015).

ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

Liquid Petroleum Gas (LPG) is emerging as an important energy source that is mostly viewed as the most viable alternative to electricity. Miniaci, Scarpa and Valbonesi (2014) describe it as a combination of various gases, such as propylene, butane and propane.

Problem statement

Even though LPG has been widely adopted as a sustainable and effective energy solution particularly in the remote areas of Zimbabwe where conventional energy sources like electricity are scarce, there have been challenges negating the effectiveness of this novel energy source in the country. With electricity being too expensive and in short supply owing to increased national demand against depressed generation, LPG has presented a ready solution, particularly for the less developed rural areas. In these areas, the delivery of health services has remained compromised as most of these areas are either not electrified or have erratic electricity supplies. This often compromises the functioning of refrigerators which health institutions need for vaccine storage.

Furthermore, it has been suggested that the LPG monitoring is not systematic nor consistent and that the usage of LPG for sterilization by reproductive health is not effectively monitored. Above this, end-user monitoring of LPG usage within UNICEF is not consistent or systematic. These challenges necessitate a study to understand the supply-chain issues and challenges leading to LPG shortages or unavailability within key District Hospitals in Zimbabwe, where it is a necessity for vaccine storage.

Objectives of the study

The objectives sought to determine the major benefits and challenges of LPG in rural settings and the effect on vaccine losses in hospitals. Strategies to enhance the effectiveness of LPG usage is considered.

Significance of the study

Theoretically, the study contributes to major academic debates in the terms of supply-chain issues, particularly the effects of shocks within the supply-chain, demand and supply bottlenecks as well as the general theory on the usefulness of outsourced suppliers to public health organisations like the District Hospitals. The study will also form the bedrock for the understanding of the LPG supply-chain in Zimbabwe especially since LPG is a relatively new and potentially more beneficial energy source as compared to other sources like electricity, solar and generators.

The study will be of benefit for staff in district hospitals to understand the issues within the LPG supply-chain so as to be better prepared for the challenges that they can face, which can compromise health delivery and service quality. To the government, the study will highlight the critical issues within the LPG industry that may need new regulations and or re-evaluating existing legislation. The study will also benefit the private LPG supplies by providing in-depth information on the expectations of their public health markets so that they can be able to improve their services.

ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

LITERATURE REVIEW

A supply-chain is defined as the integrated and coherent network for the physical flow of goods from suppliers for the distribution of finished products to designated users (Troncoso & da Silva (2017). A supply-chain can also be defined as a complex, non-linear web of relationships that exists in the supply of a product or service to end customers. Accordingly, Troncoso and da Silva (2017) define supply-chain management as the planning and management of all activities involved in sourcing and procurement, conversion and all logistics management activities. Supply-chain management (SCM) is built up of a combination of philosophies aimed at the management of the total flow of a supply network from suppliers to the final commodity user. The rationale of having a supply-chain is to make sure that consumer satisfaction, quality improvement, cost reduction, and service improvement are achieved. Also, supply-chain also involves synchronization and cooperation with distribution partners who can be either suppliers, intermediaries, third party service providers or even the final consumers (Surajit & Dhalla 2010).

Key supply-chain success factors

The success of supply-chain management is hinged on supply-chain planning. Surajit and Dhalla (2010) define supply-chain planning as the planning of necessary activities required for effective operations throughout the supply-chain. These encompass the purchasing of raw materials required in the manufacturing process, purchasing material necessary for product development as well as the product shipment. Such functions require aggressive and substantive planning to swiftly react to the increasing consumer commodity demand while flexible as well.

The vital expenses of supply-chain planning are in materials, marketing, distribution, production and finance. The supply-chain system also includes planning processes such as the materials-planning processes for both within the manufacturer and also amongst supply-chain partners. The most important and crucial components are logistics requirements, sales management, operations management, manufacturing requirements and capacity constraints (Miyake, Junior, & Favaro 2010).

In distribution, there is time-phased planning which is mainly used by retail outlets that receive products frequently. Time-phased planning allows only the scheduled deliveries to avoid product and traffic congestion at the warehouse (Miyake, Junior, & Favaro 2010), in sales-forecasting, there is capacity planning that is widely used in cases of future predictions based on sales forecasts and estimated inventory amongst others using the time-phased planning. All these give room for the users to be able to root out future constraints in time to come up with strategic alternatives. Scheming a supply-chain system begins with an inclusive plan for future estimated necessities for the end merchandise (Miyake, Junior & Favaro, 2010). The estimate is derived from input from marketing and, where applicable, firm orders from clients, anticipated orders and 'promised' but not yet booked orders. When these estimates are established, all the end products are put together as demand for the production. Eventually, 'the total demand is translated into capacity requirements, the aggregate demand into resource requirements of material quantities and labour/machine hours using appropriate standards to establish production capacity.' (Wieland & Wallenburg, 2011).

ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

Designing the supply-chain network of companies is preceded by specifying the basic business objectives. These involve developing, producing and delivering a product or service or both to customers or end-users for financial reward or profit. A supply-chain design may also be referred to as the process of setting up the supply-chain infrastructure and logistics elements which include determining the location and the plant capacity, distribution centres and transportation modes, among others (Wieland & Wallenburg, 2011). It is relatively easy for a company which produces just one product to convert aggregate demand into production units, but this becomes more complex for companies that produce a diverse range of products.

The literature shows that most scholars, such as Miyake, Junior, and Favaro (2010) and Wieland and Wallenburg (2011) agree that supply-chain success is hinged on supply-chain planning. There is convergence on the contention that the success factors of a supply-chain include comprehensive planning of such supply-chain functions like production, marketing and distribution as agreed to by (Miyake, Junior & Favaro, 2010). Jacoby (2009) suggests the need for future supply-chain forecasts. These inconsistent findings make the literature on the success factors for supply-chain largely inconclusive.

Supply-chain models

There are various models which exist for supply-chains. Gokhan and Needy (2010) state that these models include Pull versus Push Supply-chains, Process-Oriented and Customer-centred Supply-chains, Functional Supply-chains and Future Supply-chains. The literature on each of these models is discussed in the sections below.

Pull versus push supply-chains

There are two common types of supply-chains: 'push' systems and 'pull' systems. The Pull system refers to the request made by least member of the distribution network usually the retailer and this kind of strategy is when the retailers pull the product through the distribution or supply-chain network. The problem with this kind of strategy is that it has to find its own ways where demand penetration point can be pushed as further as possible (Skjott-Larsen, Schary, Mikkola and Kotzab, 2007). However, the pull system is made possible through information sharing about real demand wherein partners within the supply-chain are able to supply themselves as in accordance with the market needs. There is also the decoupling point where you find inventory committed to a specific consumer or market and this decoupling point is synchronized with the moving of the demand penetration upstream (Blanchard, 2010). The decoupling point symbolizes an uprising trajectory from forecast-driven activities to demand-driven activities.

A demand-driven supply-chain is moved by three key elements which are coping with the aggressive demand which entails moving the demand-penetration point further upstream and also the utilization of mass- customization strategies through the creation of alert and responsive supply-chains which involve demand relying on inventory and also information sharing by the supply-chain network so that they improve their performances. The integration of demand and supply-chain lead to the existence of a dynamic value-chain network model (Msoffei, 2017).

Laan, Beaton and Presta (2010) that within the 'push' system, the master production schedule (MPS) is used by the supplier at the beginning of the network and usually the manufacturer produces the finished products or service. This MPS is designed in such a way that it uses

ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

consumer demand based estimations to determine production and is usually manipulated to suit the available resources available at the manufacturing site.

The push supply-chain design use forecasts for their manufacturing and material flow decisions while wholesalers usually forecast consumer demand through retailer's order due to poor logistics management, the top-notch supply-chain partners face a challenge of having to carry more than enough inventory and also increase the production costs as they do not have access to customer demand patterns (Blanchard, 2010). The medical industry relies on the pull system whereby, they rely on the consumers or clients making their demands known to pharmacies or medical suppliers and these organise delivery with the transport-logistics company.

Process-oriented supply-chains

The process-oriented concept or also commonly known as the process-centric concept makes use of the internet connectivity or the EDI to make sure during the supply-chain information flows coherently. The process-oriented supply-chain involves organisational design, change and performance management. A complete process of the supply-chain concentrates on the functional cycles such as the customer order cycle and procurement cycle and there is a need to create suitable infrastructure that supports the process. This is of great importance as it leads to the ground-breaking support of process set up or creating databases to support the supply-chain processes (Gokhan & Needy, 2010).

Customer-centred supply-chains

The customer–centred supply-chain focuses on the one person who carries weight known as the "real" currency in the supply-chain, therefore, making the customer decision making to purchase a product ignites relative activity within the whole chain' (Gokhan & Needy, 2010). Supply-chains that are focused on consumers are customer driven hence they make sure that amongst other functions, there is increased alignment in functional organs and that they also synchronise with the supply-chain and mostly improve consumers interest (Masami, 2013).

This concept of customer-focus in a supply-chain necessitates for the focal point in which these are the members of the supply-chain on consumer satisfaction. Jacoby (2009) believes that what is of importance is to actually get to understand or gain knowledge of consumer needs thereby making customer-focus supply-chain create a more unified and less convoluted relative understanding within the supply-chain. Customer satisfaction is derived from the deliveries made or either nature and thus supply-chain gains information from providing such delivery services at a very low cost as compared to their rivals who will have to invest in research and development. (Mulupi, 2012).

This type of approach also makes the upstream distribution effective as they no longer make prompt decisions but well-informed decisions and also it improves the financial disbursements it uses value chain to improve marketing and financial performance. On the other hand, value-chain management seeks to understand value based on consumer satisfaction, thereby making customer value of the benefit in terms of product improvement and brand quality improvement. Value is realised the moment the consumer acknowledges reception of goods or service products (Troncoso, Armendáriz & Alatorre, 2013).

ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

Functional supply-chains

Functional products relate to those goods or services that are common and are purchased regularly, a day-to-day illustration could be that of grocery shopping from supermarkets or hyper store and these are known as consumer goods. Consumer goods are meant for personal satisfaction of consumers' basic needs and thus these goods are easy to predict their demand and they have a wider lifespan which is inherent of harsh competitiveness leading to very low profit margins. Whereas innovative products are erratic and novel products which have unpredictable demands which could be very unstable as they fluctuate thereby attracting a higher profit margin and a shorter lifecycle, at times only a few months (Wieland & Wallenburg, 2013). Most enterprises in the supply-chain do not show and tell their pricing systems but most leading corporates in that very field will be now forced to approach the issue as sensitive as possible with other value chain partners so that they can come up with a general pricing data as detailed pricing is not important at first. In the interest of progress, all chain members should be showing a willingness to avail this information and work together towards one goal of reducing both supplier and customer costs. (Troncoso, Armendáriz & Alatorre, 2013).

Future supply-chains

Successful future supply-chains according to Jain and Benyouncef (2007) include such features as strategies, technologies, people and systems. The ever-growing general populace will always affect the environment, hence it should also be taken into consideration that the ecosystem will be devastated by the size in the growth of the population and also the merging of technologies that rely on metals that are extracted from the ground and also re-engineering (Jain & Benyouncef, 2007).

Extent of liquid petroleum gas (LPG) use in rural hospitals

Academic literature suggests that LPG has been adopted to a great extent in developing countries like Zimbabwe, although there is a great silence on the extent of its use in public health institutions. Kojima (2011) suggests in thirty percent of the countries worldwide, or more than one-half of all households use LPG as their prime cooking petroleum. Kojima (2011) also contends that income determines LPG use such as accessibility, consistency of LPG supply, other fuel prices, cost of purchasing or acquiring LPG cylinders and stoves, safety issues, unfamiliarity with making use of LPG as cooking fuel, poor education about LPG and cultural preferences. On the other hand, Gujba, Mulugetta and Azapagic (2015) studied the life cycle, environmental impacts and costs of the household cooking sector in Nigeria and established that LPG is used to a wide extent in the form of stoves which are deemed alternatives to the highly expensive electric stoves and to the highly inefficient wood stoves. The figure below analyses the factors which affect the supply and demand for LPG.

The major factors affecting the demand for LPG include such issues as marketing, distribution, financial constraints as well as consumer preferences. The factors which enhance the demand for LPG include the increases in the prices of alternative energy sources like charcoal. For the factors affecting the supply of LPG, the lack of infrastructure, price caps and supply constraints from South Africa limit the supply of LPG (Falzon, Vignati, Halstead, van der Linden and Pols, 2013). For the factors which increase the supply of LPG, new infrastructure is the major factor.

Abubakar (2014), in his examination of the influences of sustainability implementation on the competitive performance of oil and gas companies, relates the use of LPG to sustainable supply-

ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

chains in the industry. The LPG has increasingly become a dominant energy source owing to such business drivers as the aspiration to safeguard energy, proliferate market shares and improve competitiveness (Abubakar, 2014). However, a close examination of these and other related studies reveals that there is a critical empirical gap on the extent to which LPG has been adopted in the hospital sector, and more so in the rural hospitals.

Possible strategies to enhance the effectiveness of using LP gas in vaccine programmes in rural hospitals

Supply-chain disruptions have terrible resultants on firms and therefore there is a rising need to manage them effectively. Ashok and Harikrishna (2013) confer on the rationale of a proactive imminent plan to alleviate and recover from these disturbances. To alleviate supply-chain disturbances, organisations should assess risks and design proactive activities prior to destructive.

Organisations in a supply-chain are in closer relationships than in markets that expose them to risks coming from both inside and outside the chain. It is a fact that risks may bring positive value to the company and acknowledging their existence is critical (Amanam, 2017). Nowadays, organisations tend to prefer a less vertically integrated structure and since the early 1990s, numerous companies have implemented various initiatives in the supply-chain to increase revenues and to reduce costs (Ashok & Harikrishna, 2013). This has increased the complexity however and has made the chains more vulnerable to various risks from inside and outside.

As buying LPG cylinders can be a barrier to the use of this fuel type, one of the recommended strategies has been making use of smaller cylinders which are less costly as Toft, Beaton and Lontoh (2016) suggest that this has been done in Indonesia. Toft et al. (2016) also suggest that strategies that lowering the refilling costs of the gas can also enhance its use. However, Kojima (2013) argues against the use of small gas cylinders as he states that they lead to increases in the unit prices of the gas. He gives the example of how small cylinders led to price increases in Senegal (Kojima, 2013), a position which is also reiterated by Ekouevi and Tuntivate (2012).

Another type of subsidy consists of helping with the start-up costs (stove, cylinder, installation), either by giving them for free, lowering the purchase price or offering the option of payment in instalments. MEER (2015) says that this last option is being tried in Ecuador where the government introduced induction stoves and the payment is made through the electricity bill in 12 monthly instalments. The stove can be purchased from any retail store and the import of induction stoves is not subject to tariffs (MEER, 2015). This strategy is generally of little help to the poor since because they do not have the financial means to make payments for the even use of LPG throughout and other clean fuels unless these subsidies are coupled with fuel subsidies, or unless the prices of alternative fuels are also higher, as in the case of Haiti and in some Guatemalan urban sets (Lascurain, 2016; Kojima, 2013).

Many factors need to be considered before claiming that affordability is the only problem that needs to be solved. Economic incentives to buy clean fuels should be combined with awareness campaigns and promotion strategies, such as introducing smaller cylinders in the market. Realisation of the occurrence of stacking should not deter efforts to promote clean fuels and technologies as the best option to promote good health. As stated by Lascurain (2016), even when stacking diminishes the benefits of using clean technologies and fuels, it is important to consider that adoption is a process. For example, a home that is already using a clean fuel or technology

ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

is more likely to use it more frequently if circumstances improve. It is also more likely that the next generation will choose a clean solution if available (Troncoso et al., 2013). Energy needs and cooking practices can change as people access a higher level of development; for example, in urban Central America, most people no longer make tortillas but buy them, which reduces energy needs (Troncoso et al., 2013).

Lascurain (2016) is of the opinion that governments, donors and international agencies need to collaborate and send a clear message to stop promoting only intermediate solutions, like improved biomass stoves. Instead, options for the transition should be diversified and clearly communicated, always promoting a portfolio of possibilities, highlighting the importance of a transition towards the exclusive use of clean fuels. In the perspective of Kojima (2013), a significant factor in the implementation of a new technology or fuel is the ability to manage the risks, perceived and real. These include the time invested in learning to use the new technology, the possibility that it does not fit traditional cooking practices, concerns with safety, and the potential financial challenges of managing payments for the fuel using a different time schedule (Kojima, 2013).

Lest the economic situation of the poor improves substantially, subsidies and cash transfers will be needed to reduce these risks, and effectively provide the poor with access to clean technologies and fuels. Figure 2.1 presents a model which shows how supply-chain solutions can impact on a hospital's performance.

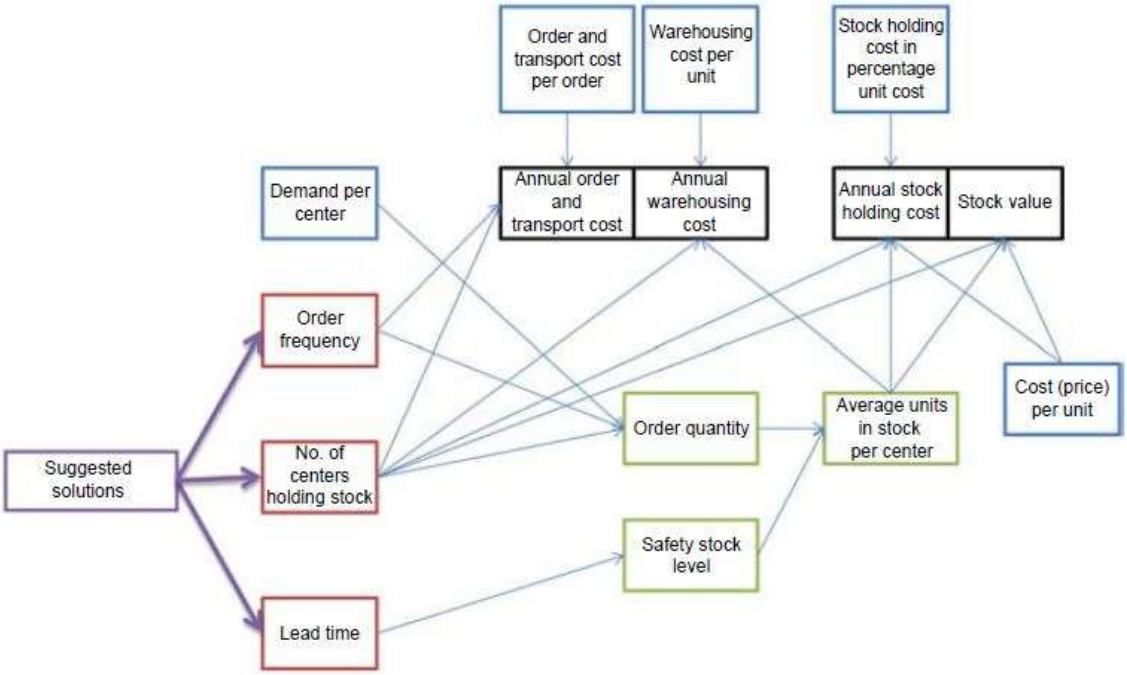

Figure 2.1 Model for the quantification of solutions' impacts on hospital performance
Source: Jahre, Dumoulin, Greenhalgh, Hudspeth, Limlim and Spindler (2012)

As shown in Figure 2.1, the suggested supply-chain solutions can affect the demand, order frequency, stock levels, and the lead time for LPG supply. These, in turn, determine other LPG supply-chain variables such as the quantity ordered, the stock level and the costs of the order (Jahre et al., 2012). According to Dhanabhakyam and Sumathi (2014), supply-chain challenges can be managed easily by having supply-chains incorporate in their culture the necessary means

ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

of dealing with potential risks and having a supply-chain professional looking after these channel processes.

Although the best long-term solution of handling such uncertainties will be to introduce an integrated supply-chain risk management (ISCRM) programme at a tertiary level such that the current students will learn and adopt the system so as to drive the risk management in the corporate world. Dhanabhakyam and Sumathi (2014) recommend a four-step planning process to avoid such events from happening and these are identifying the key locations of the supply-chain, estimate probabilities and losses for each location, evaluating the alternative measures for each location and also selecting necessary measures for a specific location. They also perpetuate a designed framework that identifies three sources of risk which are usually supply side, demand side and catastrophic.

Andrea, Marjan, Dikolela and Hostettler (2017) also have their own discoveries where he places supply-chain risks in four classifications which are mainly, supply risk, process and control risks, environmental and sustainability risks, and demand risks. According to Chege (2013), the process of identifying risks is a key activity on which all other aspects of the process are based. Nevertheless, it is rather impossible to lose all risk factors and thus the identification only helps cover ground on the most important risks in relation to their effect on the supply-chain. Mostly inter-organisational actors have access to intimate knowledge about the organisation and its positions, but they do not have the capacity of risk identification. These organisations cannot rely on their own information and unprofessional procedures, thus they need formal arrangements (Chege, 2013).

From the above literature, academic debates on the strategies to mitigate LPG supply-chain challenges are not conclusive. Whilst Chege (2013) suggest proactive planning, and the use of cost reduction measures and finds support in Toft et al. (2016) yet Kojima (2013) argues against this by stating that it can lead to increases in the unit prices of the gas. Lascurain (2016) places the responsibility of managing LPG supply-chain challenges on governments, donors and international agencies whilst Kojima (2013) puts it on LPG firms which have to use new technology, among other internal measures to which he is supported by Jahre et al., (2012) who suggest such internal measures as controlling the quantity of LPG ordered, the stock level and the costs of the order. These positions show how academic literature is inconclusive on whether or not LPG supply-chain management is a proactive or reactive process, whether or not cost reduction measures are effective in managing LPG supply-chains and whether or not the responsibility of ensuring LPG supply-chain effectiveness is the responsibility of LPG firms or other external stakeholders like Governments.

Theoretical framework: The new public management theory

The New Public Management (NPM) Theory states that public services come from new public and this theory originated in the early 1970s in the United Kingdom, Australia and New Zealand. Since its conception, it has come to fruition that it's now a dominant factor in the public sector reform and is addressed as a new epitome. According to Andrews and Steven (2013), different factors led to the emergence of NPM, some of which are: fiscal crises of governments, poor performance of the public sector in different arenas, imperious bureaucracy, lack of accountability, corruption, changes of people's expectations and the emergence of better alternative forms of service delivery. In other words, government was poorly performing by

ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

being non-accountable and irresponsive to the beneficiaries, while on the other hand there has seen a wave of competitive private sector customer-oriented strategy; all this called for customer-oriented, result driven, and effectively enterprising government.

Andrews and Steven (2013) state that the NPM emphasized the need for modern bureaucracy with no traditional bureaucracy so as to reinvent government and changing its role from rowing to steering. Thus, NPM heralds the transformation of the civilian into a consumer of public product and services, who pays for these products and the chance to provide feedback on public service provision, as Andrews and Steven (2013) suggest. Daft and Marcic (2014) add to this by stating that as per NPM viewpoint the contemporary government should be customer-oriented, competitive and result oriented, therefore auditing has a possibility to play a role in relation to the enhancement effective government services. The rationale of this concept of new public management is used to fortify the need and importance of internal auditing in the public sector is now a dominant factor in the public sector reform and is addressed as a new epitome. According to Andrews and Steven (2013), different factors led to the emergence of NPM, some of which are: fiscal crises of governments, poor performance of the public sector in different arenas, imperious bureaucracy, lack of accountability, corruption, changes of people's expectations and the emergence of better alternative forms of service delivery. In other words, large government was poorly performing being non-accountable and irresponsive to the beneficiaries, while on the other hand there has seen a wave of competitive private sector customer-oriented strategy; all this called for customer-oriented, result driven and effectively enterprising government.

Conceptual framework

The conceptual framework of the study is shown diagrammatically in Figure 2.2.

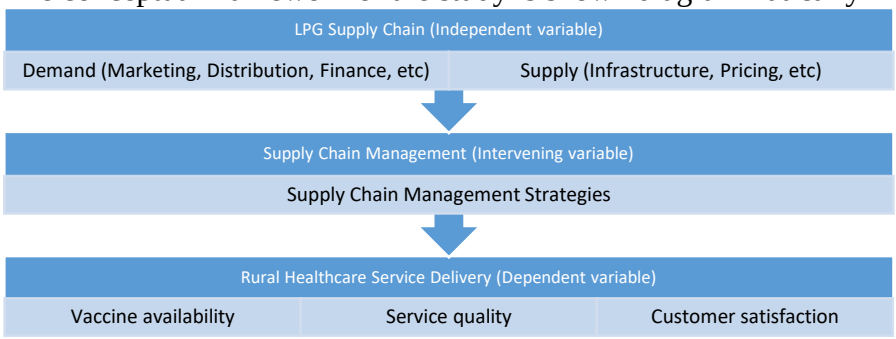

Figure 2.2 Conceptual framework of the study

Source: Primary Data

As presented in Figure 2.2, the independent variable in this study was the LPG supply-chain whose variables were the demand for LPG (in the terms of the gas' marketing, distribution and financing, among others) as well as its supply (in terms of the necessary delivery infrastructure and gas price, among others). The intervening variable in the study was supply-chain management activities and strategies undertaken by LPG firms and other stakeholders. The dependent variable in the study was the rural healthcare service delivery as denoted by the three variables of vaccine availability, hospital service quality and the level of customer or patient satisfaction with the hospitals' service. This relationship between the method of supply-chain management and the service delivery and functional effectiveness of the supply-chain is supported by such scholars as Daft and Marcic, 2014.

ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

RESEARCH METHODOLOGY

A case study design was chosen as a research design in order to better illustrate a more detailed picture of the study in each case in a way that overviews and statistics typically cannot (Yin, 2009). The focus of the study is to obtain a holistic, in-depth investigation of a given phenomenon (e.g. impact of LPG supply-chain challenges). A case study is deemed a descriptive, exploratory analysis of a person, group or event. In clarifying lines of impact of Liquid Petroleum Gas (LPG) supply-chain challenges on rural healthcare service it was more useful to select subjects that offer an interesting, unusual or particularly revealing set of circumstances (Thomas, 2011). A case selection that is based on representativeness will seldom be able to produce these kinds of insights. When selecting a subject for a case study, the researcher used information-oriented sampling, and then random sampling within that population as a case was selected as a key case, chosen because of the inherent interest of the case or the circumstances surrounding it.

For the purposes of the study, the researcher used descriptive research and exploratory research for collecting data and analysing information. The mixed methods is preferred in this study to take advantage of the benefits of both positivism and interpretivism. Kasi (2009) suggests that this is a rather more persuasive way used in social science. Whilst taking advantage of the objectivity that positivism offers, adopting an interpretivist perspective to the research process is beneficial as it offers greater insight into the complex business issues under study, as suggested by Saunders et al (2011). An interpretivist perspective allows the research study to be part of the research process in a manner that facilitates a greater understanding of the research phenomena, as Kasi (2009) also suggests that a mixture of the designs is beneficial as it allows for the triangulation of the study as well as to ensure its complimentarily as indicated by (Saunders et al, 2012). Thus, creating the use of both philosophies enriches the understanding of the singularities and the discoveries made during the study.

Research population

Kasi (2009) describes the population as a collective of individuals within a specific geo-spatiality under study. In this study, the research population includes provincial hospitals in Zimbabwe, private LPG gas suppliers as well as the non-governmental organisations (NGOs) which are involved in the purchase and supply of LPG gas in Zimbabwe, and composed of individuals from the 320 organisations. As the population of this study comprised of 320 organisations in Zimbabwe, the quantitative research sample of 97 was used as indicated by the formula suggested by (Sekaran & Bougie, 2010). The qualitative research sample included 12 managers involved in the supply and delivery of LPG in the hospitals who were selected through purposive sampling.

Data analysis

As the study is a mixed methods design, both quantitative and qualitative approaches were used to analyse data. The study made use of the Statistical Package for Social Science (SPSS) for a more rigorous data analysis. The data analysis was made up of three data analysis levels. At a low level, data were analysed using mean, mode and standard deviation. The second level was statistical analysis. This level of analysis used regression and correlation. The last level was the inference stage which applied Single ANOVA and multiple regression. The SPSS package was used to undertake such statistical tests such as regression, correlation and Analysis of Variance (ANOVA) at 95% level of significance.

ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

Qualitative data analysis

Thematic analysis was used as a qualitative analysis tool and this encompassed data collected from interviews and grouped into themes. Saunders et al., (2011) argue that thematic analysis is good in terms of accessibility and theoretically flexible making it easy to analyse qualitative data. Narratives that were based on these themes were produced and their findings were also cross-referenced with key literature. After data collection, the researcher can also read through the collected data which gave her an added advantage of getting different perspectives, views and opinions of the participants. Furthermore, the study used comparative analysis to compare and contrast data from different people.

Validity and reliability

To ensure that the results obtained in this study are valid, the research commenced with a pilot study to test the questionnaires. These respondents or rather participants who had been included in the pilot study were omitted from the final study. The pilot test of the questionnaires helped determine whether they were effective in drawing desired results which they were designed in order to meet the objectives of the study. Error detection of issues such as the existence of vague or leading questions were eradicated by either restructuring or deleting the questions. The researcher also ensured not to be personally involved in the distribution of the questionnaires so as to avoid unnecessary collective information instead of subject related answers during the data collection and analysis process. Triangulation was also implemented as a strategy to put checks and balances on the use of the research tools and hence to help make sure that the resultant findings were reliable and valid.

Limitations of the study

Participants gave information which was not satisfactory as they fabricated and withheld some valid information required during the research as they did not give much of their effort in helping improve the research.

The research was only limited to provincial hospitals set up. Data from provincial hospitals in Zimbabwe, private LPG gas suppliers and non-governmental organisations (NGOs) was used in the study. This limited the use of other private hospitals that are also using the same facilities.

The study evaluated only one type of energy resource and did not make use of methane and other gases.

Some of the questions were based on assessing hospitals failures and therefore some employees did not discuss or disclose some information as they feared for their jobs.

Budget deficits due to lack of finance to conduct the research on a daily basis as there were travel expenses, stationery and food to be included in the budget hence data capture was not easy.

Illiteracy was a problem in carrying out the research survey using questionnaires written in English therefore vernacular was used to express the questions by the researcher.

Elimination of bias

The researcher eliminated biasedness within the study by adopting the use of the right language to the specific ethnic group so as to avoid stereotype or ethnic labelling. The researcher avoided gender discrepancy. The research was defined to mostly those in the age group as it used statistics from hospitals and other institutions.

ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

Ethical considerations

This study applied the ethical principles of informed consent, confidentiality, anonymous participation as well as the freedom of withdrawal from the study. The researcher had to first obtain legal permission to carry out the study.

RESULTS

Out of a total of 97 distributed questionnaires, all 97 were returned completed, creating a percentage response rate of 100%. For the interviews, seven were successful out of the scheduled 12, creating a response rate of 58.3%.

Demographic details of the respondents

There were 30 females as compared to 67 males in the study. The females were therefore 31% of the total respondents whilst males were 69% of the respondents in the study. The gender distribution shows an alignment with the general gender distribution of African employee gender since the phenomenon of patriarchy refuses females from participation in mainstream economic activates (Chabaya & Gundhlanga, 2011). This was true in this study as the organisations included were of economic motive by nature, being hospitals, private firms of NGOs.

The majority of respondents were aged between 36 and 50 years while there were very few respondents who were above 50 years of age. Respondents with first degrees were most abundant, being 35% in the study. Those with academic diplomas were the second most abundant respondents in the study, being a total of 28% whilst those with postgraduate's degrees were third at 24%. Respondents with certificates as their highest academic level were 8% whilst 6% reported having secondary education and only 1% stated having the primary level as their highest level of education. The findings, therefore, show that most of the respondents had significant education, having Bachelor's degrees, Diplomas or Postgraduate degrees. 35% of the respondents had between 2 and 5 years in the organisation, which was the highest frequency recorded. Those with between 6 and 10 years in the organisation were the second most abundant group, being 22% whilst 21% was the percentage for both respondents with below 1 and those with above 10 years in their respective organisations. As such, most of the respondents in the study had significant experience and knowledge of the issues of LPG use, having served in the organisations for significant amounts of time. This was important in this study as such people could provide valid and reliable responses to the questions asked by the researcher owing to their familiarity with the issues and practical exposure to the research problem.

Research objective one: The extent of LP Gas (LPG) use in rural hospitals in Zimbabwe

The study determined the extent of adoption of LP Gas in rural hospitals. To meet these objectives, the adoption of LP gas, participation in LP gas procurement activities as well as the level of adoption of LP gas usage were examined. The majority (76%) of the respondents confirmed that the organisations had adopted the use of LPG whilst 24% said that the organisations were not using LPG. The findings agree with those of Kojima (2011) who suggests that there is a high extent of use of LPG in developing countries like Zimbabwe, with at least a third turning to these renewables energy systems as used in households for primary cooking fuel, most of which were upper-middle-income households.

ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

Participation in LP gas procurement activities

The findings on whether or not the respondents in the study participated in LPG procurement activities showed that 23% of the respondents in the study expressed that the organisation was not participating in LPG procurement activities whilst 74% of them suggested that the organisation was involved in the procurement. As such, the majority of the respondents in the study were from organisations which were actively involved in the procurement of LPG. The findings are important as they suggest that the respondents were people with knowledge on the issues surrounding LPG use, as Kojima (2011) contends that there can be such problems as fears about safety, unfamiliarity with cooking with LPG, lack of knowledge about the harm caused by smoke from solid fuels burned in traditional stoves, and cultural preferences.

Level of adoption of LP gas usage

83% of the respondents in the study highlighted that the organisations had adopted the use of LPG to a high extent. Those who suggested that their organisations had adopted LPG use to a medium extent were 16% of the total respondents in the study whilst 1% said the extent of LPG use in their organisation was low. According to these findings, the majority of the organisations, namely the provincial hospitals, the private LPG suppliers and the NGOs were making use of LPG. The high level of LPG use as established in this study is in line with the notion held by Abubakar (2014) who states that LPG has increasingly become a dominant energy source owing to such business drivers as the desire to conserve energy, increase market share and improve competitiveness.

Research objective two: Major benefits and challenges accrued from LP gas use in rural settings

The major benefits and challenges of using LPG in the rural settings were established. To this extent, the study examined whether the use of LP gas is beneficial to the hospital as well as the extent to which outsourcing leads to the achievement of strategic objectives. There was a unanimous agreement by all the respondents in the study that the use of the LPG has been beneficial to the hospitals. The unanimous agreement that LPG use is beneficial to the hospitals agrees with Asamoah, Amoakohene and Adiwokor (2012) who suggest that some of the major benefits of using LP gas include that the gas is affordable, efficient and friendly to the environment. The findings also confirm Kaburia's (2016) notion that LPG is beneficial as it provides reliable, convenient and efficient lighting, telecommunication services, transport, heating, clean water, cooking, healthcare and mechanical power.

Extent to which procurement leads to achievement of strategic objectives

The extent to which procurement leads to the achievements of strategies objectives in the hospitals was investigated. To this end, such strategic objectives of procurement as reductions in threats to drug storage, the enhancement of the hospital's day-to-day operations, enhancement to the hospital's service delivery and improvements to the overall hospital performance were investigated.

It is important to discover the mean of the extent to which the LPG procurement achieves strategic objectives as the mean is important in that the researcher can determine whether or not the results are really representative of the data. The mean for the extent to which the LPG procurement reduces drug storage threats was 3.4 whilst that for the extent to which it enhances hospitals' day-to-day operations was 2.9. The mean for the extent to which procurement enhances service delivery in the hospitals was 2.7 whilst that for the extent to which it enhances hospital

ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

performance was 2.8. Accordingly, the findings show that sound LPG procurement fairly helps hospitals to manage drug storage threats and also fairly leads to the enhancement of the hospital's day-to-day operations, service delivery and performance. The majority of these challenges are critical in the LPG supply-chain as Asamoah, Amoakohene and Adiwokor (2012) relate it to the existence of various stakeholders such as customers, retailers, distributors and producers as well as service providers. These challenges complicate the major functions of the LPG which R´ıos-Mercado and Borraz-S´anchez (2014) describe as to gather, transmit, and distribute products, LPG in this case.

Research objective three: Effect of LP gas supply-chain challenges on total vaccine losses in the rural hospitals

The study also focused on the effect of LPG supply-chain challenges on the total vaccine losses in the rural hospitals. To achieve this objective, the researcher focused on the major supply-chain challenges in the LP gas sector in Zimbabwe; the effect of challenges on hospital performance; the extent to which LPG supply-chain challenges knowledge is significant to supply-chain risk management; the significance of current risks to hospitals' supply-chain; the extent to which hospitals are affected by supply-chain problems as well as the effects of LPG supply-chain disruptions on the total vaccine losses.

The mean for the existence of supply-chain issues was 4.1 whilst 1.4 was that for the existing of demand-side issues. The mean for the existence of operational challenges was 1.5 whilst that for the existence of security challenges was 2.0. From these findings, it is clear that supply challenges exist significantly in the studied organisations, whilst those of demand, operation and security nature are insignificant in occurrence.

Effect of challenges on hospital performance

A correlation of the extent to which the supply-chain challenges are related to the performance of the hospitals in terms of vaccine storage was done. There was a significant correlation between the supply variables and the hospitals' technological performance, which was 0.878 at the $P<0.05$ significant level. Other significant correlations were obtained for the relationship between the LPG supply variable and the hospitals' ability to meet customer expectations, which was 0.687, the relationship between the LPG demand and hospital technological performance, which was 0.778 and between the hospitals' LPG operational variables and their customer expectations performance which was 0.550. This statistic concludes a strong positive relationship between technology and both demand and supply aspects of the LPG. The higher the technology application the higher the improvements in both demand and supply management of LPG distribution.

Extent to which LPG supply-chain challenges knowledge is significant to supply-chain risk management

The findings show that 57% of the respondents said that their LPG knowledge was somewhat significant, whilst 39% suggested their knowledge to be slightly significant. Those who suggested that their LPG knowledge was not very significant were 3% of the total respondents in the study whilst 1% said the level of their knowledge was not at all significant. None of the respondents in the study suggested that their level of LPG knowledge was very significant. The findings, therefore, show that there was a significantly high number of respondents with knowledge of LPG.

ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

Significance of current risks to hospitals' supply-chain

The findings show that 68% of the respondents in the study alluded to the fact that LPG risks are very significant. Those who suggested the risks to be somewhat significant were 21% of the respondents whilst 5%, 4% and 2% suggested the risks to be slightly significant, not very significant and not at all significant, respectively. The findings, therefore, suggest that the supply-chain risks are very significant in terms of the delivery of LPG to the studied hospitals.

Extent to which hospitals are affected by supply-chain problems

It is important to discover the mean of the extent of supply-chain problems as it determines whether or not the results are really representative of the collected data. 2.9 was the mean response for the existence of LPG delays whilst the mean for LPG delivery disruptions was 2.8. The mean response to the loss of key LPG suppliers was 3.2 whilst that for the problem of customer dependence was 3.6. The means for the existence of such supply-chain problems as forecasting errors, low-priced products, poor delivery capacity, poor technical skills, counterfeit products and information leaks were 3.6, 3.4, 3.6, 3.6, 3.4 and 4.2, respectively. These findings confirm the position that there are some considerable challenges met in the use of LPG due to the distribution model of the gas. However, the findings did not at all suggest that LPG can be challenged by the problem of a regulatory framework and as such differs from the suggestions made by the ESMAP (2007). Likewise, the findings of the present study did not confirm or deny the existence of distribution monopolies that can complicate the provision of all LPG-related services as suggested by Lascurain (2016).

Effects of LPG supply-chain disruptions

The findings suggest that LPG supply-chain disruptions greatly lead to product shortages, late gas deliveries, customer dissatisfaction, contractual disagreements, lawsuits and legal problems as well as bad organisational image. To a lesser extent, however, supply-chain disruptions lead to LPG product recalls demurrage charges and product counterfeiting. A mean of 4.6 was obtained for the effect of LPG supply-chain disruptions on LPG shortages, whilst a mean of 4.6 was obtained for its effect on LPG late deliveries. The means for the effect of supply-chain disruptions on LPG recalls customer dissatisfaction, contractual disagreements, lawsuits and legal complications as well as on bad organisational image were 1.1, 4.4, 4.2, and 4.2. For the effect of LPG supply-chain disruptions on demurrage charges and on product counterfeiting, means of 3.7 and 1.0 were obtained in the study.

These are some of the bottlenecks that need to be managed if the use of LPG in the studied hospitals is to be effective. In this light, the findings of the study agree with Surajit and Dhalla's (2010) position that the success of supply-chain is dictated by how well a company controls its supply base and mitigates supply bottlenecks and liabilities. The findings not only confirm Craighead, Blackhurst, Rungtusanatham and Handfield's (2007) definition that supply-chain disruptions are major breakdowns in the production or distribution nodes that comprise a supply-chain but also go a step further in specifying these specific challenges, in so doing filling some of the empirical gaps in current literature.

Research objective four: Possible strategies to enhance effectiveness of using LPG rural hospital vaccine programmes

The possible strategies that can be used to enhance the effectiveness of using LPG in rural hospitals vaccine programmes were also investigated. To this end, the research determined

ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

whether there are other strategies to enhance vaccine storage, the effectiveness of LPG fridge system in hospital performance and other aspects to include in the appropriate strategy for hospital LPG usage. The findings show that the LPG system is fairly effective in improving hospital technological performance.

The other strategies that must be included in the appropriate LPG usage policies in hospitals were investigated. Respondents from the survey have indicated that it of great importance that the hospital should employ LPG technicians. They also indicated that shortage of skilled technicians who can tackle the challenges brought about by LPG such as installation and routine monitoring of the gas tanks and connections. Despite the fact that hospitals are being supported by NGOs and private companies, most of the times these are once-off consultants and there is a need to have an in-house technician who can attend to the gas systems if there are any challenges.

Also, the LPG systems in the hospitals need to be supported through proper staff training on the use of the gas systems. There was an identification made by a number of hospital employees that most of the hospital staff are people without any practical knowledge as to what LPG is about. Such a dilemma will result in over maintenance of the systems as they need someone to open and close or mend them and it is costly for the hospital to keep on hiring outside private firms when its own employees can be trained to do that. It was noted that LPG systems can be enhanced by both employing trained artisans who can manage the LPG systems, as well as by training the hospital staff on the use and maintenance of the gas systems. The findings contrast with the position held by Toft et al. (2016) who state that one of the recommended strategies has been making use of smaller cylinders which are less costly as well as the use of LPG subsidies as suggested by MEER (2015).

CONCLUSIONS AND RECOMMENDATIONS

On the extent of LP Gas (LPG) use in rural hospitals in Zimbabwe, the majority of the respondents in this study suggested that they were making use of LPG in their organisations and that their organisations were actively involved in the procurement of LPG. It was established that the provincial hospitals, the private LPG suppliers and the NGOs were making use of LPG.

Benefits of using LPG

On the major benefits and challenges accrued from LP gas use in rural settings, all of the respondents in the study suggested that the use of the LPG has been beneficial to the hospitals. The study also established that sound LPG procurement fairly helps hospitals to manage drug storage threats and also fairly leads to the enhancement of the hospital's day-to-day operations, service delivery and performance.

Effect of supply-chain challenge

On the effect of LP gas supply-chain challenges on total vaccine losses in rural hospitals, it was established that supply challenges exist significantly in the studied organisations, whilst those of demand, operation and security nature are insignificant in occurrence. There was a significant correlation between the supply variables and the hospitals' technological performance, for the relationship between the LPG supply variable and the hospitals' ability to meet customer expectations, for the relationship between the LPG demand and hospital technological

ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

performance, and between the hospitals' LPG operational variables and their customer expectations performance.

Knowledge of LPG

The findings also showed that there was a significantly high number of respondents with knowledge of LPG as well as that the supply-chain risks are very significant in terms of the delivery of LPG to the studied hospitals. The study also established that LPG supply-chain disruptions greatly lead to product shortages, late gas deliveries, customer dissatisfaction, contractual disagreements, lawsuits and legal problems as well as bad organisational image**.**

Recommendations

This section presents the recommendations of the study. These recommendations are for the adoption of LPG use, for stakeholder coordination and support in dealing with LPG-supply-chain challenges and for staff training and employing LPG specialists in the rural hospitals.

Adopt LPG use

The study recommends that for those rural hospitals which have not yet adopted the use of LPG, they must do so as a matter of urgency. It was a finding of this study that in those hospitals which have adopted the use of LPG, they have been able to manage drug storage and to enhance their day to day operations, service delivery and performance. As such, rural hospitals which have not yet adopted LPG use must do so as it enhances their service delivery by providing a reliable, efficient, cheap and easily available energy source to use in their refrigerators as well as for other energy needs.

Stakeholder coordination and support in dealing with LPG-supply-chain challenges

The study concluded that stakeholders in the LPG sector must enhance their coordination through proper and routine consultations. This is one of the ways through which these stakeholders, who include the government, NGOs and private LPG suppliers, can manage to deal with challenges in the supply and delivery of LPG to rural hospitals. It was the findings of this study that there are LPG supply-chain disruptions which greatly lead to product shortages, late gas deliveries, customer dissatisfaction, contractual disagreements, lawsuits and legal problems as well as bad organisational image. Dealing with these challenges requires holistic stakeholder efforts.

Staff training and employing LPG specialists in the rural hospitals

It was noted that rural hospitals must train their staff on LPG use and maintenance. The study established that the use of LPG rural hospital vaccine programmes can be enhanced by both employing trained artisans who can manage the LPG systems, as well as by training the hospital staff on the use and maintenance of the gas systems. The hospitals are also advised to employ LPG specialists and to not solely rely on private firms as they may sometimes be unavailable to offer LPG support for the hospital LPG systems.

Areas for future studies

It is a commendation of this study that researchers in the future should try to focus on the same research topic using a bigger sample size. The researcher had financial and time constraints hence the study was a small sample whose results may be difficult to oversimplify particularly given the large size of the hospitals' sector. Also, the researcher did not have access to financial data for analysis and therefore relied on the usage of Likert Scale whose results did not permit for

ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

more unswerving statistical tests for the data, such as multivariate analysis. It is also recommended that future researchers should learn to apply data analysis models since they provide a more detailed and accurate understanding of the relationship between the study's variables through their capacity to take into reason more variables that are involved in this relationship.

Conclusions

Most provincial hospitals in Zimbabwe are making use of LPG and are actively involved in the procurement of LPG. LPG is also used, to a great extent, by private LPG suppliers and the NGOs which shows that a larger portion of organisations have adopted the use of LPG in recent years.

The use of the LPG has been beneficial to the hospitals and fairly helps them to manage drug storage and to enhance their day-to-day operations, service delivery and performance. There was, therefore, a unanimous agreement by all the respondents in the study that the use of the LPG has been beneficial to the hospitals.

LPG supply challenges exist significantly in provincial hospitals. There is a significant correlation between LPG supply and the hospitals' technological performance, the ability to meet customer expectations and hospital technological performance. However, LPG supply-chain disruptions greatly lead to product shortages, late gas deliveries, customer dissatisfaction, contractual disagreements, lawsuits and legal problems as well as bad organisational image

The use of LPG rural hospital vaccine programmes can be enhanced by both employing trained artisans who can manage the LPG systems, as well as by training the hospital staff on the use and maintenance of the gas systems.

Possible strategies

On the possible strategies to enhance the effectiveness of using LPG rural hospital vaccine programmes, there was a unanimous agreement that there exist other strategies which can be used to enhance vaccine storage in the hospitals. It was also established that the LPG system is fairly effective in improving hospital technological performance though it is largely effective in enhancing the service quality expectations of the customers. It was also revealed that LPG systems can be enhanced by both employing trained artisans who can manage the LPG systems, as well as by training the hospital staff on the use and maintenance of the gas systems.

References

Avila, N., Carvallo, J.P., Shaw, B. and Kammen, D.M. (2017) The energy challenge in sub-Saharan Africa: a guide for advocates and policy makers. Part 1: Generating energy for sustainable and equitable development. Oxfam Research Backgrounder.

Osoro, A. 2015. Challenges affecting performance of supply chain systems in the petroleum industries in Kenya. Journal of Energy Technologies and Policy, Vol.5, No.3, 2015.

Miniaci, R., Scarpa, C. and Valbonesi, P. (2014) Fuel poverty and the energy benefits system: The Italian case. The Center for Research on Energy and Environmental Economics and Policy, Bocconi University, Milano.

Troncoso, K. and da Silva, A.S. (2017) LPG fuel subsidies in Latin America and the use of solid fuels to cook. Energy Policy 107 (2017) 188–196.

Surajit R. and Dhalla R.S. (2010) Management of supply chain in petroleum corporations in India. Proceedings of the 2010 International Conference on Industrial Engineering and Operations Management. Dhaka, Bangladesh.

ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

Miyake, D.I., Junior, A.S.T., Favaro, C. (2010) Supply chain mapping initiatives in the Brazilian automotive industry: challenges and opportunities. Journal of Operations and Supply Chain Management, 3(1), 79-97.

Wieland, A. and Wallenburg, C.M. (2011) Supply-chain-management in stürmischen Zeiten. Berlin: Universitätsverlag der TU.

Jacoby, D. (2009) Guide to supply chain management: how getting it right boosts corporate performance. The Economist Books 1st ed. Bloomberg Press.

Gokhan, N.M., and Needy, N. (2010) Development of a simultaneous design for supply chain process for the optimization of the product design and supply chain configuration problem. Engineering Management Journal. 22 (4): 20–30.

Skjott-Larsen, P.B. Schary, H.H. Mikkola, T. H. and Kotzab. (2007) Managing the global supply chain. CBS Press, Liber, Copenhagen, Denmark.

Blanchard, D. (2010) Supply chain management best practices, 2nd ed. NY: John Wiley & Sons.

Msoffei, R.M. (2017) Increase in deforestation: a key challenge to household charcoal supply – a case of Tanga Urban, Tanzania. European Journal of Social Sciences Studies, Vol. 2 Issue 2.

Laan, T., Beaton, C. and Presta, B. (2010) Strategies for reforming fossil-fuel subsidies: practical lessons from Ghana, France and Senegal. The Global Subsidies Initiative (GSI) of the International Institute for Sustainable Development, Geneva.

Masami, K. (2013) The role of liquefied petroleum gas in reducing energy poverty. World Bank.

Mulupi, D. (2012) Gas company sees opportunity in Kenya's 'kadogo' economy. Available at: http://bit.ly/mulupikadogo; Accessed: 17 March 2017.

Troncoso, K. Armendáriz, C. and Alatorre, S. (2013) Improved cook stove adoption and impact assessment: a proposed methodology. Energy Policy 62, 637–645.

Jain, V. and Benyoucef, L. (2008) Managing long supply chain networks: some emerging issues and challenges. Journal of Manufacturing Technology Management, 19 No. 4.

Kojima, M. (2011) The role of liquefied petroleum gas in reducing energy poverty. Extractive Industries for Development Series, No. 25, December 2011. World Bank.

Gujba, H., Mulugetta, Y., and Azapagic, A. (2015) The household cooking sector in Nigeria: Environmental and Economic Sustainability Assessment. Resources, 4, 412-433.

Falzon, J., Vignati, F., Halstead, M., van der Linden, N. and Pols, D. (2013) Accelerating uptake of LPG in Maputo for lower income households: study to support scoping of an intervention.

Abubakar, T., (2014) A study of sustainability in the oil and gas supply chain. University of Central Lancashire, UK.

Ashok, T., and Harikrishna, A. (2013) Analysis of LPG Cylinder using composite materials. IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), Volume 9, Issue 2.

Amanam, U.U. (2017) Natural gas in East Africa: domestic and regional use. Stanford University, CA.

Toft, L. Beaton, C. and Lontoh, L. (2016) International experiences with LPG subsidy reform: options for Indonesia. International Institute for Sustainable Development.

Ekouevi, K. Tuntivate, V. (2012) Energy access for cooking and heating: lessons learned and the way forward. World Bank, Washington D.C.

MEER. (2015) Plan Nacional de Cocción Eficiente. Ministerio de Electricidad y Energía Renovable. Ecuador.

ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)

Lascurain, J. (2016) Market segmentation: improved cookstoves and clean fuels in Guatemala. Fast-Track Carbon. Global Alliance for Clean Cookstoves, Washington, D.C.

Jahre, M., Dumoulin, L., Greenhalgh, L.B., Hudspeth, C., Limlim, P. and Spindler, A. (2012) Improving health in developing countries: reducing complexity of drug supply chains. Journal of Humanitarian Logistics and Supply Chain Management, Vol. 2 Iss: 1 pp. 54 – 84.

Dhanabhakyam, M. and Sumathi, T. (2014) A study on customers attitude and satisfaction towards LPG in household, Coimbatore. The SIJ Transactions on Industrial, Financial & Business Management (IFBM), Vol. 2, No. 2.

Andrea, F., Marjan, S., Dikolela, K. and Hostettler, S. (2017) A review of sustainable energy access and technologies for healthcare facilities in the Global South. Sustainable Energy Technologies and Assessments xxx (2017) xxx–xxx.

Chege, S.M. 2013. Strategies adopted by Liquefied Petroleum Gas (LPG) companies to deal with the challenge of cross-filling activities in Kenya. University of Nairobi.

Andrews, R. and Steven, V. (2013) New public management and citizens' perceptions of local service efficiency, responsiveness, equity and effectiveness. Public Management Review. Retrieved August 8 2017.

Daft, R. and Marcic, D. (2014) Building management skills: an action-first approach. South-Western Cengage Learning.

Yin, R.K. (2009) Case study research: design and methods, 4th edition. Thousand Oaks: Sage, CA.

Thomas, G. (2011) How to do your case study, Thousand Oaks: Sage

Kasi, P. (2009) Research: what, why and how? A treatise from researchers to researchers, 1st Ed. Bloomington: AuthorHouse.

Saunders, M. Lewis, P. and Thornhill, A. (2011) Research methods for business students 3rd Ed. Essex: Pearson.

Sekaran, U. and Bougie, R. (2010) Research methods for business: a skill building approach, 5th Ed. Hoboken, N.J./Chichester: John Wiley and Sons.

Chabaya, O. and Gudhlanga, E.S. (2011) Striving to achieve gender equity in education: opportunities and challenges, paper presented at the Southern African Society for Education (SASE) Conference, University of the North, Pietersburg, South Africa, 27-29 September.

Asamoah, D., Amoakohene, R. and Adiwokor, E. (2012) Analysis of Liquefied Petroleum Gas (LPG) shortage in Ghana: a case of the Ashanti region. International Journal of Business Administration Vol. 3, No. 5.

R´ıos-Mercado, R.Z. and Borraz-S´anchez, C. (2014) Optimization problems in natural gas transportation systems: a state-of-the-art review. Los Alamos National Laboratory, Los Alamos, USA.

ESMAP. 2007. Haiti: strategy to alleviate the pressure of fuel demand on national woodfuel resources. World Bank.

Craighead, C.W., Blackhurst, J., Rungtusanatham, M.J., and Handfield, R.B. (2007) The severity of supply chain disruptions: design characteristics and mitigation capabilities. Decision Sciences, 38(1), 131-156.

ISSN 2054-0930 (Print), ISSN 2054-0949 (Online)