



# **Building a Diagnostic Tool: A Preliminary Exploration of Saudi Arabian Petrol Supply Chain Integration**

A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy of Supply Chain and Logistics

Ibrahim Mohammad I. Alhawas

BA Lang. German Language (King Saud University)

MBIT. Master of Business Information Technology (RMIT University)

School of Business IT and Logistics

College of Business

RMIT University

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## **Declaration**

I certify that except where due acknowledgement has been made, the work is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; the content of the thesis/project is the result of work which has been carried out since the official commencement date of the approved research program; any editorial work, paid or unpaid, carried out by a third party is acknowledged; and, ethics procedures and guidelines have been followed.

Ibrahim Mohammad I. Alhawas

19 February 2015

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## **List of Abbreviations**

Automated Fuel Management System (AFMS)

Business Process Management (BPM)

Collaborative Planning Forecasting and Replenishment (CPFR)

Customer Relationship Management (CRM)

Decision Support Systems (DSS)

Diffusion of innovation (DOI)

Electronic Data Interchange (EDI)

Electronic Funds Transfer (EFT)

Enterprise Resource Planning (ERP) System

Fuel Control Terminal (FCT-RT)

Fuel Third Party Logistics Providers (3PLs)

Global Positioning System (GPS)

Gulf Cooperation Council (GCC)

Information and Communication Technologies (ICT)

Information System (IS)

Information Technology (IT)

Jazan Economic City (JEC)

King Abdullah Economic City (KAEC)

Mail Transfer Protocol (SMTP)

Mixed-Integer Linear Program (MILP)

On-Board Diagnostic System (OBD)



Perceived E-Readiness Model (PERM)

Petroleum Refinery Integrated Supply Chain Modeller and Simulator (PRISMS)

Point of Sale Data (POS)

Prince Abdul-Aziz bin Musaed City (PABMEC)

Radio Frequency Identification (RFID)

Saudi Arabian Marketing and Refining Company (SAMAREC)

Saudi Standards Metrology and Quality Organisation (SASO)

Supply Chain (SC)

Supply Chain Management (SCM)

Systems, Applications and Products in Data Processing (SAP) System

Technology Acceptance Model (TAM)

Terminal Management System (TMS)

Terminal Management System (TMS)

The Arabian American Oil Company (ARAMCO)

The Ministry of Petroleum and Mineral Resources (MOPM)

The Technology-Organisation-Environment (TOE) Framework

Three-Dimensional Visual Information (3D-design platform)

Transaction Cost Economics (TCE)

## **Publications Associated with the Thesis**

The following paper was written as part of the research of this thesis:

1. Alhawas, I, Peszynski, K & Young, L 2013, 'Saudi Arabian Petrol Stations Supply Chain Integration', paper presented to 27<sup>th</sup> Australian and New Zealand Academy of Management Conference - ANZAM 2013, Hobart, Tasmania 4-6 December 2013

## Abstract

Petrol stations in Saudi Arabia are considered the lifeline of transportation in the Kingdom because the only means of transportation is either through the use of cars or buses. The major petroleum products to refuel vehicles in Saudi Arabia are petrol and diesel, pinpointing the importance of petrol stations in Saudi Arabia. However, Saudi Arabian petrol stations experience petrol delays and poor service quality. In addition, Saudi Arabian petrol stations utilise traditional petrol operational processes that include manually measuring petrol levels in tanks, testing for leaks and book-based accounting processes to minimise cost and increase profit.

Moreover, considering that approximately 90% of Saudi Arabian petrol stations are operated and managed by individuals, either locals or expatriates, this intensity to compete causes serious problems such as mixing petrol products to reduce petrol prices and thus, attract customers; defrauding petrol pump meters; wasting petroleum resources; and, petrol smuggling to nearby countries, leading to a shortage in petrol products in the domestic market. On the basis of the literature reviewed, this is considered as explanation source of uncertainty and quality problems that will consequently impact budgets and schedules. Hence, this study diagnoses and explores the key factors that influence the Saudi Arabian petrol supply chain to answer the research question, ‘how do the technological, organisational and environmental aspects of the Saudi Arabian petroleum industry impact on petroleum supply chain integration?’

The researcher developed a conceptual model and diagnostic tool, incorporating nine sub-factors based on the technology-organisation-environment (TOE) framework (Tornatzky & Fleischer 1990). The research employed a qualitative research methodology and hermeneutics to analyse the data. The researcher conducted a case study of rural and metropolitan petrol stations in Saudi Arabia, fuel haulers, petrol supplier (Saudi Aramco), and fuel third party logistics providers (3PLs). The research findings confirmed that the Saudi Arabian petrol supply chain is influenced by the technological (i.e. relative advantage and IT infrastructure), organisational (i.e. culture, religion, firm size and firm resources), and environmental (i.e. geographic location, competition intensity and government regulation) factors. This research also found that each factor has sub-categories that influence the operational performance in the Saudi Arabian petrol supply chain context.

# Chapter 1- Introduction

## 1.1 Introduction

This thesis is a study of operations based research in the supply chain context. The focus of this study is on the issues involved in three key areas - technology, organisation, and environment - that influence petrol supply chain integration. Describing the issues involved in these areas will help provide richness to an understanding of what contributes to enhance operational performance of the Saudi Arabian petrol supply chain.

## 1.2 Background of the Kingdom of Saudi Arabia

The Kingdom of Saudi Arabia occupies the greater part of the Arabian Peninsula, with the Red Sea and the Gulf of Aqaba to the west and the Arabian Gulf to the east. Neighbouring countries are Jordan, Iraq, Kuwait, Qatar, the United Arab Emirates, the Sultanate of Oman, Yemen, and Bahrain which is connected to the Saudi mainland by a causeway. Saudi Arabia has an extremely hot climate, with no rivers or fresh water lakes, and it has the world's largest continuous sand desert, the Rub Al-Khali, or Empty Quarter. Its oil region lies primarily in the eastern province along the Arabian Gulf (Figure 1.1)



Figure 1.1: Map of Saudi Arabia and the 13 provinces

Due to a high number of expatriates and a high rate of population growth, the population of Saudi Arabia is fluid, officially 29.95 million in 2013 (CDSI 2010). The population of expatriates can vary between 5.5 and 6.5 million (CDSI 2010). Arabic is the mother language and English is the lingua franca for social occasions and business purposes. All Saudi nationals are Muslims and Saudi Arabia is the holy seat of Islam. Religious affiliation is a mandatory requirement for citizenship. Islam is the basis of society and the constitution: the legal system, government and commercial transactions.

In terms of the oil industry, Saudi Arabia possesses the largest oil reserves in the world. According to the US energy agency (EIA 2014) , the Saudi Arabian crude oil reserves standing at 268.350 billion barrels. Furthermore, Saudi Arabia is the largest exporter and producer of oil in the world where the oil sector accounts for over 90% of total export earnings and over 75% of the country's total revenue (Squalli 2007).

### **1.3 Problem Domain**

Petrol stations in Saudi Arabia are considered the lifeline of transportation in Saudi Arabia because the only means of transportation in Saudi Arabia is either cars or buses. The major petroleum products to refuel vehicles in Saudi Arabia are petrol and diesel, pinpointing the importance of petrol stations in Saudi Arabia.

Moreover, according to the Council of Saudi Chambers, there are approximately 70,000 petrol stations in the country with only seven companies registered to manage and operate 10% of these stations (Avancena 2011). Approximately 90% of Saudi Arabian petrol stations are operated and managed by individuals, either locals or expatriates, who illegally rent petrol stations from Saudis and lease the station's utilities (e.g., groceries, car service utilities, etc.) to other expatriates through subcontracts (Alsaied 2011; Matar & Al-Zahrani 2011a). When interviewed on the *8.00 report with Dawood* (2012) the undersecretary of Riyadh region municipalities, Eng. Altwaigry stated that in the Riyadh region along the national highways, there were approximately 1000 petrol stations, and 400 of these petrol stations were not built in compliance with pre-construction regulations of the Ministry of Municipalities and Rural Affairs. This led to the intention that there is lack of surveillance from government authorities and no earnest legal implications if petrol station owners do not follow government regulations.

In addition, Saudi Arabian petrol stations utilise traditional petrol operational processes that include manually measuring petrol levels in tanks, testing for leaks and book-based accounting processes to minimise cost and increase profit (Groznik & Trkman 2006). However, these processes increase uncertainty in the petrol supply chain. Increased uncertainty contributes to the petrol supply chain complexity which includes increased potential for delivery delays and quality problems, consequently this will increase the chance of budget and schedule overruns (IEA 2006; Simangunsong, Hendry & Stevenson 2012). Moreover, approximately 90% of Saudi Arabian petrol stations are operated and managed by individuals, either locals or expatriates and this intensity to compete causes serious problems such as mixing petrol products to reduce petrol prices and thus, attract customers; defrauding motorists by tampering with petrol pump meters; wasting petroleum resources; and petrol smuggling to nearby countries, leading to a shortage in petrol products in the domestic market and quality problems.

In addition, owing to the geographical location of rural petrol stations and with Saudi Aramco's bulk plants located only in metropolitan areas, the distance from rural petrol stations to metropolitan areas is approximately 450 kilometres and thus, petrol tanker drivers have to travel approximately 14 hours to supply the customers (petrol stations). This is considered an issue that causes delays in terms of logistic operations. Moreover, owing to the fact that Saudi Aramco is a state-owned company and the only petrol supplier in Saudi Arabia, this highlights the lack of competition in terms of petrol supply.

On the basis of a literature review on supply chain integration, the importance of the cooperation and collaboration between the supply chain units e.g. (providers, retailers, distributors and customers) to establish tight partnerships with the objectives of reduced inventory, shorter lead times and better service to the customers has been emphasised. Therefore, exploring the Saudi Arabian petrol supply chain as well as performing a diagnosis on the factors that influence Saudi Arabian petrol supply chain integration would contribute to petrol supply chain integration. The following sub-section discusses the research question and the objectives of this research.

## **1.4 Objectives and Research Question**

This research aims to explore the Saudi Arabian petrol supply chain, as well as to perform a diagnosis to identify the key factors that influence Saudi Arabian petrol supply chain integration, based on the technology-organisation-environment (TOE) framework (Tornatzky & Fleischer 1990).

Based on the extant literature (discussed in chapter 2) and the resultant conceptual framework, the following primary research question was framed for this research:

- How do the technological, organisational and environmental aspects of the Saudi Arabian petroleum industry impact on petroleum supply chain integration?

While the major focus was on answering this primary research question, the research also aims to address the following sub-questions as an aid to better understand the primary question on the basis of the TOE framework:

- How do the technological aspects of the Saudi Arabian petroleum industry impact on petroleum supply chain integration?
- How do the organisational aspects of the Saudi Arabian petroleum industry impact on petroleum supply chain integration?
- How do the environmental aspects of the Saudi Arabian petroleum industry impact on petroleum supply chain integration?

Answering these sub-questions will help to determine the technological-organisational-environmental factors that influence Saudi Arabian supply chain integration. Hence, the researcher will be able to answer the primary research question. Petrol supply chain integration is the research proposition because it will help provide good service quality and competitive advantage whilst keeping cost and lead-times low. However, supply chain diagnostics is an important step before supply chain integration. Supply chain diagnostics means organisations perform a diagnosis on their supply chains for the same reason that a doctor might perform a diagnosis on a patient to identify any problems (current or latent) and ultimately develops a solution to ensure ongoing well-being.

Hence, to learn about integration, we need to diagnose the Saudi Arabian petrol supply chain first, and the outcome is a diagnostic tool that is a contribution to both research and industry. Organisations who apply the same diagnostic tool to their supply chain are typically successful at their implementing and sustaining healthy improvements across their supply chains (Allvine & Gore 2003). The next sub-section discusses the significance of the research.

## **1.5 Construction and Limitations of the Research**

On the basis of the literature review on the petrol supply chain and the theory on the technological-organisational-environmental contexts proposed by Tornatzky and Fleischer (1990), it was noted that

there was a lack of integration in the petrol supply chain. In addition, the majority of literature reviewed for the purpose of the research that applied the TOE framework has been heavily quantitative. Since TOE has been used for quantitative research only, this research using an explorative approach with TOE is original and has potential significant contributions to both research and practice. This is from the point of view of the originality and significance of the research. Therefore, the research is primarily aimed at addressing this inadequacy and exploring the research opportunity within this area of knowledge.

This study has some limitations that can provide direction for future research. This study focused only on two regions to diagnose and explore the petrol supply chain in Saudi Arabia. Moreover, the researcher selected three petrol stations those were located in Alkhurmah in the Western region, as well as three petrol stations and four fuel haulers in Riyadh, in the Middle region. The researcher interviewed fifteen interviewees from these respective units (petrol stations and fuel haulers). However the theoretical saturation approach has been adopted, which posits the notion the researcher no longer needs to conduct further interviews once no new insights are obtained, no new themes are identified, and no issues arise regarding a category of data (Bowen 2008). Furthermore, TOE may be perceived as too broad a concept. However, it has been found to be very useful and insightful in this study. This is because the broadness of this framework assisted in the identification of the factors that provided a rich understanding of how the Saudi Arabian petrol supply chain may lead to petrol supply chain integration.

## **1.6 Research Methodology**

In order to address the research questions using the TOE conceptual framework, the researcher has used a qualitative research method belonging to the interpretivism research paradigm. The research design has followed a case study research design by using qualitative data collection techniques.

The research has used a qualitative exploratory approach to understand the Saudi Arabian petrol supply chain in the context of operations management, from the perspective of individuals. Qualitative research is useful in cases where the researcher attempts to understand and explore what a technology or practice means to people (Kaplan & Maxwell 1994).



There are different strategies of inquiry in qualitative research for example, ethnography, grounded theory phenomenological research, narrative research, and case studies (Creswell 2009). ‘Case studies are a strategy of inquiry in which the researcher explores in depth a program, event, activity, process, or one or more individuals’ (Creswell 2009, p. 13). On the basis of the literature, a case-study method has been used in this research to answer the research question.

The sampling process started with primarily selecting petrol stations in Saudi Arabia that are supplied by the state-owned oil company, Saudi Aramco, which is the only provider of fuel in Saudi Arabia. Saudi Aramco owns 20 bulk plants (distribution stations) located in different metropolitan cities in Saudi Arabia. These cities are considered distant from customer locations, such as petrol stations and fuel haulers.

Based on the locations of Saudi Aramco’s petrol distribution centres and petrol stations, the research sorted into two investigative areas: rural and metropolitan. Rural petrol stations mainly consist of petrol stations that are located in villages or on national highways, and are considered distant from Saudi Aramco’s distribution stations (e.g. Alkhurmah). Metropolitan petrol stations consist of petrol stations that are located in metropolitan cities, and are closer to Saudi Aramco’s distribution stations (e.g. Riyadh). Riyadh and Alkhurmah were the two sample areas for the purpose of the research.

Between November 2011 and February 2012, twenty four participants were interviewed for the purpose of the research. Ten participants were interviewed from six different petrol stations; the participants were (the owners, managers, accountants and truck driver). Five of the participants were from three rural petrol stations in Alkhurmah village, located 450 km away from Saudi Aramco’s distribution station in Jeddah city, and the other five participants were from three metropolitan petrol stations in Riyadh city. Moreover, five participants were interviewed in respect to fuel haulers, two owners and two CEOs of fuel hauling firms and one truck driver. Furthermore, five participants were interviewed from Saudi Aramco, they were selected on the basis of their job description in bulk plants. They are a petroleum engineer, a process control system technician, a loss prevention advisor, an operations supervisor, and a customer relationship manager. The final unit was fuel 3PL providers from which four participants were interviewed. They were the CEO (of F-3PL Limited), marketing manager, operations manager, and a technician.

The researcher approached the research units of analysis (i.e. petrol stations, fuel haulers and fuel 3PLs) through the Saudi Arabian Chambers of Commerce and Industry. The data collected using multiple approaches: face-to-face audio recorded interviews, documents provided by organisations and key informants, and other publicly available information (e.g., press releases, financial

statements, and trade press articles). Extensive notes were taken during these interviews. The data was analysed by cross-case analyses technique based on the similarities and differences between research units.

## **1.7 Thesis Structure**

Chapter 2 provides an overview of the literature pertaining to technology, petrol supply chain, third party logistics providers (3PLs), and operations management as part of petrol supply chain integration. A review of the concepts of integration, diagnostics and business technology is discussed in detail.

Chapter 3 explains how technology-organisation-environment TOE theory has been used as a lens to analyse the data collected for this thesis, as well as how TOE framework is used as a conceptual lens in order to answer the research question. The literature review systematically builds the conceptual framework of this thesis.

Chapter 4 discusses the philosophy that is applicable to this research, specifically exploring the Saudi Arabian petrol supply chain. This chapter explains the research design, including the data collection and data analysis strategies. Finally, this chapter explains issues of validity and reliability in this thesis.

Chapter 5 represents the findings of the case study of the Saudi Arabian rural petrol stations from the owners' perspectives. This chapter starts with a background of petrol stations in Saudi Arabia. This is followed by an overview of petrol stations in rural areas, an overview of metropolitan petrol stations, petrol supply processes, petrol measurement processes, petrol procurement processes, petrol unloading processes and accounting processes in the Saudi Arabian petrol stations. Then the findings of the three components of TOE are discussed from the perspective of participants, followed by a summary of the chapter.

Chapter 6 represents the findings of the case study of the Saudi Arabian metropolitan petrol stations from the owners' perspectives. This chapter starts with an overview of metropolitan petrol stations and petrol supply processes. Then the findings of the three components of TOE are discussed from the perspective of participants, followed by a summary of the chapter.

Chapter 7 provides an overview of the importance of the fuel hauling sector in the Saudi Arabian petrol supply chain, an overview of the four fuel haulers and a truck driver, an explanation of the procedures to operate a fuel hauling firm, the process of fuel uploading from Aramco's distribution station and the operation process of hauling fleets. This is followed by the factors that influence the role of technology in fuel hauling firms according to the TOE framework. At the conclusion of this chapter, a summary of findings is provided.

Chapter 8 discusses the case of Saudi Aramco. This chapter starts with an overview of Saudi Aramco followed by a summary of interviewed participants. This is followed by the findings of the three components of TOE that were discussed from the perspective of participants, followed by a summary of the chapter.

Chapter 9 explores the influence of the TOE factors; technology, organisation and environment on the petrol supply chain operations management in fuel 3PL providers. This chapter starts with an overview of the F-3PL Providers Company which is considered the only fuel 3PL provider in the country that delivers technical solutions for customers that lack IT infrastructure. In addition F-3PL Providers Company are considered a logistics service provider. The overview of the company is followed by an overview of participants, and then the findings of the components of the TOE factors are discussed from the participants perspective, followed by a summary of the chapter.

Chapter 10 discusses the triangulation of the research findings. This chapter starts with the process of data validation for greater consistency of the research findings. The chapter highlights the internal and external consistency in order to prove that the information given by the participants interviewed was accurate, minimising the misinformation potentially given by participants therefore the consistency of this research is verified.

Chapter 11 contains a cross-case analysis and discussion in view of the findings of the studies conducted in this research, i.e. (Chapter 5, Saudi Arabian petrol rural stations); (Chapter 6, Saudi Arabian metropolitan stations); (Chapter 7, fuel haulers); (Chapter 8, Saudi Aramco), and (Chapter 9, fuel 3PL). The chapter highlights the similarities and differences on the basis of the cross-case analysis of the research units.

Chapter 12 concludes the results of the research, aligning these results with the theory, as well as the research questions and highlighting the modified TOE framework for this research. This is then followed by the contributions of this research to practice. This chapter also describes the limitations, and proposes directions for future research.

In summary, this chapter provided an overview of the thesis, starting with a brief background to the Kingdom of Saudi Arabia and the major problems relating to the petroleum industry and supply chain. This is then followed by sections that present the research objectives and research questions, discussion on the significance and limitations of the research, research methodology and thesis structure. The next chapter discusses literature review.

# Chapter 2 – Literature Review

## 2.1 Introduction

This chapter provides an overview of the literature pertaining to operations based research in the supply chain context, as part of petrol supply chain integration. The analysis of the literature begins with the definition of supply chain management (SCM) and exploration of SCM as a business process transitioning from traditional SCM to integrated SCM. However, from reviewing the literature it has been highlighted that the exploration of SCM integration needs SCM diagnostics tools to provide an overview of the entire SCM integration process. Therefore, an SCM diagnostics tool is the focus in this research.

Saudi Arabia is the focus of this research because Saudi Arabia possesses the largest oil reserves in the world standing. According to the US energy agency (EIA 2014), the Saudi Arabian crude oil reserves are 268,350 billion barrels. Furthermore, Saudi Arabia is the largest exporter and producer of oil in the world where the oil sector accounts for over 90% of total export earnings and over 75% of the country's total revenue (Squalli 2007). In addition, Saudi Arabia has been a member of World Trade Organisation (WTO) since 2005 and the intensity of global competition pushes Saudi firms to utilise all of the available resources to survive and succeed in the global economy (Aloqlah & Alankeri 2010).

In addition, this research explores the petrol SCM in the Kingdom of Saudi Arabia, the largest exporter and producer of oil in the world, represented by Saudi Aramco Oil Company. Hence, this chapter provides an overview of the Saudi Arabian oil industry, procurement processes, third party logistics providers (3PLs), and logistics ports, as essential echelons in the petrol SC to help better understand the extent of the petrol industry and supply chain integration in Saudi Arabia.

Furthermore, this chapter also provides an overview of the issues surrounding integration in the petrol SC environment such as the barriers that hinder SC integration. Through the review of the literature, the gaps in the literature will be highlighted in order to assist the development of the conceptual framework needed to detect the factors that influence the integration process in petrol SC. This field of study has not been widely addressed in the literature.

Considering the apparent shift from traditional SCM to integrated SCM, there is a need to expand this knowledge by specifically exploring the factors that influence the integration process in the petrol SC

to understand the petroleum industry, which will eventually lead to better SC integration. In order to identify the factors that influence the Saudi Arabian petrol supply chain integration, the researcher reviewed several sources of literature to provide an insight into the three contexts of TOE: Technological, Organisational and Environmental. This led to the research question, how do the technological, organisational and environmental aspects of the Saudi Arabian petroleum industry impact on petroleum supply chain integration?

## **2.2 Supply Chain Management Integration**

In terms of management literature, the researcher encompasses Supply Chain Management (SCM) to add cohesive understanding of the Saudi Arabian petrol supply chain. By definition, the Council of Supply Chain Management Professionals (cited in Gill & Pabla 2013, p. 2464) defines supply management as ‘supply chain management encompasses the planning and management of all activities involved in sourcing and procurement, conversion and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers and customers. In essence, supply chain management integrates supply and demand management within and across companies’. Therefore, this definition has been acknowledge and applied throughout this thesis.

Management of such an arrangement needs an inter-organisational relationship with the objective of improving the efficiency, responsiveness and overall profitability of the activities of the organisations involved (Power 2005). Gill and Pabla (2013) indicate that, as a concept, SCM has shifted its significance from the internal environment to the external structure. Hence, it is crucial to understand the ‘as-is’ scenario of business processes because this is considered the fundamental stepping stone for building a supply chain infrastructure (Wood 1997). This also helps to recognise the description of an organisation’s supply chain. However, the term business process is a general term used in this thesis. My definition is business process is the operational aspects of the petrol supply. As such business processes is outside of this scope.

Stewart (1995, p. 28) stated ‘the traditional supply chain – of product development, procurement, production, sales, distribution and field service – is therefore not a chain at all. Its traditional results are that it introduces error and distortion; adds unnecessary cost; delays reaction to market change; pushes strategic decisions low down; undermines competitive positioning’. Moreover, in terms of integrating supply chains, Stewart (1995) indicated that integrating the supply chain requires

philosophical, operational and systems changes. Moreover, the supply chain consists of logistical and informational elements: plan; source; make; and deliver, which are bounded by the combined demands of the marketplace at one end, and by specific product/service delivery at the customer site, at the other end (Stewart 1995).

Furthermore, the integration of the supply chain highlights the importance of the cooperation and collaboration between the supply chain units (e.g. providers, retailers, distributors and customers) to establish tight partnerships with the objectives of reduced inventory, shorter lead times and better service to the customers (Wood 1997). Julka, Karimi and Srinivasan (2002) stated that today's business environment needs integrated supply chain management to evaluate business processes and policies with consideration of their impact on overall business performance.

Thus, a large body of literature on SCM examines the collaborative SCM practices, such as Collaborative Planning, Forecasting and Replenishment (CPFR) (Fliedner 2003). However, supply chain costs include production, inventory, marketing, distribution, and selling costs, which are often cited as a major factor influencing CPFR adoption (Hofmann & Wessely 2013). In addition, Fliedner (2003) found that the factors that hinder CPFR Implementation include:

- lack of trust in sharing sensitive information;
- lack of internal forecast collaboration;
- availability and cost of technology/expertise;
- fragmented information sharing standards;
- aggregation concerns (number of forecasts and frequency of generation); and
- fear of collusion.

Though, he cited that the front-end partnership agreement, nondisclosure agreements and limited information access may help overcome these fears (Fliedner 2003). Some of the most important business benefits that CPFR partners are able to get by embracing CPFR are: enhanced relationship between partners; increased sales revenues; improved product offering; reliable and accurate order forecasts; reduction in inventories; and improved technology return on investment (Hofmann & Wessely 2013).

Turban et al. (2008) provide an example from the world's leading aerospace company (Boeing) in terms of the success of using a collaborative three-dimensional visual information (3D-design platform) that allows engineers from worldwide to collaborate on the design of each part of the 787 aircraft. As a result, the firm can finalize the design without creating a physical model and delay the

manufacturing process until the final decision. This led Boeing to be the final assembler and integrator. This eventually helped Boeing to gain customer satisfaction and fulfil customers' requirements.

Furthermore, worldwide best-in-class companies have invested in enabling infrastructure and technology to realise their logistics and supply chain vision into reality, such as cross-docking, Collaborative Planning Forecasting and Replenishment (CPFR), which replaces the 15 years old EDI system (Flidner 2003), Vendor Managed Inventories (VMI), Point of Sale Data (POS), Barcode and Radio Frequency Identification (RFID) devices, Third Party Logistics (3PLs) etc. All of these best practices are to align an organisation's supply chain management as one entity.

Bosstorff and Rosenbaum (2012, p. 2) indicated that for schooling fish, for example sardine strategy, the 'move as one' trait is innate, but separation means likely death. For global supply chains, misalignment -failure to move as one- means poor service, high inventory, unexpected costs, constrained growth and profits, and loss of market share. Stewart (1995) also indicated that the supply chain philosophically viewed as a single entity is addressing: customer satisfaction; logistics strategies; function of inventories; and control mechanisms. Hence, regardless of the practices that an organisation utilised for SCM integration, it is obvious from the literature that to align an organisation's supply chain management as one entity would help organisations to reap significant benefits.

### **2.3 Supply Chain Diagnostic Tool**

Allvine and Gore (2003) elucidate that the idea behind the term 'supply chain diagnostics' is that organisations might perform a diagnosis on their supply chains for the same reason that a doctor might perform a diagnosis on a patient to identify any problems (current or latent) and ultimately develops a solution to ensure ongoing well-being. Organisations who can apply the same diagnostic method to their supply chain are typically successful at implementing and sustaining healthy improvements across their supply chains (Allvine & Gore 2003). Accordingly, Allvine and Gore (2003, p. 106) illustrate that supply chain diagnostic is 'a structured, disciplined assessment of the supply chain (evaluating symptoms)'. The goal of integrating processes along the components of the supply chain to reduce costs and improve service is well established as one of the key objectives of logistics and supply chain management (Mason & Lalwani 2006). According to Hammer (2001),



streamlining cross-company processes is the next great frontier for reducing costs, enhancing quality and speeding operations.

Mason and Lalwani (2006) highlighted that in terms of the integrated supply chain, the scene is first set by summarising the principal factors that are supporting the push for the better integration of supply chains. Then, the diagnostic tool can be utilised by supply chain echelons to support the process of better supply chain integration. The tool help to understand the following questions:

- What is happening within the supply chain?;
- How well it is performing?; and
- What is the degree of current integration?

On the basis of existing literature, there are different diagnostic tools and phases. Mason and Lalwani (2006, p. 60) addressed 'By taking a broad view and managing transport within the context of the supply chain, substantial performance gains can be made. The question that needs to be asked by managers involved in the supply chain is: How integrated is my supply chain, and the transport and logistics processes within it?' Hence diagnostic tools are presented by Mason and Lalwani (2006) as a 'menu', which can be either worked through a complete suite of aids, or picked out as individual steps that can be customised to suit the supply chain or network being examined. Principally they are tools that aid understanding, but they also invariably lead directly to improvement initiatives to advance supply chain performance through better integration. For example, Mason and Lalwani (2006) addressed different diagnostic tools that include; mapping tools that do not provide a statistically generalizable sample, but provide a method to gain a valuable, detailed insight into what maybe typically happening.

Mapping tools provide all parties in a supply chain with a high-level overview of the total supply chain processes for the selected stream and product. The diagnostic tools contain four different techniques of mapping tools, i.e. 1) Big picture mapping, which provides an overview of the entire process, and help to visualise the flows to see where waste (e.g. slow vehicle turnaround times, duplicate administration, or poor fleet utilisation) occurred and show relationships between information and physical flows. 2) Processes activity mapping, for detailed mapping, when one or a confined series of processes needed to be assessed. 3) Demand amplification mapping is a diagnostic mapping tool to gain an insight into the degree of amplification or bullwhip that occurred in supply chains. 4) Quick scan diagnostic tool that aims to develop our understanding and documentation of

supply chains and assesses the capabilities, competencies and weaknesses. Figure 2.1 below illustrates an overall framework of Mason and Lalwani (2006, p. 72) to guide the selection and deployment of transport integration tools for supply chain management.

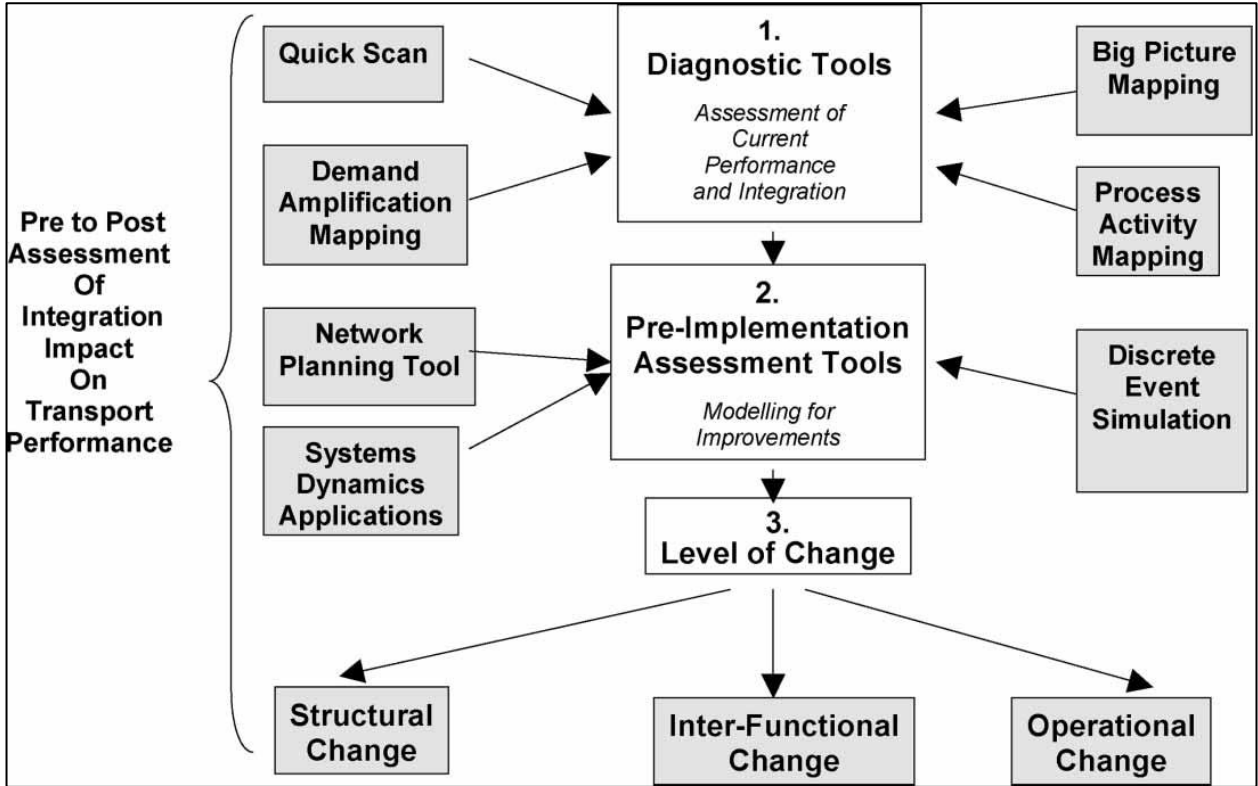


Figure 2.1: An overall framework to guide the selection and deployment of transport integration tools for supply chain management (Mason & Lalwani 2006, p. 72).

Mason and Lalwani (2006) elucidated that not all diagnostic tools need to be deployed in conjunction with one another. However, the selection of tools being contingent to the situation, time, budget and potential gains will aid in the understanding of what is happening in the supply chain operation and ultimately this will deliver detailed insight supporting the push for the better supply chain integration. Since this research is focused on exploring the Saudi Arabian petroleum industry in order to understand petrol supply chain integration based on best practices e.g. (technology) to align petrol supply chain management as one entity, this research will deliver detailed insights supporting the push for the better petrol supply chain integration in Saudi Arabia.

## 2.4 Crude Oil Supply Chain and Procurement Process

Neiro and Pinto (2004) proposed a general model for petroleum supply chains, Figure 2.2 below illustrates the proposed model. According to Neiro and Pinto (2004) the general petroleum supply chain begins from crude oil exploration and oil imports to bulk plants for storage and then distribution to petroleum refineries. The processed petroleum products are then transported from refineries to terminals storage tanks for distribution to end-customers.

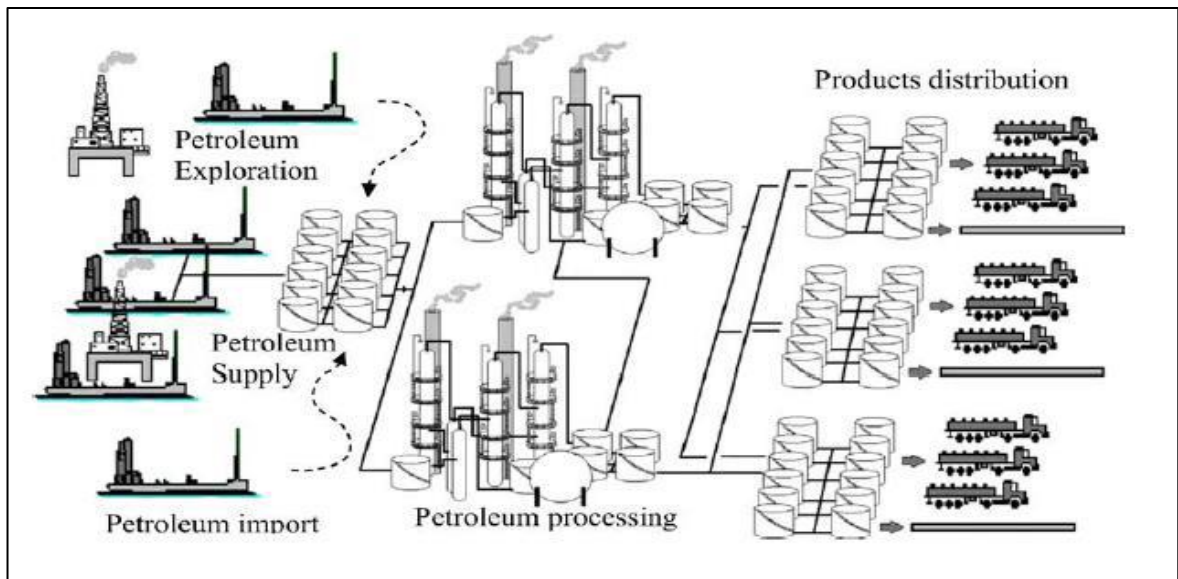


Figure 2.2: A general framework for modelling petroleum supply chains (Neiro & Pinto 2004)

According to Lasschuit and Thijssen (2004), there is great appeal that the supply chain of the oil and chemical industry involve horizontal integration across departmental divisions and coupled coordination of the layers of strategic, planning, scheduling and operational execution (vertical integration).

Julka, Karimi and Srinivasan (2002) stated that the refinery business involves tasks such as crude procurement, logistics scheduling, storage (tank) scheduling and crude scheduling, which require interaction among several departments and process large amounts of data. Decisions are normally taken based on business policies and guidelines. These decisions impact the overall economic performance of refineries. Often, the departmental objectives are conflicting, and thus some of the decisions do not contribute positively to the overall performance of the refinery.

Therefore, refiners are looking for new approaches to manage their business to profitability. The integration of planning and scheduling processes requires information from multiple sources such as expected stocks from previous planning cycles, expected product demands, ship arrival information, jetty and tank availability, etc. (Julka, Karimi & Srinivasan 2002).

For example, decision support systems (DSS), that are computer-based systems intended to help decision makers utilise data and models to identify and solve problems (Rauscher 1999), helped to integrate and align the various decision-making processes of a refinery with other departments such as procurement, storage and logistics, operations, simultaneously. More so, it shows a saving of over ‘thirty million US dollar per year’ which has been achieved in all Texaco refineries in the USA (Julka, Karimi & Srinivasan 2002, p. 1772). Julka et al. (2000) stated that the need for information visibility on the web, such as crude prices, logistics prices, and logistics availability is crucial in terms of refinery supply chains to achieve the incorporation of decision-making processes across the whole supply chain and to ease data exchanges between suppliers and customers. Moreover, Julka, Karimi and Srinivasan (2002) indicated that the important business process in a refinery is crude oil procurement, because when the crude oil is out of stock, the unit will be forced to shut down and this must be prevented under all circumstances.

Pinto, Joly and Moro (2000) highlighted that in the planning of diesel production in the RPBC refinery in Cubatão (SP, Brazil), no computer algorithms are used and the stream allocation is made based on experience, with the aid of manual calculations. Hence, the lack of technology to schedule production is the major hindrance of production objectives and operations processes in the petrol supply chain. Lee et al. (1996) tested mixed-integer linear program (MILP), which is mainly to resolve several techniques in refinery inventory management. This program helps to import information of several types of crude oil from different vessels. As such, this program helped achieve faster inventory scheduling, by reducing the computation time and priority branching based on storage bulk plants locations. This highlights some of the issues that occur in oil refinery inventory management and pinpoints the importance of technical integration to diminish timeliness and achieve faster inventory of crude oil.

Julka, Karimi and Srinivasan (2002) listed the internal departments’ processes in the refinery supply chain as follows:

- 1- The procurement department, to coordinate the crude procurement process and decide which crude is suitable to buy depending on oil exchange prices and deciding what amount is needed;

- 2- The sales department, which is in charge of predicting the current and future demand and prices;
- 3- The operation department, which takes responsibility in selecting the crude type and how much to process every day;
- 4- The storage department, to manage the tank farm and to schedule jetties. It makes sure that the refinery has been supplied by the required crude on regular daily basis; and
- 5- The logistics department, which involves transporting the crude from oil suppliers to the refinery. It takes the accountability of contracting with shippers or 3PL providers.

The information flow of these internal departments should function as one unit, therefore Julka, Karimi and Srinivasan (2002) state that today's petrol supply chains need integrated supply chain management to evaluate business processes and policies with consideration of their impact on overall business performance. Hence, they developed a system called Petroleum Refinery Integrated Supply Chain Modeller and Simulator (PRISMS), which simulates a refinery's supply chain and supports crude procurement utilising intelligent system agents to emulate the departments in the refinery and their business processes.

Wilding (1998) suggested that the supply chain is a chain of activities that are interlinked in order to complete a particular process, and the control and schedule of these activities is difficult and involves a lot of manual work. However, the manual work is inefficient and leads to many errors in the supply chain. The control and schedule of these activities requires accuracy at a level that is difficult to achieve with the manual work (Burke & Peppard 1995). Therefore, the control and schedule of supply chain activities must be automated to minimise errors and achieve accuracy (Trkman et al. 2007).

Eventually, the utilisation of information technology in internal departments will help these departments to know the status of activities that are being performed and would help them to readily calculate the queuing time, re-work time and the time when they are waiting for certain decisions to come. While these processes are maintained online, it is easy to understand and track the latency during a particular cycle and to manage it by the right allocation of resources and prioritisation of activities (Gavirneni 2002).

### **2.4.1 Petrol Supply chain and information technology**

Literature analysis suggests that IT utilisation in oil procurement and supply chain management can assist in gaining sustainable competitive advantage (Barratt & Oliveira 2001).

The interrelated activities which take place within the petrol supply chain require a lot of information related to marketing and business needs; this information needs to be effectively and electronically shared between the partners, suppliers and distributors to ensure a smooth function of the supply cycle which is maintained on a regular basis (Cachon & Lariviere 2001). Thus, the question that arises is the kind of information which has to be shared and the frequency of the same. Childhouse and Towill (2003) conducted a study on information sharing that was specifically related to the supply chain integration. The introduction of IT that simplified material flow holds the key to supply chain integration, which revealed the importance of sharing market data concerning required supply forecasts amongst supply chain nodes.

Moreover, the frequency, the availability of current information technology can help to make this process live so that every time there is information shared, it is available to all the concerned parties without any latency of petrol supply chain. This will not only change the effectiveness of the process but will also help to cater to the changing customer needs which would again result in gaining a competitive advantage (Childhouse & Towill 2003).

If we look at the above discussion, it is easy to infer that the information that gets shared between the petrol supply chain partners helps the entire node to function as one unit. Therefore, even if there are last-minute changes on certain petrol products, they can easily be handled with the help of a live information sharing tool. This not only helps to improve the communication system during the entire petrol supply chain management cycle, it will also help to achieve minimum interference of human communication channels (Croom, Romano & Giannakis 2000).

Supply chain is the backbone of many business processes and needs to be looked at from a highly strategic perspective in order to ensure that there is a genuine continuity and no latency. There have been numerous studies that have emphasised and have researched the importance of information management and transfer in the supply chain perspective. The interrelation between the supply chain and information management impacts not only the long-term business outcomes but will also impact the stock level, inventory management and may provide some immediate shocks to the process cost drivers.

In general, if we talk about the application of information technology into the petrol supply chain the most important factors that would be discussed would be the integration of demand chain information, process optimisation, and reduction of non-value-added business processes (lean thinking strategy), customer segmentation, demand management and monitoring the schedule of petrol supply chain to ensure flows of information among all units of the petrol Supply Chain (SC). Although, all the above discussed factors are extremely important in order to ensure that there is a flawless business process, hence those factors are posited to have an influence in petrol supply chain in Saudi Arabia.

Consequently, the planned utilisation of information technology can influence provision of an effective business process model, which would help to maintain the timelines of the petrol supply chain and help create an effective information management process (Burgess 1998). Various researchers in this area have revealed that an introduction of information technology into the supply chain system can lead to a cost reduction of between zero and 35%. It will not only help to reduce the lead time and the supply chain cycle, but will also help to improve the overall information flow (Holweg & Bicheno 2002). It is therefore crucial to use information technology in the processes of the petrol supply chain in Saudi Arabia. The various entities of petrol, oil and natural gas in the petrol stations, haulers, Saudi Aramco and 3PLs should work together towards improving the processes of the distribution and supply management of petrol. Hence while this development is essential for effective supply chain integration, diagnosing and understanding, the current petrol SC would be a positive step for better SC integration (Chan & Qi 2003).

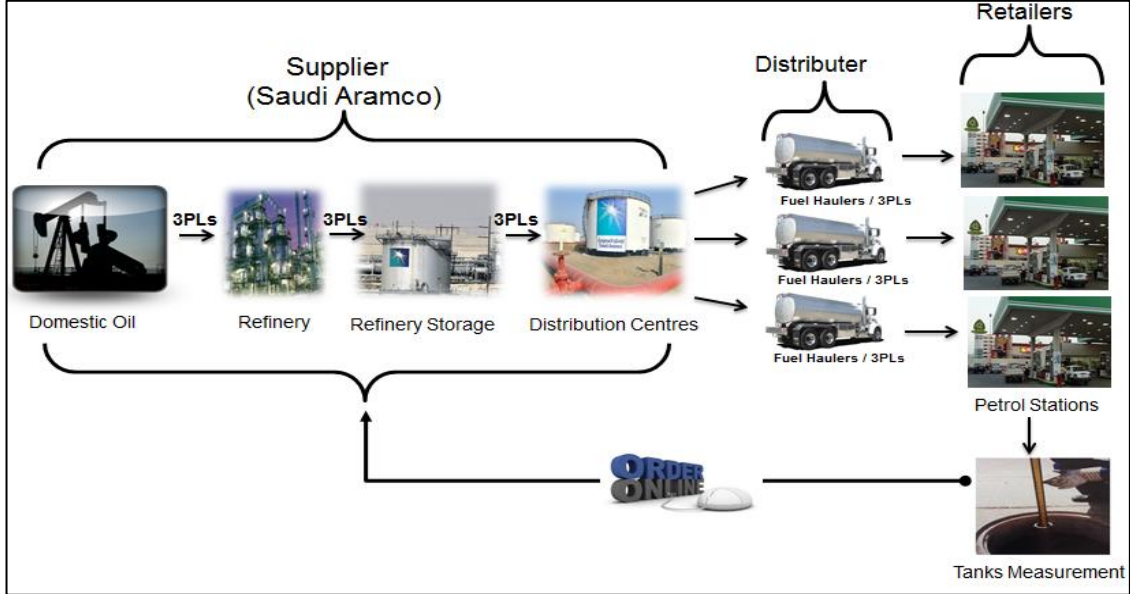


Figure 2.3: Petrol Supply Chain in Saudi Arabia

The current procurement and supply chain process related to the petrol stations and inventory management in Saudi Arabia is based on traditional and manual processes. The scheduling and forecasting of the entire process is based on the three levels of supply chain which are covered from the initial state to the final delivery to the customers. Figure 2.3, above shows the level 1 which includes the supplier (Saudi Aramco) who is involved into the crude manufacturing and the supply is also directly dependent upon the information which is received from customers (retailers level 3). The third party logistics providers (3PLs) are involved in crude oil transportation from the jetties to Saudi Aramco refineries (level 2) and then to Saudi Aramco bulk plants and petrol stations (level 3). It is important to mention here that the forecasting and transactional scheduling is done by the petrol stations on a manual basis by taking seasonal and cyclical movements into account and using traditional manual measuring of petrol levels in tanks, testing for leaks and book-based accounting processes to minimise cost and increase profit (Groznik & Trkman 2006). The final product is delivered to petrol stations by 3PLs.

It is clear that, considering a manual approach to handle the retailers, purchasing, production control, distribution and the customers, there is a probability that an introduction of information technology to the supply chain management system would ensure greater reduction in lead time and would also have to improve the process as a whole and cut extra costs (Chen 1999).

It is important to highlight that two previous studies concentrated on the petrol station supply chain (Groznik & Trkman 2006; Jaklic et al. 2006). These researchers described how the performance of the supply chain could be improved with the integration of various tiers in the chain of procurement in petrol, which highlights the paucity of literature in terms of petrol SCM/integration.

The first study, Groznik and Trkman (2006) was a study that dealt with the fulfilment/procurement process in a supply chain that contains the petrol company (with multiple fuel stations at different locations) and the supplier that transports the fuel to the fuel stations from a few larger warehouses. Groznik and Trkman (2006) described the 'as-is' scenario of the procurement process in a petrol supply chain in Europe (Slovenia). They described how the petrol procurement process begins with daily manual measurement of petrol station tanks, with the results faxed to the purchasing department. The purchasing department then forecasts the future demand based on cyclical and seasonal purchases. An additional consultation with a fuel station manager is possible.

All petrol station orders are merged into one order. Employee knowledge is used to make and optimise orders and transport routes. The analytical department controls possible changes in demand and supply patterns and transport routes. If necessary, it can adjust or cancel orders. After that, the



order is sent to the transport company, this is also the first information given to the transport company about the needs. The order has to be fulfilled with the available fleet, but cannot be modified. Financial compensation is paid to the transporter for its services based on the number of kilometres driven, fuel delivered and punctuality of deliveries. While the description focuses on one typical fuel station, the inputs from other stations are also taken into account at various points in the model. Most importantly, the capacity of each truck is considerably higher than the needs of one station so orders from different stations are usually merged into one. Based on the description, above the ‘as-is’ model was developed by Groznik and Trkman (2006) as shown in Figure 2.4 below.

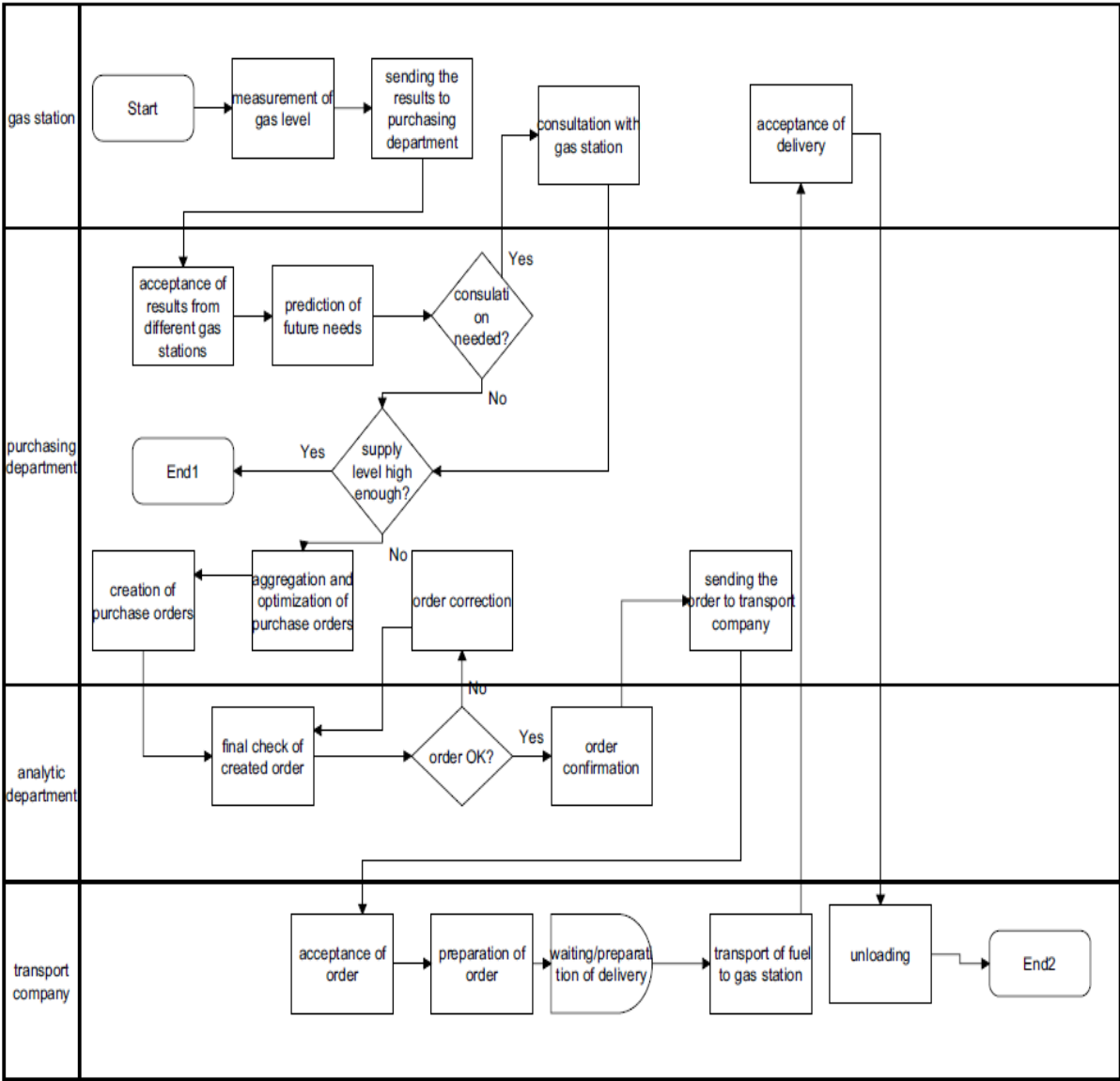


Figure 2.4: AS-IS model of petrol procurement process in petrol stations (Groznik & Trkman 2006)

In the second study, Jaklic et al. (2006) conducted a study that summarises the most important concepts of SCM and specifically concentrates on the importance of business process management (BPM) in supply chains. The concepts are illustrated with a case study of fuel supply processes. For example, they indicated that the use of traditional communication between petrol stations departments and fuel companies, such as the telephone and fax machines in terms of information flow are slow and costly. Furthermore, in terms of logistic operations, Jaklic et al. (2006) found that 3PLs' trucks were not fully utilised and the transportation could not be optimised because manual optimisation of transportation was applied. As a result, the inventory levels and transportation costs were considerably higher than expected. Jaklic, et al. (2006) addressed that, as the majority of the problems were heavily dependent on the inadequate information flow, it was decided to implement a new supply chain system specifically designed for the oil and gas industry. The selected application offers required functionalities to both involved petrol companies and all departments: inventory management, order management and fulfilment, demand planning, transportation planning, delivery scheduling, and delivery management. Artificial intelligence algorithms used for forecasting fuel demand, were based on the competent information provided by the automated tank gauging systems. These ensured optimal transportation plans and delivery schedules. Then the application was integrated within the existing ERP system in the oil and transportation companies.

Despite the ease of use of several manual approaches that can help to forecast the demand in supply chains, these approaches led to various problems. For example, Trkman et al. (2007) debated the bullwhip effect which occurs when companies significantly cut or add inventories. Owing to the higher dependency on internal supply chain, the small fluctuation may grow larger and larger and may either create a complete shortage or may increase the inventory to levels which may lead to unbalanced supply chain structure.

However, by using technology in petrol transportation, for example, the transport company/3PLs is not only considered as a transporter but it is considered as a strategic partner in providing services to customers (petrol stations) because transporters would know the forecast demand for each of the contracted petrol stations by the integration of information flow between petrol stations, transporter and oil companies. This helps the transporters to supply petrol stations with fuel just-in-time and in accurate quantities. Eventually, this will help to fill the capacity of transport trucks based on the required petrol quantity. Jaklic, et al. (2006) highlighted that sharing information allows for improved customer service, shortened process cycle time, decreased utilisation of resources, reductions of the bullwhip effect, and improved decision making, all of which provides globally optimal solutions and

reduced inventory costs. Based on the description above, the TO-BE model of fuel supply process was developed by Jaklic, et al. (2006) as shown in Figure 2.5 below.

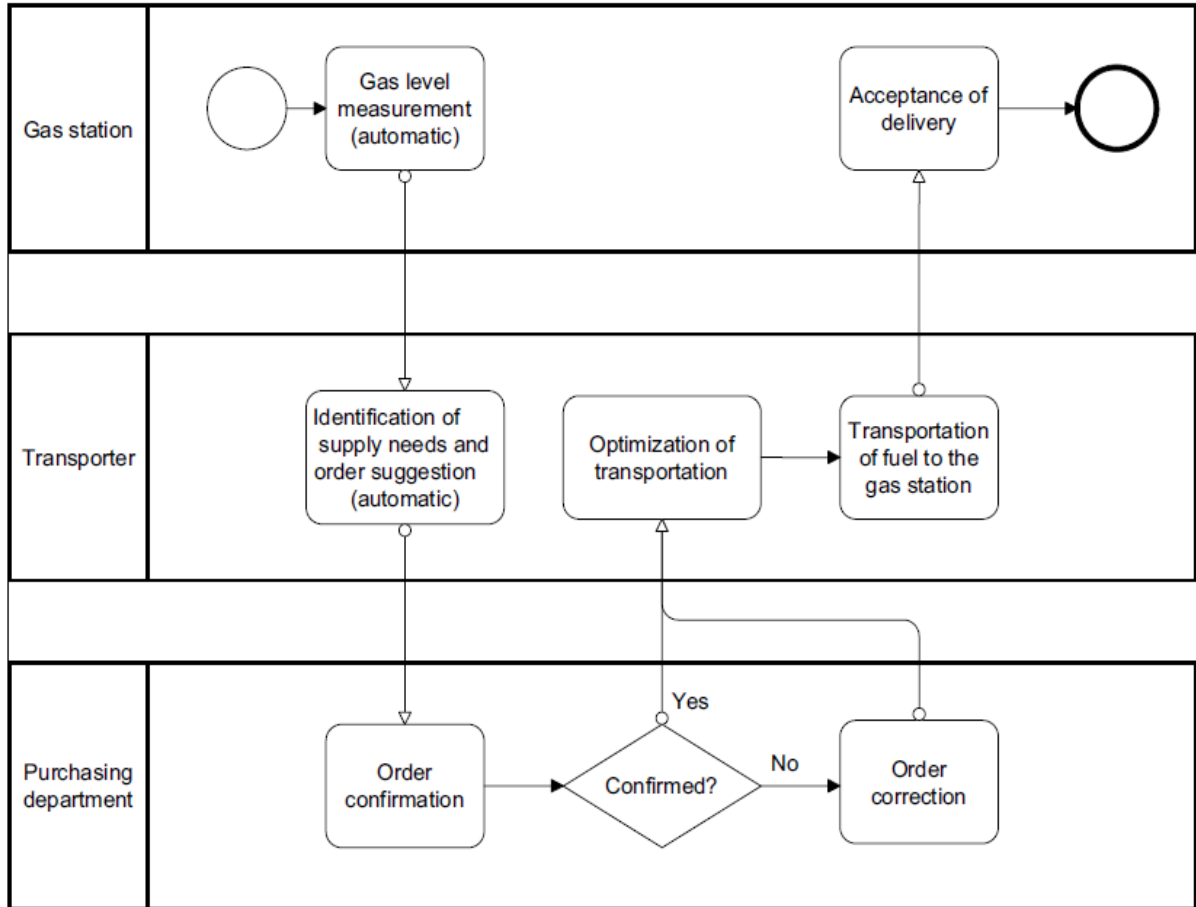


Figure 2.5: the TO-BE model of fuel supply process (Jaklic et al. 2006)

Based on the above rationalisation, sharing information and supply chain integration by IT utilisation will help to enhance the Saudi Arabian petrol supply chain, which pinpoints the contribution of this research to the supply chain in the oil industry.

In the previous sections I have discussed that supply chain management is now being considered as one of the major factors behind the success of a business process. Therefore, there is a requirement for it to be improved over time due to which various techniques of improvement like business renovation, business process re-engineering and continuous process improvement have gained

significance. These are applied to the supply chain management processes in order to integrate them along with the IT infrastructure to produce processes which are fast, consistent and effective.

As an integrated business supply chain system, it is important to firstly manage the computer network operations, which includes contract management and system development both as a service provider and a supplier. Secondly, since the development and maintenance becomes important where the procurement activity takes place and all the programmes are arranged which are required for sustainable operations. Information System (IS) is responsible for the information structural design to be created, and also avails IT trends and strategies required for the structural design to be successful in the organisational system; the same also forms a major activity of the supply chain resources (Gavirneni 2002).

Lastly, from an IS perspective, business requirements identification is a huge task and this is where the suppliers and the distributors have to ensure that there is a proper information flow within the organisation and that there are teams who can do analysis and may provide good support to both IT and business processes. The integrated system will include all the benefits of information technology as discussed in the previous sections and would be able to improve efficiency of the supply chain cycle, reduce cycle time and non-value-added steps, help to better manage resources and maintain consistent information flow between suppliers and distributors. From the previous sections and on the basis of reviewed literature, the Saudi Arabian petrol stations requires a lot of improvement in terms of supply chain, considering that a major part of their revenue comes from the petroleum industry they need to ensure that the completely manual process being followed right now gets changed in order to achieve the outcomes as discussed. The next section discusses Saudi Arabian logistics ports and third party logistics providers.

## **2.5 Saudi Arabian Logistics Ports and 3PLs**

Third Party Logistics providers (3PLs) are independent companies that perform all but a portion of a client's supply chain logistics activities for a profit. The range of services offered by 3PLs is large. It can be as simple as arranging the transportation of a single shipment or as complex as designing, implementing, and/or operating and managing a client's supply chain logistics needs (Konezny & Beskow 1999). Stefansson (2006, p. 77) described them thus: '3PLs is a cooperative, three-way relationship between a buyer of goods, the supplier of those goods and a logistics service provider moving and/or storing the goods between buyer and supplier'.

In terms of technology utilisation, Brah and Lim (2006) stated that 3PLs need to increase the use of technology to maintain their operations in different ways. For example, cutting down information and processing lead time can improve efficiency and minimise errors.

Burnson (2010) found a traditional unwillingness in the region (Asia) in terms of outsourcing logistics processes. For example, in India, firms are averse to outsourcing logistics processes to 3PLs owing to the lack of trust between firms and 3PLs. In addition, firms are averse to share sensitive organisational information with 3PLs. However, 3PLs in Saudi Arabia have attracted the attention of many organisations and scholars because the Saudi Arabian economy is becoming a magnet for global logistics (Thomas 2007). The majority of big names in global logistics have had a presence in Saudi Arabia, such as; DHL; Exel (part of the Deutsche Post Group); FedEx; UPS; Danzas; Kuehne & Nagel; Schenker; Aramex; Agility and Panalpina; and thousands of local trucking and warehousing firms, but rarely has there been a focus on end-to-end services (Thomas, 2007).

Arroyo, Gaytan and de Boer (2006) found that large firms outsourced their logistics services more than smaller firms because the large enterprises are involved in many complex logistics processes and interaction with many suppliers and clients. However, Sohail and Al-Abdali (2005) found in their empirical study that 90% of 496 SMEs in Saudi Arabia were either satisfied or very satisfied with the services of 3PLs, which affirms that there is remarkable acceptance of 3PL providers in Saudi Arabian. However, there is scarcity of literature in terms of the logistics outsourcing and the influence of 3PLs in the petrol supply chain in the oil industry, which is considered a gap in the current literature that should be taken into account.

Some literature highlighted the importance of the logistics hubs in Saudi Arabia. For example, the logistics ports that are planned for the King Abdullah Economic City (KAEC) will provide a competitive logistics port for regional trans-shipments and will supply Africa and Middle East (Thomas, 2007). The King Abdullah Economic City (KAEC) is located on the Red Sea between the two holy cities (Makah and Medina) and the commercial port of Jeddah. The scheduled completion of KAEC is approximately 20 years starting from 2006, so the completion is estimated for 2025.

It is estimated that KAEC will be one of the most important economic cities in the Middle East (SAGIA 2009). The area of KAEC is approximately 168 million square metres, the cost is approximately 27 billion U.S. dollars, and will offer one million job (SAGIA 2009). This size of

investment on this area as such would contribute the opportunity to Saudi Arabia to become an important logistics hub in the Middle East (SAGIA 2009).

The Saudi Arabian government is also constructing two logistics economic cities, i.e. Prince Abdul-Aziz bin Musaed Economic City and Jazan Economic City. Prince Abdul-Aziz bin Musaed City (PABMEC) is located in the northern-central region of Saudi Arabia (Hail). It is planned to be a transportation, logistics and supply chain centre. Owing to Saudi Arabia's geographic location railway network construction that will join Saudi Arabia with Jordan, Iraq and Medina as well as joining economic cities to each other, which is considered a competitive advantage in terms of logistics services (SAGIA 2009).

Second, Jazan Economic City (JEC) will be a logistics hub in the south-west of Saudi Arabia to join Saudi Arabia with the main trade routes between Europe, Asia and Africa. The area of JEC is approximately 100 million square metres. It will consist of a modern oil refinery and integrated petrochemical complex (SAGIA 2009). Constructing JEC supports the oil and petrochemical industry in Saudi Arabia to fulfil the demands of Europe, Asia and Africa on oil and petrochemical products which will speed up the supply chain process. Owing to the geostrophic location of Jazan city which is located in the south-west of the country, the access to Europe, Asia and Africa will be faster, which will eventually minimise the lead time and maximise the reliability to fulfil the world's demand on oil and petrochemical products. In figure 2.6 below, a map illustrates the locations of the economic cities of Saudi Arabia.

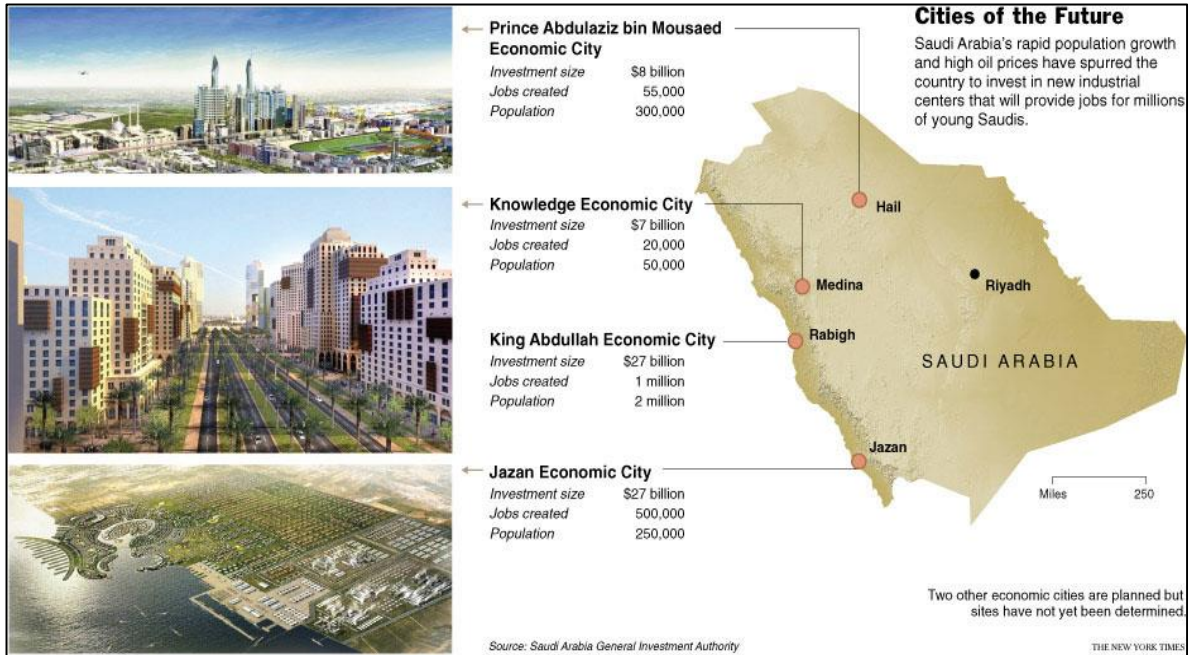


Figure 2.6: The Economic Cities of Saudi Arabia being constructed (SAGIA 2009).

To sum up, the experience of Saudi firms in contracting logistics services indicates that 3PL services in Saudi Arabia have good potential for further development, and the firms' commitment to use 3PLs services in Saudi Arabia is extensive (Sohail & Al-Abdali 2005). Moreover, the importance of Saudi Arabia, the largest exporter and producer of oil in the world and the fact that the government is initiating logistics hub projects were highlighted as important turning point for oil industry in Saudi Arabia.

**2.6 Saudi Aramco**

Saudi Aramco is the largest producer of crude oil in the world, and is believed to supply almost 11% of the world's oil on its own. The size of operations of Saudi Aramco can be understood by the fact that, it manages almost 98% of the kingdom's oil while Saudi Arabia has almost 25% of the world's total available oil reserves. It is important to understand that the influence of Saudi Aramco to the Saudi Arabian economy is huge and it is also proven by the fact that 80 to 85% of the export that takes place in the kingdom is related to oil (Anthony 2000). It is clear that the effectiveness of the supply chain of this government owned unit is critical to ensure that it can utilise its resources to the maximum (Anthony 2000).

Saudi Aramco co-operates five domestic refineries, which supply refined products for domestic use within the kingdom. Although their oil production capacity is huge, the supply chain becomes important considering the fact that the demand which is there in the market is both for export and for the domestic market. Hence, it becomes important to manage the petrol supply chain along with the export demands that come from various sectors of the world with a highly advanced supply chain structure (Abir 2005).

Saudi Aramco's board came up with an aggressive operating plan in the year 2007, where one of the greatest investments in the history of oil companies was announced (Jaffe & Ellass 2007). However, a major part of that strategy was allocated to improve the corporate culture, decision-making processes, and sales strategies and enhance the diversity of products. However, there are no major investment initiatives to drive the technology in order to automate the domestic supply chain. Another factor that has to be considered is that the upstream activities of the company are already happening at an advanced scale where the commercial and non-commercial functions and the capital management employs a lot of automation and technology (Abir 2005; Ireland & Bruce 2000). Figure 2.7 below illustrates the management organisation chart of Saudi Aramco (Jaffe & Ellass 2007). Based on the attempts have been made through contacting, checking online and publically available information, unfortunately this the only most organisational structure available up to date.



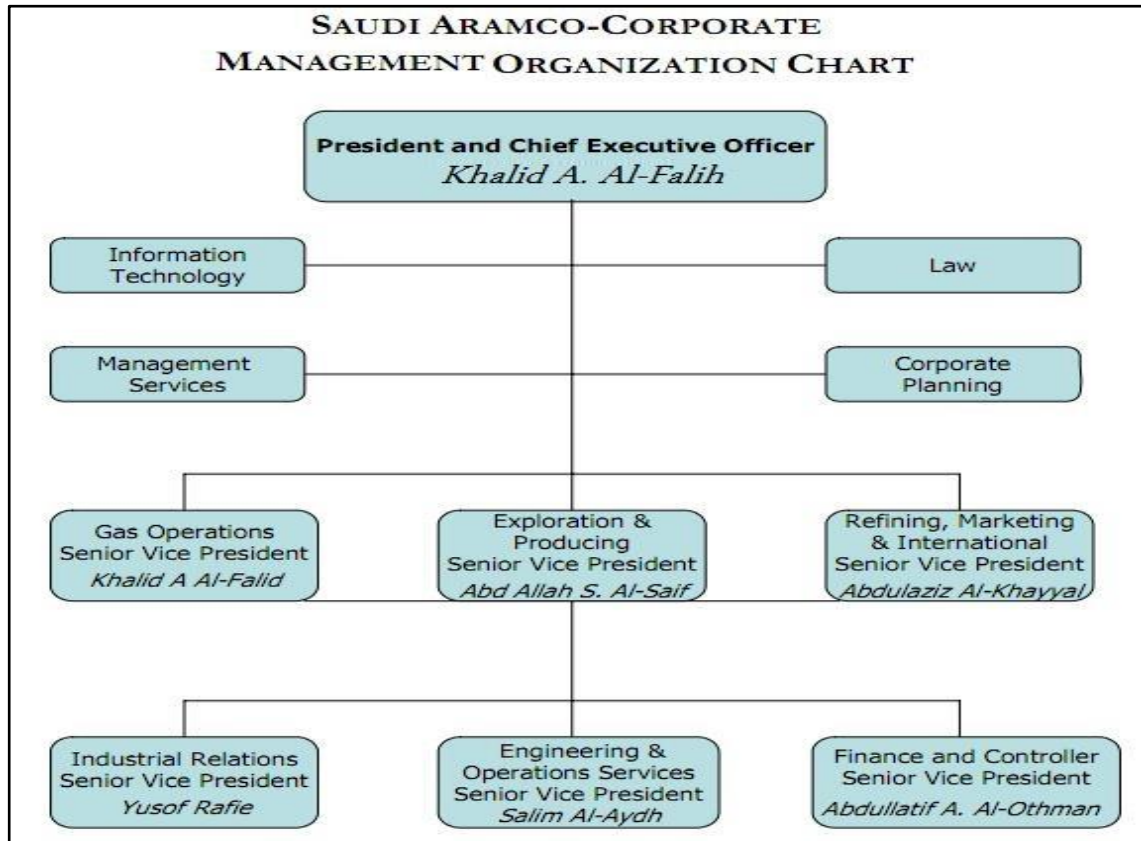


Figure 2.7: The management organisation chart of Saudi Aramco (Jaffe & Ellass 2007)

The government's structure of Saudi Aramco shown above clearly shows that the application of information technology, to any given process, forced to the information technology department and the appropriate management there. This is one of the most important factors behind the major influence of the Saudi Arabian government concerning the implementation of information technology of the petrol supply chain. It is argued that supply chain management should now be given equal importance, which must be explored and improved with the introduction of information systems and information technology (Cox, Chicksand & Ireland 2001).

In terms of the government role and legalisation, Oxley and Yeung (2001) conclude their research by advising countries with a weak rule of law to outsource their services to foreign companies as the foreign firms know how to deal with government in terms of the law and government policies. Oxley and Yeung (2001) identified that countries with a weak rule of law would face difficulty in implementing e-commerce. As this research is about petrol SC integration, government policies and the rule of law is explored in this research.

There is no doubt that the Saudi Arabian government has a firm control over the company which is handling the petroleum markets and industry for the country. The government has ensured that there is investment and improvement in their corporate governance and marketing strategies. However, as discussed in the previous sections, information technology has a major role in improving the supply chain management and the overall business processes related to the petrol stations (Abir 2005).

## **2.7 Information Technology**

The researcher encompasses information technology (IT) in the scope of this research due to the need for IT in supply chain integration. It is also essential to understand the meaning of technology and information technology to distinguish between types of technology.

Griffith (1999, p. 474), defines technology as including ‘specific tools, machines, and/or techniques for instrumental action’. He builds on Rogers (1995) and Barley (1990) definitions. Rogers (1995, p. 13), cited by 28055 researchers, stated ‘we should not forget that technology almost always represents a mixture of hardware and software aspects’. Thus, Griffith (1999) aligns his theory with Rogers’ definition and states that a technology may have two components: a hardware component made up of physical objects; and a software component made up of information. However, Barley (1990), argues that undoubtedly, when asking individuals in organisations what technology they use, they will state a machine or describe a technique, therefore, the definition becomes an ostensive one. These viewpoints and argument raised the importance of understanding technology within organisations that are related to this study. This is firstly to know how individuals describe technology and information technology in the petrol supply chain. Secondly, it helps to address the relation between technology and knowledge in respect to IT.

Lack of IT knowledge is pointed out in the existing research as a barrier to adopt technology innovation (Al-Sobhi, Weerakkody & Kamal 2010; Al-Somali, Gholami & Clegg 2010; Kaplan & Maxwell 1994; Kujawa 2003 ). Al-Somali, Gholami and Clegg (2010) highlighted the importance of people’s knowledge in respect to IT and argued that lack of knowledge will lead to a lower ability to adopt innovation and lower competency of readiness. They found that in Saudi Arabia there is lack of awareness between the users of IT, especially regarding online transactions because they do not know their rights and legal policies. Further findings of their study claim that managers, workers and owners of businesses are not enlightened in respect to the innovation of e-business and the potential of new technologies.

Moreover, Capon and Glazer (1987) state that technology can be defined broadly as ‘know-how’ in perspective to a firm, as the information is required to produce or sell a product or service. Capon and Glazer (1987) explained that as the boundary between technology and knowledge is often fuzzy, therefore technology should be distinguished, at least conceptually, from the general notion of knowledge itself (Bell 1976; Capon & Glazer 1987; Merton 1968). In addition, technology should be seen as a proper subset of knowledge, which helps to define the knowledge as a measurable resource (Merton 1968).

From these perspectives, it is important to highlight that IT knowledge is an important factor and should be encompassed in this research, because it has been identified in the existing research as a barrier to innovation adoption, which hinders supply chain integration. IT knowledge helps the workers and enterprise owners to understand the influence of technology in their firms in order to enhance the operational performance and gain competitive advantage.

According to the reviewed literature on technology, it is important to find out which type of technology will be in scope and which is out of scope of this research, as the term ‘technology’ is too broad for useful research (Mintzberg 1979). Moreover, the literature shows that it is difficult to separate technology from the knowledge and organisation. And it is emphasised that both hardware and soft aspects of technology, e.g. human skills, experiences, procedures, etc. are also a part of the technology concept (Drejer 2000). In addition, Pacey (2013) argued that many people identify technology with its technical aspect because that has to do with machines, techniques, knowledge and the essential activity of making things work. However, beyond that there are various beliefs and habits of thinking that can be indicated by thinking about ideological or cultural aspects of technology-practice. In addition, this research encompassed the organisational factors e.g. culture and religion that may be an influence in petrol supply chain integration. Hence, this highlights the importance of which types of technology should be included in this research.

According to the research by Halachmi and Bouchaert (1994), and Drejer (2000), technology has been classified into three types:

1. Organisational Technology (Traditional Technology) refers to the knowledge that enhances organisational capability such as formal job descriptions, chains of command, lines of communication or organisation charts as administrative technologies (Drejer 2000; Mintzberg 1979), process technologies, human skills (Drejer 2000), and the knowledge of people from previous generations (Sun 1993);

2. Actual Technology (Engineering Technology) refers to the tangible technology such as: machines, skills, tools and other physical engineering equipment (Drejer 2000; Mintzberg 1979); and
3. Technology (Information Technology) used to describe terms of information technology; to control an intensive use and level of sophistication of technological devices (Kelley & Rice 2002) such as the Internet and information systems used in an organisation.

These types of technologies are discussed in details in the next sub-sections.

### **2.7.1 Organisational technology (Traditional technology)**

Organisational technologies in previous literature have focussed on alliance structuring and outcomes by combining people and tasks for an expected level of productivity (Agrawal 1995). Moreover, according to Agrawal (1995b), organisational technology refers to organisational knowledge or indigenous knowledge: the knowledge that is concerned with the instant necessities of people's daily livelihoods. The collection and storage of indigenous knowledge should be supplemented with adequate distribution and exchange among interested parties, using newsletters, journals and other media (Warren, Von Liebenstein & Slikkerveer 1993). This is to highlight the importance of indigenous knowledge use by employees in order to share the knowledge and experience in the work environment.

Traditional technology is more deeply embedded in its context (Agrawal 1995). Traditional knowledge refers to '... the capstone of several convergent trends in social science thinking, and development administration practice' (Agrawal 1995a, p. 4). These individuals will utilise the knowledge of people from previous generations to develop tools or mechanisms to produce goods/or services. Traditional knowledge is often viewed as the best strategy in some less-developed countries (Fischer & Ostwald 2005; Pulido & Bocco 2003) because they have less advanced tools or technical instruments (Atte 1992). Moreover, Indigenous knowledge has value not only for the culture in which it evolves, but also for scientists and planners striving to improve conditions in rural localities (Warner 1995).

In addition, it is important to state that the use of the traditional knowledge is taking place in Saudi Arabia to meet the mandate that Saudi Arabia become globally competitive as a knowledge-based

innovative economy (Alshumaimri, Aldridge & Audretsch 2010). The Ninth Development Plan (2010–2014) of the Kingdom of Saudi Arabia has an explicit mandate to develop a globally competitive knowledge economy which increases the necessity for traditional technology (MOEP 2010). Furthermore, the Ninth Development Plan of the Kingdom sets thirteen goals (MOEP 2010). Three of the thirteen goals highlighted the focus on the drivers of a knowledge-based economy: developing sectors of small and medium-sized enterprises to increase their contribution to the gross domestic product, diversification of the economy to enhance economic competitiveness, achieving sustainable economic and social development through moving toward a knowledge-based economy (Alshumaimri, Aldridge & Audretsch 2010).

In addition, this research investigates the influence of IT factors in the petrol supply chain in Saudi Arabia, which is considered a developing country (Baker, Al-Gahtani & Hubona 2010). Therefore, it is wise to include traditional technology or traditional knowledge in the scope of this research. Aside from traditional technology, the following sub-section discusses actual technology.

### **2.7.2 Actual Technology (Engineering Technology)**

Harfield, Tongpliew and Choothong (2013, p. 184) denotes actual technology to tangible technology or what is called ‘technology you can touch’ which comprises machines, tools and other equipment (Mintzberg 1979; Pulido & Bocco 2003). Other literature defines actual technology as technology that can substitute to a degree for deficiencies in the user’s knowledge base by providing targeted, task-specific knowledge, guidance in problem solving through explanations and feedback, and repeated opportunities for experiential learning with rapid feedback that is not available in traditional or text-based materials (Goldwater & Zahller 2010). While, Price and Marshall (2013, p. 27) define tangible technologies as ‘physical objects that are embedded with computing technology and linked to various forms of digital representations (audio, visual, tactile)’.

In addition, most institutions in Saudi Arabia, for example, banks, seem to promote less actual technology, such as online banking, as compared to the institutions in Western countries (Al-Somali et al. 2009). In this context, manufacturing companies in Saudi Arabia that have a foreign partner are more likely to embrace actual technology such as material requirements planning (MRP) and computer integrated manufacturing (CIM) (Andijani & Selim 1996).

The actual technology is encompassed in the scope of this research to identify the utilisation of actual technology in the petrol supply chain in Saudi Arabia, and to observe how informants explain the actual technology, such as, machines, tools, computers, tangible ICT infrastructure, etc. This will help to understand the 'as-is' scenario of business status of petrol supply chains in Saudi Arabia.

The next sub-section explains the information technology and the contribution to this research according to the literature.

### **2.7.3 Technology (Information technology)**

Information technology is viewed in a broad sense 'as it refers to any artefact whose underlying technological base is comprised of computer or communications hardware and software' (Cooper & Zmud 1990, p. 123). However, in this study the use of the term 'information technology', is classified as an intensive use of technology such as computers and the Internet, and includes applications or software for computers (Kelley & Rice 2002). Information Technology should be viewed as an automating or mechanising force because it can fundamentally reshape the way business is directed (Davenport & James 1990). Information technology is listed in this sub-section according to benefits to organisations and its influence in terms of competitive advantage, core competencies, IT capabilities, firm resources, infrastructure and the barriers that hinder the use of information technology in organisations.

Information technology has many benefits to organisations. For example; using information technology is an easily available and low-cost alternative for IT implementation in an organisation; can allow a quick return on investment simply by publishing previously printed materials on the Internet or through servers; and users in the same organisation may share the same applications and information online (Wells 2000). Moreover, IT can help managers with greater freedom of movement from one organisational structure to another without changing one, because of change in the other. In other words, IT helps organisations to centralise or decentralise their operations while continuing to use the same computers and the same database; in the past, organisations would have required to move file cabinets and employees to and from various offices (Halachmi & Bouckaert 1994). Information technology has become a powerful instrument to link the business globally through communications via the Internet.

The adoption and use of new technologies, especially information technology (IT), is of crucial importance for the competitiveness of companies in many countries (Caldeira & Ward 2002); for example European SMEs (Oke, Burke & Myers 2007), American companies (Garavan & McGuire 2001), and that have led to positive sales turnover growth. SMEs in East Asian countries (Kyobe 2004) and SMEs in Taiwan (Lin & Chen 2007) that have showed that through overseas investment the company performs more efficiently in terms of sales because competing in an international arena challenges the company to become more innovative. Bakos and Treacy (1986) state that technology offer a greater range of compatibilities at lower costs and technology is challenging the business environment for economic aspects or IT. This is because information technology can benefit the organisation, both internally, such as communication via an intranet that people in the same organisation can contact each other; and externally, such as the Internet via email (Gerstein & Reisman 1982).

#### **2.7.4 Technology in Supply Chain Management**

The adoption of information technology (IT) along a supply chain has increasingly become a necessity to enhance supply chain performance. Organisations in a supply chain often adopt IT due to the institutional pressure exerted by their supply chain partners (Lai, K-h, Wong & Cheng 2006). Thus, the use and complexity of computerised tools can only be expected to grow, changing the way companies have traditionally serviced their customers and how they communicate with supply channel partners (Ross 2004). Furthermore, IT helps to restructure the entire distribution set up to achieve higher service levels and lower inventory and lower supply chain costs (Johnson & Johnson 2011).

Considering that the focus of this research is to diagnose the Saudi Arabian petrol supply chain for better petrol supply chain integration, Allvine and Gore (2003) highlighted that a supply chain diagnostic tool should connect supply chain capabilities to business objectives. The application of information technology has motivated the capability of IT utilisation in SCM. This is to improve specific areas of an organisation to make the operational process consistent and more functionally effective (Gerstein & Reisman 1982).

In terms of capability definition, Amit and Schoemaker (1993, p. 35), refer to capabilities as a 'firm's capacity to deploy resources'. Sabherwal and Kris (1994) defined IT capabilities as the scope to which the technology required for operation, storage, and communication of information are offered within the organisation. Bharadwaj (2000, p. 171), defined a firm's IT capabilities as 'the ability to mobilize and deploy IT-based resources in combination or co-present with other resources and capabilities'. While supply chain capabilities refer to 'the ability of an organisation to identify, utilize, and assimilate both internal and external resources/information to facilitate the entire supply chain activities' (Wu et al. 2006, p. 494).

Narasimhan and Das (2001) found that a key determinant of the ability of manufacturing to make rapid changes was the selection, development and integration of suppliers with appropriate capabilities. However, failure to achieve system integration across the supply chain has become one of major growing pains in supply chain management (Wu et al. 2006). So the investment in advanced IT helps achieve higher system compatibility and integration between channel partners (Philip & Booth 2001). For example, the transition from proprietary EDI to Internet-based EDI is widely observed across industry for companies seeking better system compatibility (Bowersox, Closs & Stank 1999). In another example, extensive research has argued the success achieved through Wal-Mart's method of managing the supply chain and the competitive advantage gained over time is from the ideal integration between its business resources and IT utilisation (Ravichandran & Lertwongsatien 2005).

Technology plays a key role in Wal-Mart's supply chain, serving as its foundation. Wal-Mart's high level of technology and network design as the largest retailer in the world, allows it to accurately forecast demand, track and predict inventory levels, create highly efficient transportation routes, and manage customer relationships and service response logistics (Smith 2005). Supply chains also need to be managed in a way that enables quick response to cope with volatile demand (Thatte, Rao & Ragu-Nathan 2013).

Handfield and Nichols (1999, p. 6) summarise the potential for information technology applications for supply chain integration thus, 'With the emergence of the personal computer, optical fibre networks, the explosion of the Internet and the World Wide Web, the cost and availability of information resources allows easy linkages and eliminates information related time delays in any supply chain network'. Furthermore, the literature suggested that supply chain practitioners need to recognise the right capabilities, such as capabilities that fit the firm's environmental demands to gain competitive advantage (Amit & Schoemaker 1993; Bharadwaj 2000; Perez-Freije & Enkel 2007). In summary, technology helps to enhance corporate image and better relations with trading partners by



reducing lead-time and improving information sharing. Increased communications technology has redefined how businesses work together, raising customer expectations and placing new demands on supply chain performance.

### **2.7.5 Barriers of IT utilisation in organisations**

In terms of the worries and barriers that hinder the utilisation of IT in organisations. Ravichandran and Lertwongsatien (2005) highlighted that system failure can result in huge business distractions and losses and ineffective IS operations, which has the potential to damage carefully built reputations for quality and trustworthiness in product and service contributions.

In addition, underutilisation of information technology can result in serious problems, such as being behind competitors in receiving important information, delays in communication processes, and high costs of communication systems incurred by the organisation (Jaklic et al. 2006; Kelley & Rice 2002). Acar et al. (2005) claimed two reasons for underutilisation of information and communication technologies (ICTs) in SMEs: lack of staff with appropriate skills in information technologies, and most employees in SMEs are satisfied with existing methods of conducting business (Acar et al. 2005).

Other barriers that hinder the successful use of information technology in organisations comprise: 1) ignorance of information technology by senior management; 2) poor communication systems within the organisation; 3) resistance to change by people in the organisation; 4) lack of knowledge about information technology in the organisation; and 5) a lack of instruments to measure the benefits (Robbins, Odendaal & Roodt 2003).

In summary, technology has been classified into three types: traditional technology (Drejer, Anders 2000), actual technology (Drejer, Anders 2000), and information technology (Kelley & Rice 2002). Different organisations may decide to utilise different types of technology depending on the type of business and requirements of business to acquire technology. Some organisations will use only one type of technology while other organisations may use two or more in combination. In this research all three types will be included in the scope of the research, however, the discussion of this research's findings, which will be addressed in (chapter 9) address which type of technology has significant influence in petrol supply chain and why. The following sub-section discusses the IT infrastructure.

### **2.7.6 Information technology infrastructure**

IT infrastructure is a further important entity that should be investigated in this study because IT infrastructure helps organisations to determine the beneficial resources, either internal or external resources, to gain competitive advantages. Weill (1993, p. 462) defined IT infrastructure by combining the literature and his empirical observations from the perspective of firms' managers as 'the base foundation of IT capability budgeted for and provided by the information systems function and shared across multiple business units or functional areas. The IT capability includes both the technical and managerial expertise required to provide reliable services'. Accordingly, it is believed that petrol supply chain integration will comprise internal and external technical and managerial units. Therefore, there is a need to explore these units in order to find out the 'as-is' petrol supply chain business status and how IT can help in terms of petrol supply chain integration.

In addition, Ravichandran and Lertwongsatien (2005); and Byrd (2001) showed that IS infrastructure flexibility is interrelated to sustained competitive advantage. They also pinpointed that the flexibility of IT infrastructure eases integration of new technologies within existing platforms, which allows the IS unit to deliver quick cost savings. This is because a flexible IT infrastructure develops the organisation's ability to deliver technical solutions rapidly and more efficiently. For example, platform readiness for new software, easy access to relevant data, and the presence of essential networking systems helps a firm to provide faster, more cost-effective IS solutions to end-users (Ravichandran & Lertwongsatien 2005).

Therefore, IT utilisation is significant in this research. More so, the researcher encompassed the IT utilisation in this research because the literature did not have much attention to discuss the importance of IT within the petrol supply chain. Hence, the researcher believes that Saudi Arabia could benefit from the IT utilisation in petrol supply chain to enhance service quality and achieve the required competitive advantages (Sohail 2008).

The above inferences are drawn on the basis of the literature and studies that were reviewed. However, due to the major influence of the Saudi Arabian government on its petroleum business across the country, there is a huge impact on the involvement of information technology in the petroleum business and more closely to the petrol supply chain. Improvement strategies need to be put into action in order to improve Saudi Aramco, which is the country's oil management firm. However the investment is not directed towards domestic petrol SC integration to improve the petrol supply chain, because there are some issues that the company is deprived of, such as the fraud at retail

supply level, and this is the area that must be explored to gain further growth in the market. This will help to particularly answer the main research question: ‘How do the technological, organisational and environmental aspects of the Saudi Arabian petroleum industry impact on petroleum supply chain integration?’ Based on the understanding that is developed in this review, this research will continue in chapter 5 with a discussion on data collection and analysis where the focus will be to capture the feedback of the entities in current operations or those indirectly involved as a part of the Saudi Arabian petrol supply chain process.

In summary, this chapter provided a useful review of relevant literature that relates to a number of topics. It started with defining supply chain management/integration (highlighting the key factors that hinder collaboration and implementation) and review of supply chain diagnostic tools and frameworks. Aspects relating to Saudi Arabian petroleum logistics are also covered and a section provides an overview of Saudi Aramco - the nationally - owned producer of crude oil and petroleum products. The final section in this chapter focused on information technology discussing three different types of technologies as well as barriers to use of IT and IT infrastructure. The next chapter discusses the technology–organisation–environment (TOE) framework.

# **Chapter 3 – The technology–organisation–environment (TOE) framework**

## **3.1 Introduction**

The previous chapter explored the existing literature in order to develop a conceptual framework enabling the researcher to address the main research question: ‘How do the technological, organisational and environmental aspects of the Saudi Arabian petroleum industry impact on petroleum supply chain integration?’ Considering that research problems are: lack of surveillance from government authorities and no serious legal implications if petrol stations’ owners do not follow government regulations; Saudi Arabian petrol stations utilise traditional petrol operational processes and; the geographical location of rural petrol stations and Saudi Aramco’s bulk plants that are located only in metropolitan areas causes delays in terms of logistic operations.

The focus lens of this research is to understand the petrol supply chain and the Saudi Arabian petroleum industry which needs a theory to help explore the factors and issues from a broader context. Hence, exploring the Saudi Arabian petrol supply chain as well as performing a diagnosis on the factors that influence Saudi Arabian petrol supply chain integration to establish tight partnerships with the objectives of reduced inventory, shorter lead times and better service to the customers would contribute to petrol supply chain integration. On the basis of the literature, the technology–organisation–environment (TOE) framework was found appropriate in terms of exploring issues related to technology, organisation, and environment.

This chapter describes how the TOE framework is used as a conceptual lens in order to answer the research question. The TOE framework is an organisation-level theory that explains that three different elements of a firm’s context influence adoption decisions. These three elements are the technological context, the organisational context, and the environmental context. All three are posited to influence technology innovation and SCM (Angeles 2012). This chapter is divided into three sections. The following section evaluates other theories and why other theories were not adopted in this research. The subsequent section discusses the TOE framework in regard to its theoretical background concepts and research applying TOE to Information Technology. The final section discusses the use of TOE within the context of this study. The next section discusses why the researcher used the TOE in this research after consideration of other theories.

## 3.2 Theory foundation

The focus lens required for this research is to help understand the petrol supply chain and the Saudi Arabian petroleum industry. Therefore, this research needs a theory that helps to explore the factors and issues from a broader context. Hence, the theory of TOE comes close to being a theoretical foundation of this research after consideration of extensive other theories. Such as, diffusion of innovation (DOI) (Rogers 1995), technology acceptance model (TAM) (Venkatesh et al. 2003), transaction cost economics (TCE) (Coase 1937), perceived e-readiness model (PERM) (Molla & Licker 2005b), and agency theory (Eisenhardt 1989).

On the basis of the literature, the TOE framework is consistent with the theory of Diffusion of Innovation in which Rogers (1995) emphasised individual contexts, both internal and external factors of organisations' IT innovation. These factors are matched with the technology and organisation contexts of the TOE framework. However, the TOE framework included the environmental context that represents constraints and opportunities for IT innovation based on different important factors, such as competition, geographic location and government regulations. Hence, the researcher selected the TOE framework because of its application in this research and the importance of the environmental context, including competition, geographic location, and government regulatory factors that help to understand the Saudi Arabian petrol SC. Environmental context significance to this research explores government regulations, e.g. rules and regulations, geographic locations of suppliers and retailers, and competition intensity between petrol SC units.

On the basis of the literature, the theory of transaction cost economics (TCE) is used with outsourcing IT (Ang & Straub 1998; Bahli & Rivard 2003) to minimise transaction costs (Bunduchi 2005; Carmel & Nicholson 2005). Moreover, Subramani (2004) employed the theory of TCE to measure the acceptance of supply chain management systems. Nevertheless, Welty and Becerra-Fernandez (2001) employed the TCE theory to define the relationship between trust and technology.

Consequently, TCE is a suitable theory to minimise the transactions costs only when the data, including values and costs, are accessible. However, in this research it would be hard to know the value and cost of the Saudi Arabian SC units i.e. Saudi Aramco, petrol stations, fuel haulers and third party logistics providers owing to the privacy of this trusted information and competition strategies. The researcher is not focusing on values and costing and therefore, TCE is not applicable to this research.

Another theory the researcher looked at is agency theory which is directed at the ubiquitous agency relationship, in which one party (the principal) delegates work to another (the agent), who performs that work (Eisenhardt 1989). Moreover, Agency theory emphasises how capital markets can affect the firm (Eisenhardt 1989). In terms of research that used agency theory in IT, Melville et al. (2004) used the agency theory to conceptualise key constructs and their interrelationships within the organisation and the performance impacts of information technology. However, this research is not aiming to measure the organisation's performance or to see how capital markets can affect the firm. Therefore, agency theory is not applicable for this research.

Technology acceptance model (TAM), According to Davis, Bagozzi and Warshaw (1989), is an appropriate model to identify the factors of technology acceptance, to explore why technology is unacceptable and examine appropriate corrective steps by identifying the factors in terms of internal beliefs, attitudes and intentions. However, this research objective is to explore the factors from the participants' perspectives to understand the 'as-is' scenario of the petrol SC in Saudi Arabia, which includes the current technology that is utilised in petrol SC and other organisational and environmental factors. So, the focus of this research is not only on technology acceptance rather to provide comprehensive understanding of the Saudi Arabian petroleum industry including petrol SC. Therefore TAM is also excluded in this research.

With respect to the Perceived E-Readiness Model (PERM), Molla and Licker (2005a, p. 85) highlighted that e-Readiness framework is 'important tools for assessing the preparation of a nation-state or an organisation to exploit the potentials of e-commerce'. Molla and Licker (2005a, p. 86) stated that the Perceived E-Readiness Model (PERM) is 'an organisation's assessment of the e-commerce, managerial, organisation, and external situations in making decisions about adopting e-commerce'. This model is based on two constructs, first, perceived organisation e-readiness (POER) and perceived external e-readiness. Four components for perceived organisation e-readiness are: awareness (innovation context), commitment (managerial context), resources and governance (organisation context). Due to the different forms that e-commerce adoption can take, initial adoption and institutionalisation adoption, the environmental e-readiness refers to the organisation's assessment of the level of e-commerce support by government and other agencies to conduct e-commerce. However, this research is not assessing or measuring the e-readiness, but exploring the petroleum industry and petrol SC in Saudi Arabia to provide a preliminary exploration of Saudi Arabian petrol supply chain integration. So, this research objective is not technology adoption and hence PERM is excluded in this research.

On the basis of 3PLs, the literature highlighted that research and theory are at their early and formative levels in terms of technology utilisation in 3PLs industry (Wamba and Chatfield 2010). This is more so in the case of petrol stations, which has not been addressed in the literature. Furthermore, Wamba and Chatfield (2010), Selviaridis and Spring (2007) and Marasco (2008) state that 3PL generally lacks a theoretical foundation.

Consequently, TOE is appropriate theory for this research, because it contains the three major foci of this study: technology, organisation and environment. Thus TOE is an appropriate and comprehensive theoretical guideline for exploring and understanding the technological, organisational and environmental factors that can lead to petrol SC integration in Saudi Arabia.

### 3.3 Conceptual Framework

In order to identify the factors that influence the Saudi Arabian petrol supply chain integration, the researcher reviewed several sources of literature to provide an insight into the three contexts of TOE: Technological, Organisational and Environmental (Tornatzky & Fleischer 1990). The three contexts of TOE are illustrated in Figure 3.1 the TOE framework. The three contexts represent ‘constraints and opportunities for technological innovation’ (Tornatzky & Fleisher 1990, p. 154).

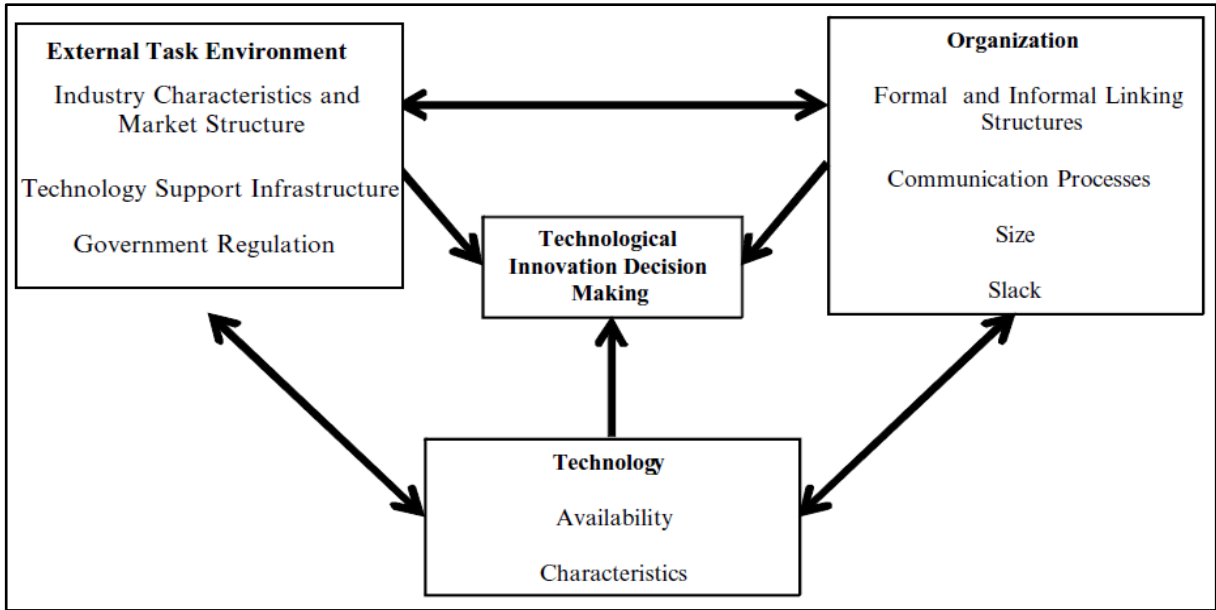


Figure 3.1: Technology-Organisation-Environment Framework (TOE) (Tornatzky & Fleischer 1990)

Under the technological context, the researcher considered texts that showed how relevant IT infrastructure is in evaluating petrol supply chain, both internally and externally. Tornatzky and Fleischer (1990) stated that the technological context is relevant to the organisation. Zhu and Kraemer (2005) refer to technology infrastructure or technological resources as hardware and software that enable Internet-related business (e.g., SAP, EDI, EFT, intranet and extranet, etc). In addition, Al-Somali et al. (2010) highlighted that countries adopting new technologies must have the right basic infrastructure. However, many companies lack the fundamental supply chain infrastructure required to apply technologies across multiple tiers of suppliers and customers (Wood 1997).

In addition, Al Falah et al., (2003) studied the SCM practices in Saudi Arabia's manufacturing industry. The results of their research shows that, the private manufacturers have a weak awareness concerning SCM concepts and similarly in international joint venture firms the local partners (Saudi nationals) have less awareness of SCM than that of their joint venture partners. In other words, manufacturers look at SCM as a traditional inventory management system. Hence, IT infrastructure is considered as one of the technological factors that impacts the Saudi Arabian petrol supply chain integration. Therefore, IT infrastructure is seen as a potential influencing factor concerning supply chain integration for this research.

Another technological factor encompassed in this research is relative advantage. Relative advantage refers to 'the degree to which an innovation is perceived as being better than the idea it supersedes' (Rogers 1995, p. 213). Several studies found that relative advantage was a significant variable in the adoption of IS innovation in electronic supply chain management (Ramdani, Kawalek & Lorenzo 2009), and has positively influenced electronic commerce adoption decisions (Al-Qirim 2007). Tornatzky and Klein (1982) also mentioned that 'relative advantage is the only variable that has been consistently identified as a critical adoption factor and as the most important factor for IT growth in small firms' (Kuan & Chau 2001, p. 511). In this research, relative advantage refers to the perceived benefits from technology with both direct and indirect benefits such as minimising cost, reducing lead time and increasing competitive advantage (Jeffcoate, Chappell & Feindt 2002).

The second context is the organisational context. Different organisational factors introduced in various studies include size of the organisation (Lai, F et al. 2008; Ramdani & Kawalek 2007; Zhu, Kraemer & Xu 2003), age of the business (Kamal 2006), resources (Groznik & Trkman 2006), culture (Aleid, Rogerson & Fairweather 2010; Kamal 2006; Senior 1997), organisational structure (Kamal 2006), innovation ability (Al-Qirim 2007; Thong 1999), financial (Kamal 2006), investment (Kamal 2006) and performance (Kamal 2006). Stewart (1995) also indicated that four categories of operational change must be considered in terms of the integrated supply chain: policies, practices and



procedures; organisation; structure; and systems. On the basis of the literature and for the purpose of this research, the research explores culture, religion, firm size and firm resources as being relevant to organisational context.

The 'intention to use' and 'usage behaviour' of IT have been validated in Western nations exclusively (Al-Gahtani, Hubona & Wang 2007). However, in a non-Western cultural context, specifically Saudi Arabia, in which norms and human behaviour play a significant role (Al-Gahtani, Hubona & Wang 2007), there is a need to highlight organisational culture as an important factor to explain the anomalies of norms and behaviours that influence IT integration and acceptance in Saudi Arabia (Al-Gahtani, Hubona & Wang 2007; Rose & Straub 1998). Hence, the organisational culture based on the user's behaviour and the norms of Saudi nationals that might influence IT utilisation in terms of the petrol supply chain integration is included in this research.

Literature highlighted that religion can influence business firms from different perspectives. Saudi Arabia is a Muslim country that applies Sharia law, which is the primary instrument of social control. 'In Islam, the combination of divine revelation (Quran) and the acts and sayings of the prophet Mohammad (Sunna) basically constitute Sharia law. Sharia replaces positive law promulgated in the West through legislation' (Souryal 1987, p. 431). In perspective of the influence of religion on supply chains, Ciliberti et al., (2013) investigated the practices adopted and difficulties experienced by Small and Medium-sized Enterprises (SMEs) to transfer socially responsible behaviours to suppliers that operate in developing countries. The result of their study indicated that religion can prevent corruption in developing countries, for example, company #2 in their study did not experience corruption in Egypt, the informant thinks 'probably because of their Muslim religion' (Gill & Pabla 2013, p. 8). A study of consumers' perspective on E-commerce conducted in Saudi Arabia exposed that applying offline payments may help consumers to adopt e-commerce due to the argument about compatibility of some credit cards with Islamic Law (Sharia) (Aleid, Rogerson & Fairweather 2010). Moreover, Saudi Arabia is the only Muslim country in which shops and businesses close during all prayer times, not just on Fridays as mentioned in the verse of Quran (Gill & Pabla 2013). This means that all business processes must be closed during prayer times and this can influence Saudi Arabian businesses and supply chains and in petrol supply chain in terms of this research. Hence, it is obvious that religion can influence organisations that are part of a community that applies Sharia law. Therefore, the researcher encompassed religion as a factor that may influence petrol supply chain integration.

Moreover, several prior studies stated how firm size impacts IT utilisation, where the larger the firm, the greater IT utilisation and associated resources. (Al-Somali, Gholami & Clegg 2010; Brynjolfsson et al. 1994; Ramdani & Kawalek 2007; Zhu, Kraemer & Xu 2003). Moreover, Al-Somali et al. (2010) found that the size of a business is positively related to e-business adoption in Saudi Arabia. Nevertheless, Morrisson et.al (1994), stated that micro-enterprises employ one to ten workers, including independent workers. Accordingly, petrol stations in Saudi Arabia are considered micro businesses that have an average of eight workers. From the contribution of the literature, the researcher included firm size as an organisational factor that might impact on the technology utilisation towards the Saudi Arabian petrol station supply chain integration.

In addition, understanding the organisational resources (people, materials and technology) allows an organisation to leverage these resources more productively and achieve a competitive advantage (Wood 1997). It is also noted that the resources that a firm intends to employ as their IT solution is a critical factor in the development of IT capability (Bharadwaj 2000). Amit and Schoemaker (1993, p. 35), refer to capabilities as a 'firm's capacity to deploy resources'. More so, Bharadwaj (2000, p. 171), defined a firm's IT capabilities as 'the ability to mobilise and deploy IT-based resources in combination or co-present with other resources and capabilities'. These definitions show the contribution of capability in combination with IT, firm, and resources. As this research aims to explore the key factors that characterise Saudi Arabian petrol station supply chain integration, IT capabilities, if combined with firm resources, are important factors to be included in this research as an organisation's aim is to achieve petrol supply chain integration, and eventually gain cost-savings, added value, and decrease lead time (Applegate, McFarlan & McKenney 1999; Turban et al. 2008).

The third context in this research is the environmental context. Environmental factors refer to the environment in which an organisation conducts its business (Lee & Lim 2009). There are various types of environmental factors, including: an organisation's industry; competitors; access to resources supplied by others; and dealing with the government (Tornatzky & Fleischer 1990). In this research, the geographical locations have been included despite the lack of literature within the context of TOE (Giunta & Trivieri 2007) only because of the importance of the geographic location of Saudi Arabia (Burnson 2010; SAGIA 2009). Al Falah et al., (2003) pinpointed that, the geographical location (e.g. location of main competitors' operation sites) is one of the threats to world-class manufacturers who are not aware of the importance of developing a management of their supplies. In addition, the distance from Saudi Aramco's petrol distribution stations to petrol stations is expected to be an issue in the petrol supply chain in Saudi Arabia.

The researcher included competition intensity as another environmental factor in this research because several studies have highlighted its significance in supply chain integration (Lai, et al. 2008; Wongpinunwatana & Lertwongsatien 2003; Zhu, Kraemer & Xu 2003) and its impact on developing countries (Dittmer 2008). The researcher also touched on the aspect of government regulation, which is extensively mentioned in the literature, and has been pinpointed as an important influence in Saudi Arabian governance (Al-Somali, Gholami & Clegg 2010; Wang, Wang & Yang 2010).

Based on the above review of the literature and the contribution of TOE on this research, the TOE appears to be an appropriate and comprehensive theoretical guideline for exploring the key factors that influence the integration of Saudi Arabian petrol supply chain.

### **3.4 Research applying TOE to Information Technology**

Extant research has demonstrated that the TOE model has broad applicability and possesses explanatory power across a number of technological, industrial, and national/cultural contexts. Tornatzky and Fleischer (1990) contextualised three elements that influence the technology implementation, adoption and innovation in firms.

The technological context represents the available technologies a firm may adopt. However, the decision to adopt a technology depends not only on the technologies available in the global market, but on how these technologies fit with the technologies a firm already possesses (Chau & Tam 1997; Scupola 2009; Tornatzky & Fleischer 1990). The organisational context denotes the factors that influence innovation adoption and implementation in organisations including, scope, size, and managerial structure (Tornatzky & Fleischer 1990). Finally, the environmental context denotes different kinds of external pressure from competition intensity and government regulation to market uncertainty (Iacovou, Benbasat & Dexter 1995).

However, different types of innovations have varied factors that influence their adoption. Similarly, dissimilar national/cultural contexts and distinct industries will have different factors as well. Thus, other research studies use different factors for the technological, organisation, and environmental contexts. The TOE framework provides a useful analytical framework for studying the adoption and assimilation of different types of IT innovation and it has a solid theoretical basis with consistent

empirical support (Oliveira & Martins 2001). In spite of this framework's stability since its initial development, many avenues for evolution and development appear promising.

The TOE framework has been used to explain the adoption of inter-organisational systems (Chau & Tam 1997; Grover 1993; Kuan & Chau 2001), e-business (Zhu & Kraemer 2005; Zhu, Kraemer & Xu 2003). Electronic data interchange (EDI) (Kuan & Chau 2001), open systems (Chau & Tam 1997), enterprise systems (Ramdani & Kawalek 2007; Ramdani, Kawalek & Lorenzo 2009), and a broad spectrum of general IS applications (Thong 1999). The TOE model has been utilised to explain the adoption of innovations in a host of industries, including manufacturing (Mishra, Konana & Barua 2007; Zhu, Kraemer & Xu 2006), retail, wholesale and financial services (Zhu et al. 2006). Furthermore, the TOE model has been tested in European, American, and Asian contexts, in both developed and developing countries including Saudi Arabia (Al-Somali, Gholami & Clegg 2010; Zhu & Kraemer 2005; Zhu, Kraemer & Xu 2003; Zhu, Kraemer & Dedrick 2004; Zhu, Kraemer & Xu 2006).

In each of these studies, the three elements of technology, organisation, and environment have been shown to influence the way a firm identifies the need, searches, and adopts new technology. In each study, researchers have used slightly different factors for the technological, organisation, and environmental contexts. These researchers have then presumed that for each specific technology or context that is being studied, there is a unique set of factors. For example, in Zhu et al. (2004, p. 25), the authors argue that one relevant factor in the technological context that affects the adoption of e-business is 'technology readiness'. Similarly, these authors argue that 'firm size', 'global scope' and 'financial resources' are the relevant factors that should be studied to understand how the organisation context affects the adoption of e-business.

Furthermore, Teo et al. (2009) used TOE framework in terms of the adopters and non-adopters of e-procurement in Singapore. They found that 'firm size, top management support, perceived indirect benefits and business partner' influence e-procurement adoption. In addition, Salwani et al. (2009) acknowledged that TOE is a popular foundational framework to understand the factors contributing to successful e-commerce implementation and usage. This provides further confirmation that TOE has been applied in the adoption of information technology in organisations. Dedrick and Wes (2003, p. 238) state that TOE is 'a useful analytical tool for distinguishing between inherent qualities of an innovation itself and the motivations, capabilities, and broader environmental context of adopting organisations'.

Finally, government regulation can have either a beneficial or a detrimental effect on innovation. The ‘regulatory environment’ and ‘competition intensity’ are relevant when researchers wish to understand how the environmental context influences the adoption of e-business (Al-Sobhi, Weerakkody & Kamal 2010; Al-Somali, Gholami & Clegg 2009). Table 3.1 below, illustrates the literature that has employed the TOE framework and why the framework was employed.

Table 3.1: Prior studies employed the TOE framework

Authors	Why TOE?
(Chau & Tam 1997; Kuan & Chau 2001; Lee, C & Shim 2007; Thong 1999; Zhu, Kraemer & Xu 2003)	Information technology adoption to enhance supply chains
(Teo, Lin & Lai 2009)	Evaluates the adoption of information technology
(Zhu, Kraemer & Xu 2003)	Appropriate theoretical framework to support empirical studies
(Chau & Tam 1997; Kuan & Chau 2001)	Suitable for identifying factors that impact the adoption of technology
(Zhu, Kraemer & Xu 2003)	Popular foundational model to study the drivers contributing to successful e-commerce
(Dedrick & West 2003)	TOE is useful analytical tool for distinguishing between inherent qualities of an innovation itself and the motivations, capabilities, and broader environmental context of adopting organisations

### 3.5 Applying TOE to this research

While the major focus was on answering this primary research question, ‘How do the technological, organisational and environmental aspects of the Saudi Arabian petroleum industry impact on petroleum supply chain integration?’ the research also aims to address the following sub-questions as an aid to better understand the primary question on the basis of the TOE framework:

- How do the technological aspects of the Saudi Arabian petroleum industry impact on petroleum supply chain integration?
- How do the organisational aspects of the Saudi Arabian petroleum industry impact on petroleum supply chain integration?

- How do the environmental aspects of the Saudi Arabian petroleum industry impact on petroleum supply chain integration?

Answering these sub-questions will help to understand the technological-organisational-environmental factors that influence Saudi Arabian petrol supply chain integration, hence the researcher will be able to answer the primary research question.

A significant amount of literature has been reviewed to provide an insight into the three contexts of TOE: Technological, Organisational and Environmental. Understanding the factors interrelated to these three contexts that influence in the Saudi Arabian petrol supply chain will help to diagnose Saudi Arabian petrol supply chain that will lead to better petrol supply chain integration.

### **3.5.1 Technological factors**

As stated in Tornatzky and Fleischer (1990), internal and external technological factors are relevant to the organisation. Technological factors included in this research are IT infrastructure and relative advantage ‘perceived benefits’. The next sub-section discusses the IT infrastructure.

#### **3.5.1.1 Information technology infrastructure**

In a technological context, the researcher reviewed texts that showed how relevant IT infrastructure is in organisations, both internal and external. Zhu and Kraemer (2005) refer to technology infrastructure, technological resources, hardware and software that enable Internet-related business (e.g., electronic data interchange (EDI), electronic funds transfer EFT, intranets and extranets). Weill (1993, p. 462) defined IT infrastructure as ‘the base foundation of IT capability budgeted for and provided by the information systems function and shared across multiple business units or functional areas. The IT capability includes the technical and managerial expertise required to provide reliable services’. More so, IT infrastructure is regarded as a major e-business source of sustainable competitive advantage (Keen 1991).

In addition, Al-Somali et al. (2010) highlighted that countries adopting new technologies must have the right basic infrastructure. Al-Somali et al. (2010) also considered IT infrastructure as an important technological factors influencing the adoption of e-business in Saudi Arabia. Hence, IT infrastructure is considered one of the influencing technological factors in the Saudi Arabian petrol supply chain

integration that relies on IT infrastructure. Therefore, IT infrastructure is seen as an important in this research.

### **3.5.1.2 IT relative advantage**

From the literature, it appears that technological factor to be an important element in this research. Relative advantage refers to ‘the degree to which an innovation is perceived as being better than the idea it supersedes’ (Rogers 1995, p. 213). Several studies found that relative advantage was a significant factor in the adoption of IT innovations in electronic supply chain management (Ramdani, Kawalek & Lorenzo 2009) and has positively influenced electronic commerce adoption decisions on the basis of the theoretical significance (Al-Qirim 2007).

Tornatzky and Klein (cited in Kuan & Chau 2001, p. 511) argued that ‘relative advantage is the only variable that has been consistently identified as a critical adoption factor and as the most important factor for IT growth in small firms’. In this research, relative advantage refers to the perceived benefits from technology in terms of direct and indirect benefits such as cost savings, lead time reduction - the shorter the lead time, the less complex inventory management will be - and competitive advantage gains (Jeffcoate, Chappell & Feindt 2002) to enhance the operational performance in the Saudi Arabian petrol supply chain which eventually will lead to better integration.

### **3.5.2 Organisational context**

The organisational context defined by Tornatzky and Fleischer (1990) includes several descriptive factors: organisation size, organisation formation, organisational structure, human resources, availability of resources, decision making, links between employees, and the transactions performed throughout the organisation. Senior (1997) stated that books on management, decision-making, even organisational design, do not give a clear definition of what organisation means. However, Senior (1997) deliberated that a typical definition of an organisation might be a social entity that has a purpose, boundary, so that some participants are considered inside the organisation while others are considered outside, and forms activities of participants into a recognisable structure.

Different organisational factors introduced in the studies include: size of the organisation (Lai, F et al. 2008; Ramdani & Kawalek 2007; Zhu, Kraemer & Xu 2003), age of the business (Kamal 2006), resources (Grozniak & Trkman 2006), culture (Al-Sobhi, Weerakkody & Kamal 2010; Aleid, Rogerson & Fairweather 2010; Del Aguila-Obra & Padilla-Melendez 2006; Kamal 2006; Senior 1997; Sherer, Kohli & Yao 2009), organisational structure (Kamal 2006), innovation ability (Al-Qirim 2007; Thong 1999), financial (Al-Sobhi, Weerakkody & Kamal 2010; Kuan & Chau 2001), leadership (Wongpinunwatana & Lertwongsatien 2003), customer reaction (Kamal 2006), and performance (Kamal 2006). For the purpose of this research in enhancing the operational performance of the Saudi Arabian petrol supply chain, the researcher will explore culture, religion, firm size and firm resources as being addressed in the literature as relevant factors to the organisational context in Saudi Arabia (Al-Gahtani, Hubona & Wang 2007; Al-Sobhi, Weerakkody & Kamal 2010; Al-Somali, Gholami & Clegg 2010). These are discussed in the following sub-sections.

### **3.5.2.1 Culture**

Senior (1997) acknowledged that many definitions of culture can be found in the literature review, however Schein (1992) refers organisational culture to ‘the deeper level of basic assumptions and beliefs that are shared by members of an organisation, that operate unconsciously’ (Schein 1992, p. 6).

Moreover, Hofstede (1980) highlighted the dimensions of national culture (i.e. power distance, individualism/collectivism, masculinity/femininity and uncertainty avoidance). Power distance referred to the inequality within a society and how a society deals with it (Hofstede 1980). For example, physical and intellectual abilities, some societies let these inequalities grow over time into inequalities in power and wealth. Other societies try to underplay inequalities in power and wealth. In organisations, the level of power distance is related to the level of centralisation of authority and the level of leadership. While high power distance societies accept the inequalities in power and wealth, not only by the leaders but also by the people who at the bottom levels in status and salaries. In high power distance societies the people without power accept the situation just as much as those with power, as all will be treated as equals (Senior 1997).

Individualism/collectivism, referred to relationships between an individual and his or her fellow individuals. In individualistic societies everybody is expected to take care of his or her self or the individual fellow. Thus the relationship within this society is very loose, contracts between employers and employees are based on common advantage, and promotions are based on knowledge and skills.



However, in collectivist society the relationship between the individuals are very tight. The family and fellows are important and this can be extended to work groups and organisations. Contracts between employers and employees are based on moral terms and promotion may be based on group's needs as well as the individual's (Senior 1997).

Masculinity/femininity, refers to the gender roles. In high-masculinity society, the social division between the sexes is maximised, this includes the importance of showing how big is the success, money and materials. In feminine societies, the dominant values for both sexes, are those more traditionally associated with the feminine role of nutrition and caring, putting relationships before money, minding the quality of life, conflict solved by negotiation (Senior 1997).

Uncertainty avoidance, refers to the fact that time runs only one way from the past to the future, thus the future is unknown and uncertain. Some people accept the life as it is and accept each day as it comes. They do not get upset about the uncertain future. Those people are more tolerant than others who have different opinions and are comfortable with risk-taking (Senior 1997).

In terms of organisational culture and SCM, the literature suggests that organisation cultures prevent a truly integrated logistics concept (Gattorna, Chorn & Day 1991). According to Lambert and Cooper (2000), the importance of corporate culture and its compatibility across supply chains cannot be underestimated. Meshing cultures, individuals and attitudes is time consuming, but it is necessary at some level in order for the channel to perform as a chain. Aspects of culture include how employees are valued and how they are incorporated into the management of the firm (Lambert & Cooper 2000).

In terms of the influence of organisational culture in IT utilisation, the 'intention to use' and 'usage behaviour' of IT, that is important integration portion in SCM, have been exclusively validated in Western nations' cultural context (Al-Gahtani, Hubona & Wang 2007). However, there is a need to highlight organisational culture as an important factor to explain the anomalies of norms and behaviours that influence integrated IT and technology acceptance in Saudi Arabia (Al-Gahtani, Hubona & Wang 2007; Rose & Straub 1998).

On the basis of the literature, Saudi Arabian culture is expected to have an influence in petrol supply chain in terms of the managerial levels and management centralisation levels. More so, Saudi Arabia is considered high-masculinity society in job opportunities and management levels. There are rigid boundaries in social roles and expectations for women compared to men in Saudi Arabia and thus

there are far fewer women in professional knowledge worker roles (Al-Gahtani, Hubona & Wang 2007). The managerial hierarchy and power-distance in Saudi Arabia also exert influence in organisational contexts (Mobashar, Bala & Bhagwatwar 2011). Therefore, the organisational culture is embraced in this research. Hence, this research incorporated the organisational culture based on the workers' and customers' behaviours and norms of Saudi Arabians that might influence IT utilisation in terms of petrol supply chain.

### **3.5.2.2 Religion**

Co-management involves understanding and respecting traditional values, in particular when they are organised in places of religion with significant tangible and intangible values and an important spiritual significance to traditional owners (Lo Presti & Petrillo 2010). Differences in languages and religions mean that one nation's culture will diverge significantly from another's (Senior 1997). This addresses the importance of religious and language factors in terms of managerial paradigms.

Aleid et al. (2010) found that most published papers in the area of e-commerce have considered language and religious factors as an obstacle to consumers' adoption of e-commerce, especially in the Islamic countries. However, there is a consensus among most participants in their study that language and religion is no longer considered a barrier that influences consumers' adoption of e-commerce. This is due to the availability of both Arabic and English versions on most Saudi sites. In addition, the Islamic religion is no longer considered a barrier to e-commerce adoption. This is due to improvements in Islamic banking and finance and the new commercial transactions that are consistent with the principles of Islamic law (Sharia). For example, the availability of the Islamic credit card, that avoids dealing with Riba (interest). Consequently, they suggested that religious factor should no longer be considered an obstacle in the e-commerce adoption in the Islamic world (Aleid, Rogerson & Fairweather 2010).

However, the literature in the area of SCM and SC integration did not discuss language and religious factors in terms of cultural issues. Therefore, this research included the religious and language factors to explore if there is any influence of these factors in petrol SC in Saudi Arabia. It is expected that this will help understand the religious and language issues amongst petrol SC echelons in the Saudi Arabian petroleum industry, which will lead to better SC integration.

### **3.5.2.3 Firm size**

Intensive research indicated how firm size impacted IT utilisation, where the larger the firm, the greater the utilisation of IT and associated resources. (Al-Somali, Gholami & Clegg 2010; Brynjolfsson et al. 1994; Ramdani & Kawalek 2007; Zhu, Kraemer & Xu 2003). Moreover, Al-Somali et al. (2010) found that the firm's size positively influenced e-business adoption in Saudi Arabia.

Nevertheless, Morrisson et al. (1994), surveyed 300 micro-enterprises in seven different countries (i.e. Niger, Swaziland, Algeria, Tunisia, Ecuador, Jamaica and Thailand) with two Arab countries surveyed amongst them (i.e. Algeria and Tunisia), which revealed that over 90% of these enterprises have fewer than ten workers. Consequently, they argued that based on the practical distinction, micro-enterprises employ one to ten workers, including independent workers (Morrisson, Lecomte & Oudin 1994).

In terms of the workforce in Saudi Arabia, according to Al-Asfour and Khan (2014) Saudi Arabia is hugely popular with expatriates primarily as they pay no tax on their income. While foreigners make up about one third of the total Saudi population, the figure is much higher within the working population. Foreign workers are believed to make up nine out of 10 of the private sector workforce, highlighting the huge dependence on expatriates. The government has been criticised for allowing so much foreign labour into the Arab state, which has led to an increase in local unemployment that has now crept above 10 per cent.

This obviously proves that foreigners comprise not only 90 percent of petrol stations' workforce but also of the whole private sector. This highlights the importance of firm size on the basis of the number of employees/workers to be explored in this research.

Thus, petrol stations subject to this research in Saudi Arabia are considered micro-enterprises that incorporated an average of eight workers. On the basis of previous research, this project incorporates firm size as an organisational factor that might influence in Saudi Arabian petrol supply chain integration.

### **3.5.2.4 Firm resources**

Amit and Schoemaker (1993, p. 35), referred to capabilities as ‘a firm’s ability to deploy resources’. Bharadwaj (2000, p. 171), defined a firm’s IT capabilities as ‘the ability to mobilise and deploy IT-based resources in combination or co-present with other resources and capabilities’. These definitions show the influence of IT capability in combination with IT and firm resources.

Moreover, Sohail and Al-Abdali (2005) highlighted that, the benefits reported by respondents include improved customer service resulted from a 6.7 percent increase in the usage of 3PL in Saudi Arabia, delivering a more effective utilisation of human resources.

Although the research aims to explore the key factors that influence Saudi Arabian petrol supply chain integration, understanding firm resources in Saudi Arabian petrol supply chain echelons ‘units’ include firms, human resources and IT-based resources will help to describe the ‘as-is’ scenario of business process, which is considered the fundamental stepping stone for building a supply chain infrastructure (Wood 1997).

### **3.5.3 Environmental context**

The third context in this study is the environmental context. Environmental factors refer to the work environment in which an organisation conducts its business (Lee, S & Lim 2009). There are different sorts of environmental factors, including: organisation’s industry; competitors; access to resources supplied by others; and dealing with the government (Tornatzky & Fleischer 1990). Moreover, the environmental consequences of transport including air and water quality, noise level and public health are significant, therefore transport is a dominant factor in contemporary environmental issues (Rodrigue, Comtois & Slack 2013). Hence, this research included different environmental factors that are related to the environmental context. The following sub-section discusses the geographic location.

### **3.5.3.1 Geographic location**

According to Rodrigue et al. (2013), the purpose of transportation is to overcome space, which is shaped by a variety of human and physical constraints such as distance, time, administrative divisions and topography. They also highlighted that the fundamental purpose of transport is geographic in nature, because it facilitates movements between different locations. Transport thus plays a role in the structure and organisation of space and territories, which may vary according to the level of development (Rodrigue, Comtois & Slack 2013).

In this research, geographic locations has been included despite the lack of literature within the context of TOE (Giunta & Trivieri 2007). This is due to the importance of the geographic location of Saudi Arabia and the distance between Saudi Aramco's petrol distribution stations and petrol stations that is anticipated to influence the understanding of petrol logistics processes in Saudi Arabia.

### **3.5.3.2 Competition intensity**

As highlighted in sub-section 3.5.2.3, foreign workers are believed to make up 90 percent of the private sector workforce, highlighting the huge dependence on expatriates. This is also considered an issue in the competitive environment in petrol stations in Saudi Arabia (Matar & Al-Zahrani 2011a). Thus, exploring competition intensity in order to understand the competitive environment in this research is important.

Moreover, Saudi Aramco is the only petrol provider in Saudi Arabia which could influence customer service quality due to the lack of competition in petrol distribution in the Kingdom. Therefore, competition intensity appears an important factor that could influence petrol supply chain members.

Competition intensity was also incorporated in this research as an environmental factor because, from the literature review of the TOE contexts, several researchers discussed competition intensity in supply chain integration (Lai, F et al. 2008; Wongpinunwatana & Lertwongsatien 2003; Zhu, Kraemer & Xu 2003) and its influence in developing countries (Dittmer 2008). However, it is noted that there is lack of literature in terms of the competition intensity in the petrol supply chain context.

### **3.5.3.3 Government regulations**

Last but not least, this research included the aspect of government regulation that was extensively discussed in the literature, and pinpointed as an important factor that influences Saudi Arabian governance in the public and private sector (Al-Somali, Gholami & Clegg 2010; Wang, Wang & Yang 2010).

According to Rodrigue, et al (2013, p. 43) ‘Various levels of government are often lobbied by transport firms for financial and/or regulatory assistance in projects that are presented as of public interest and benefit. The consolidation of regional markets and the resulting increase in transporter traffic has led transport firms to seek global alliances and greater market liberalization in the transport and communication sector as a means to attract investments and to improve their productivity’.

This highlights that the government influence is obvious in the transportation system. In this research, the researcher is exploring two important units related to the transport system i.e. fuel haulers and 3PL fuel haulers. Therefore the influence of Saudi Government and the relationship of the government with the Saudi Aramco as the only provider in the country is important. Hence, the researcher includes the government regulations as a sub-factor that appears to influence in the Saudi Arabian petrol supply chain.

Based on the literature and the contribution of TOE to this research, a conceptual framework has been initially framed, illustrated in Figure 3.2. The proposed framework appears to be an appropriate and theoretical guide for understanding the technological, organisational, and environmental factors that influence the Saudi Arabian petrol supply chain. Understanding these factors will lead to petrol SC integration.

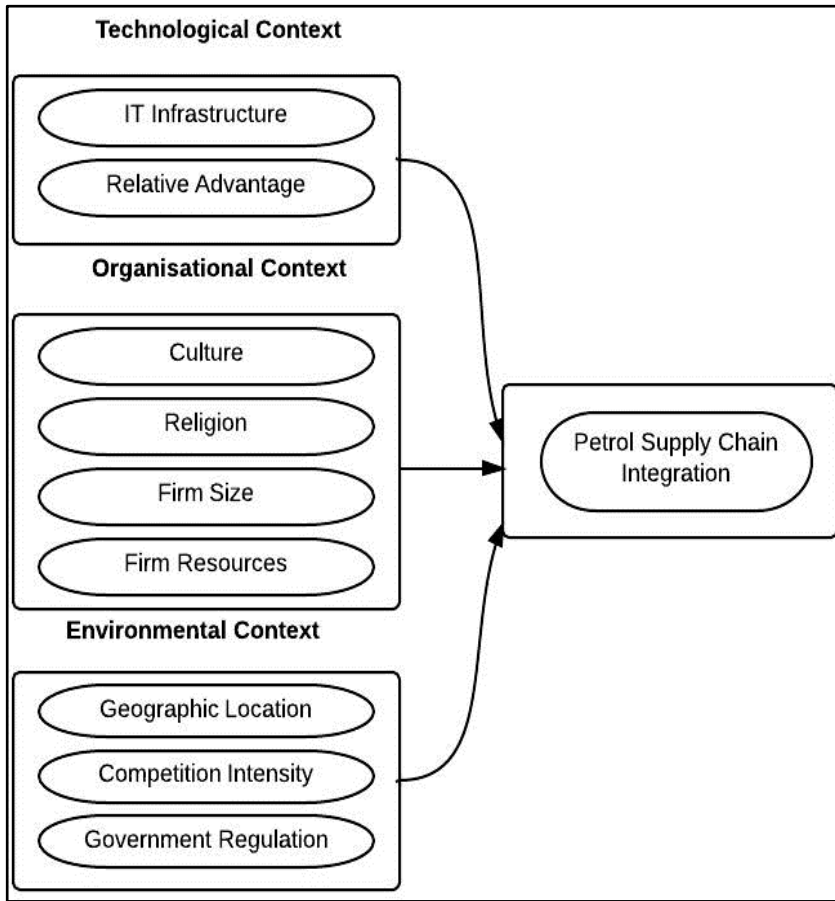


Figure 3.2: proposed conceptual framework for the research

As the focus of this research is to diagnose the Saudi Arabian petrol supply chain, this conceptual framework incorporates the three main contexts of the TOE that have sub-factors considered to have influence in the petrol supply chain integration. Understanding the issues related to these sub-factors will lead to petrol supply chain integration in Saudi Arabia.

This framework does not consider which factors are the most important and whether the factors influence one another. However, Chapter 11 discusses the cross-case analysis and findings based on the similarities and differences between the research units, which revealed the significant factors and whether the factors influence one another. Consequently, Chapter 12 will address the final modified framework, which incorporates sub-categories that highlight the significant issues related to each sub-factor of the TOE contexts.

Eventually, the conceptual and modified frameworks will help to understand the Saudi Arabian petrol supply chain industry, which answers the research question ‘How do the technological, organisational and environmental aspects of the Saudi Arabian petroleum industry impact on petroleum supply chain integration?’

In summary, what has been done previously in terms of TOE is technological, organisational, and environmental and these factors are broadening out. But it is quite a generic approach used for a lot of organisations and many different industries and units. What the researcher is interested to understand is what impact, what factors, what issues concern that influence in petrol supply chain in Saudi Arabia. Moreover, TOE is providing a good framework for collecting and analysing the data. Also what the researcher is trying to do in this research is qualitative exploratory, because no research of qualitative exploratory using the TOE in a petrol supply chain has been done before. It is expected that the result of this study will have a quite big impact not just contributing to the research literature of supply chain management, but also to research theory concerning the TOE framework. Finally, with this framework, this research is attempting to build a rich and broad picture of the petrol supply chain within Saudi Arabia. The next chapter is methodology.



## **Chapter 4 – Methodology**

### **4.1. Introduction**

This chapter provides a detailed description of the methodological approach taken in this study. This chapter covers the research approach, which discusses the characteristics of research design and why the researcher selected a qualitative research approach. This is then followed by research design, which describes the research approach, research perspectives, and the type of research method that was used in this study.

This chapter discusses sampling processes, which describes the context of this research in utilising the TOE framework, the background of the participants approached in this study, the process of pretesting the interview schedule, the process of organising the support letter, and interview arrangements. Moreover, this chapter discusses the units of analysis, which includes the four case studies of this research (rural and metropolitan petrol stations, fuel haulers, Saudi Aramco, fuel 3PLs).

This chapter also discusses the process of analysing the data, which includes the process of transcribing, interpreting, and coding data into meaningful categories. This involves identifying and describing themes, patterns and concepts and then organizing them into meaningful categories to be able to understand and explain these themes, patterns or concepts. This research also discusses the processes of reliability and validity and the issues of credibility and how minimizing errors and biases in this study performed. This is then followed by a summary of the research methodology utilised in this study.

In order to address the research questions on the basis of the conceptual framework, the research has used a qualitative research method belonging to the interpretive research paradigm. The research design followed a case study research design by using qualitative case study data collection techniques.

## 4.2. Research Approach

The determination of why a researcher should select a particular research method is based on the nature of the problem that he/she wants to study (Creswell 2009). A research method defines the type of research tools and techniques that may be used to collect empirical evidence (Creswell 2009). There are two basic types of data collection methods: quantitative methods and qualitative methods (Cavaye 1996).

Creswell (2009) stated the difference between qualitative and quantitative research is framed in terms of using words (qualitative) rather than numbers (quantitative), or using closed-ended questions (quantitative hypotheses) rather than open-ended questions (qualitative interview questions). Generally, quantitative research specifies numerical assignments to the phenomena under study, whereas qualitative produces narrative or textual descriptions of the phenomena under study (VanderStoep & Johnson 2009). The following Table 4.1 describes the characteristics of these approaches.

Table 4.1: Characteristics of quantitative and qualitative research design

<b>Characteristics</b>	<b>Quantitative research</b>	<b>Qualitative research</b>
Type of data	Describes the phenomena numerically	Describes the phenomena as a narrative
Analysis	Statistics are descriptive and inferential	Identification of themes
Scope of inquiry	Specific questions or hypotheses	Broad, thematic analysis
Primary advantage	Large sample, statistical validity, accurately reflects the population	Rich, in-depth, narrative description of sample
Primary disadvantage	Superficial understanding of participants' thoughts and feelings	Small sample, not generalised to the sample population

Source: Vanderstoep & Johnston 2009, p. 7

The quantitative research methodology incorporate 'identifying a problem, formulating a hypothesis, collecting data to test the hypothesis, and then testing the hypothesis through the use of statistical procedures' (Solomon & Draine 2009, p. 27). This differs for a qualitative study whereby the study is of an exploratory nature, the variables are unknown, the context is important and there is a lack of theory.

Quantitative research was originally developed in the natural sciences in order to study natural phenomena (Lind et al. 2005). The underlying philosophical assumptions of the researcher in quantitative research largely rely on a positivist approach (Neuman 2000). They emphasise the measurement and analysis of the causal relationships between variables (Denzin & Lincoln 2005). Quantitative research allows researchers to familiarise themselves with the problem or concept to be studied, and to perhaps generate hypotheses to be tested (Neuman 2000). The analysis of data in quantitative research is based on a statistical analysis that can be divided into two parts: descriptive analysis and inferential analysis (Creswell 2009). Descriptive analysis is the method of organising, summarising, and presenting data in an informative way, typically through statistics. The data can be organised into a frequency distribution, and various charts can be used to describe the data (Lind et al. 2005). Inferential analysis is the method used to determine something about a population on the basis of a sample (Lind et al. 2005).

Qualitative research has different objectives from quantitative research. It answers questions about what is happening in a particular situation. It gives an impression and feeling that can describe in detail what is happening in a community or in a conversation and includes the meaning of the message, feelings, and effects (Bouma & Ling 2004; Creswell 2009). Moreover, qualitative research is useful in cases when a researcher needs to understand and explore what a technology means to the users (Kaplan & Maxwell 1994). However, each research methodology may have its own advantages and disadvantages, depending on the type of research question, the control that the researcher has of the research objective and the focus on current or historical phenomena (Yin 2009).

A mixed method approach is the third choice for research method. The mixed method approach is defined as ‘the research focuses on collecting and analysing both quantitative and qualitative data in a single study’ (Creswell 2009, p. 210). The mixed method approach has also been referred to as ‘quantitative and qualitative methods’, ‘multi-method’ and ‘multimethodology’ (Bazeley 2006; Hunter & Brewer 2003; Neuman 2000). Easterby-Smith et al. (2012) pointed out that the mixed method approach allows the research design and strategies to be offset by counter-balancing strengths from one method to another. By attempting to answer the research question the only way is through a qualitative approach.

On the basis of the reviewed literature, there is a lack of research focusing on understanding the technological, organisational, and environmental factors that influence supply chain integration using the qualitative approach (Al-Somali, Gholami & Clegg 2010; Bosch-Rekvelde et al. 2011).

Therefore, studying these factors in the petrol supply chain using a qualitative research adds rich exploratory data and nuance that illustrates the existing knowledge of the phenomenon being explored, in this case how does our understanding of the technological, organisational, and environmental factors lead to Saudi Arabian petrol SC integration. In addition, in attempting to answer the research question the only way is through a qualitative approach.

### **4.3. Epistemology of the Research**

Chua (1986) described three categories in which a researcher's perspective is based: positivist, interpretive and critical. Qualitative research is a type of interpretive research in which researchers create an interpretation of what they see, hear, and understand (Creswell 2009). The researcher's interpretations should not be separate from their own background, history, context, and prior understanding (Creswell 2009). Chua (1986) described these research categories based on the researcher's perspective:

- 1) Positivist is generally assumed that reality is objectively given and can be described by measurable properties, which are independent of the observer, 'the researcher' and the used instruments. Generally, positivist studies endeavour to the predictive understanding of phenomena (Chua 1986).
- 2) Critical researchers assume that social reality is historically founded and that it is produced and reproduced by people. Although people can consciously act to change their social and economic circumstances, critical researchers recognize that their ability to do so is constrained by various forms of social, cultural and political domination (Chua 1986).
- 3) Interpretive research emphasises the complexity of human sense making as the situation emerges. It does not rely on dependent or independent variables however it attempts to understand phenomena through the meanings that people assign to them (Kaplan & Maxwell 1994). Interpretive methods of research in information systems are 'aimed at producing an understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context' (Walsham 1993, pp. 4-5).

Interpretive research is adopted in this research because the researcher attempts to understand the petroleum industry and the technological, organisational, and environmental factors that lead to Saudi Arabian petrol SC integration through the meaning that people assign to them (Kaplan & Maxwell

1994). The participants will deliver their understanding of the issues and related causes from their experience.

#### **4.4. Case Study Research**

There are different strategies of inquiry in qualitative research for example, ethnography, grounded theory phenomenological research, narrative research and case studies (Creswell 2009). ‘Case studies are a strategy of inquiry in which the researcher explores in depth a program, event, activity, process, or one or more individuals. Cases are bounded by time and activity, and researchers collect detailed information using a variety of data collection procedures over a sustained period of time’ (Creswell 2009, p. 13).

Yin (2009) notes three categories of case study designs, namely exploratory, descriptive, and explanatory. This research uses a ‘how’ question and therefore, according to Yin (2009) this makes the study an explorative one. In short, the research outlined in this thesis is qualitative and exploratory in nature (Creswell 2009).

The ‘case’ can be some event or entity other than a single individual (Yin 2009). Consequently, Yin (2009) highlighted that there are four types of designs of case study, which include single-case study, multiple-case study, holistic (single-unit of analysis), and embedded (multiple units of analyses).

An embedded-case study may comprise more than one unit of analysis. This occurs within a single case, where attention is also given to a subunit or subunits. Even though a case study might be a single organisation, e.g. a hospital, the analysis might include outcomes about the clinical services and staff employed by the hospital (Yin 2009). Consequently, this research used a single embedded case study design, because the research focus is on the Saudi Arabian petroleum industry, which contains four units of analysis namely, rural and metropolitan petrol stations, fuel haulers, Saudi Aramco, and fuel 3PL providers (discussed in sub-section 4.6 units of analysis).

#### **4.5. Data Collection Strategy**

According to Creswell (2009) different methods of data collection are highly recommended in case study research. As the objective of this research is to provide a rich understanding of the Saudi Arabian petroleum industry, including petrol SC operation processes, the data was collected using multiple approaches, including: face-to-face audio recorded interviews, documents provided by

organisations and key informants, and other publicly available information (e.g., press releases, financial statements, and trade press articles).

Face-to-face interviews are ‘one of the most important sources of case studies’ (Yin 2009, p. 106). Easterby-Smith et al. (2012) highlighted that there are two types of interviews, namely, face-to-face interviews and focus group interviews. Easterby-Smith et al. (2012) claimed that the most fundamental and effective of all qualitative methods is that of in-depth interviewing. One would ask why not focus group interviews, the answer is having one on one interviews face to face with individuals allows the individual interviewee freedom to express their own answers privately and openly. Since the researcher is looking at rich data and opinions of particular petrol stations owners, and haulers, this is the most effective way of obtaining rich data (Creswell 2009; Neuman 2000; Easterby-Smith et al. 2012).

Yin (2009) highlighted that documented information is likely to be relevant to every case study topic. The collection of documented information in this study will include annual reports, business proposals, government rules and regulations, and other publicly available information (e.g., local press releases, financial statements, and trade press articles). These methods of data collection are useful when there is limited access to data (Yin 2009).

Before the face-to-face interviews were conducted, the researcher prepared the interview questions. The interview questions were prepared based on the main research question posed in this study: *How does the understanding of the Saudi Arabian petroleum industry lead to petrol SC integration?* The interview questions were structured in three sections based on the TOE contexts: technology; organisation; and environment. The details of these questions can be seen in Appendix B.

In order to provide a coherent picture of the data collection process to be undertaken based on the TOE contexts and literature review, the tables below (4.2 technological context, 4.3 organisational context, and 4.4 environmental context) illustrate the research units and the expected factors that might influence the Saudi Arabian petrol supply chain. Consequently the researcher conducted the semi-structured interviews.

Table 4.2: Technological context

TOE contexts	Research units	Data collection to be actioned	Processes to be explored	Factors explored
<b>Technology</b>	Petrol stations	To explore Saudi Arabian petrol stations' technology infrastructure and the extent of IT utilisation	<ul style="list-style-type: none"> <li>- Communication</li> <li>- Fuel tank measurement</li> <li>- Fuel forecasting and replenishment</li> <li>- Procurement</li> </ul>	<ul style="list-style-type: none"> <li>- IT infrastructure</li> <li>- Relative advantage</li> </ul>
	Fuel haulers	To explore fuel haulers' fleets in terms of IT infrastructure and the influence of technology in fleet management	<ul style="list-style-type: none"> <li>- Fuel Transportation</li> <li>- Fleet management</li> <li>- Communication</li> </ul>	
	3PL providers	<ul style="list-style-type: none"> <li>- To explore fuel 3PL providers' technology infrastructure and the relationship with the Saudi Arabian petrol stations and Saudi Aramco</li> <li>- To explore the borders of fuel 3PLs operations e.g. logistics, IT, fuel storage ... etc.</li> </ul>	<ul style="list-style-type: none"> <li>- Transportation</li> <li>- Procurement</li> <li>- Communication</li> <li>- Contracts</li> </ul>	
	Saudi Aramco	To explore the technology infrastructure and the extent of collaboration with the customers (petrol stations, fuel 3PL providers, and fuel haulers)	<ul style="list-style-type: none"> <li>- Communication</li> <li>- Terminal tank measurement</li> <li>- Petrol forecasting and replenishment</li> <li>- Procurement</li> </ul>	

Table 4.3: Organisational context

TOE contexts	Research units	Data collection to be actioned	Processes to be explored	Factors explored
<b>Organisation</b>	Petrol stations Fuel haulers Saudi Aramco 3PL providers	<ul style="list-style-type: none"> <li>- To explore the influence of :                             <ul style="list-style-type: none"> <li>▪ power distance</li> <li>▪ individualism/collectivism</li> <li>▪ masculinity/femininity</li> <li>▪ uncertainty avoidance in the Saudi Arabian petrol SC echelons</li> </ul> </li> <li>- To explore if there are any issues related to Sharia Law e.g. using credit cards</li> </ul>	<ul style="list-style-type: none"> <li>- Tally and procurement processes</li> <li>- Management systems</li> <li>- Organisations hierarchy</li> <li>- Customers relationship</li> </ul>	<ul style="list-style-type: none"> <li>- Culture</li> <li>- Religion</li> </ul>
	Petrol stations Fuel haulers Saudi Aramco 3PL providers	To explore the firm-size of Saudi Arabian petrol SC echelons	Number of employees and workers	- Firm size
	Petrol stations Fuel haulers Saudi Aramco 3PL providers	To explore firm resources in petrol SC echelons to achieve advanced IT capability and business performance	IT capability	- Firm resources



Table 4.4: Environmental context

TOE contexts	Research units	Data collection to be actioned	Processes to be explored	Factors explored
Environment	Petrol stations Fuel haulers Saudi Aramco 3PL providers	<ul style="list-style-type: none"> <li>- To explore the influence of geographic location in petrol SC echelons</li> <li>- To explore the work-life environment in Saudi Arabian petrol SC echelons</li> <li>- To explore the environmental issues surrounding petrol SC echelons</li> </ul>	<ul style="list-style-type: none"> <li>- The distance and time from refineries to petrol stations</li> <li>- Rural and metropolitan petrol stations' locations</li> <li>- Fuel haulers locations</li> <li>- Saudi Aramco's terminals and bulk plants locations</li> <li>- 3PLs locations</li> <li>- Technology suppliers locations</li> <li>- delays of petrol supply process</li> </ul>	<ul style="list-style-type: none"> <li>• Geographic location</li> </ul>
	Petrol stations Fuel haulers Saudi Aramco 3PL providers	<ul style="list-style-type: none"> <li>- To explore the extent of competition intensity amongst Saudi Arabian petrol SC echelons</li> </ul>	<ul style="list-style-type: none"> <li>• Providers competition intensity</li> <li>• Suppliers competition intensity</li> <li>• Rural/metropolitan petrol stations' competition intensity</li> </ul>	<ul style="list-style-type: none"> <li>• Competition intensity</li> </ul>
	<ul style="list-style-type: none"> <li>• Saudi Aramco</li> <li>• Government authorities (e.g. MOPM)</li> </ul>	<ul style="list-style-type: none"> <li>• To explore the government rules and regulations</li> <li>• To explore the role of the Ministry of Petroleum and Mineral Resources (MOPM) in local petrol supply chain</li> </ul>	<ul style="list-style-type: none"> <li>• Rules and regulations related to petrol SC echelons</li> <li>• Extent of government supervision on petrol SC</li> <li>• Sanctions list</li> </ul>	<ul style="list-style-type: none"> <li>• Government regulation</li> </ul>

Several processes were undertaken to ensure the reliability of the prepared questions. First, the researcher prepared the questions based on the main research question. Second, the researcher's supervisor checked the prepared questions and made several changes. Third, in order to review questions that were not clear, the questions were modified after initial interviews working data. The purpose of this process was to ensure that the interview questions were as clear and accurate as possible. A semi-structured interview was used to capture the data. Sekaran (2003) highlighted that the objective of semi-structured interviews is to bring preliminary issues to the surface, so that the researcher can determine what variables need further in-depth investigation. In the semi-structured interview, respondents were encouraged to offer their own definitions of particular activities (Silverman 2013). Thus, in the case of this research, all the interviewees were encouraged to give their own opinions regarding the influence of social issues on the petrol supply chain. At the beginning of each interview, the researcher gave the respondent a copy of the project summary, specifically the Plain Language Statement and the interview questions (see Appendices A and B), and asked them to sign a form providing their informed consent to the interview, as well as their consent to the audio-recording of the interview. The interviewer recorded the conversations, with the permission of the interviewee, and made written notes during the interview. The interviews took approximately 45 to 60 minutes. All interviews were transcribed in Arabic then translated in English, an example of transcribed interviews can be seen in Appendix D.

#### **4.6. Units of Analysis**

The sampling process started at selected petrol stations in Saudi Arabia that are supplied by the state owned oil company, Saudi Aramco, which is the only provider of fuel in Saudi Arabia. Saudi Aramco owns four refineries, two joint venture refineries and one integrated refinery and petrochemical plant and 20 bulk plants (distribution stations) located in different metropolitan cities in Saudi Arabia. These cities are considered far in distance from customers' locations, such as petrol stations and fuel haulers.

On the basis of the locations of Saudi Aramco's petrol distribution centres and petrol stations, these units of analysis were sorted into two investigative areas: rural and metropolitan. Rural petrol stations mainly consist of petrol stations that are located in villages or on national highways, and are distant from Saudi Aramco's distribution stations (e.g. Alkhurmah). Metropolitan petrol stations consist of petrol stations that are located in metropolitan cities, and are near to Saudi Aramco's distribution stations (e.g. Riyadh). The reason for investigating these two distinctive areas is to explore if there are any differences between

the two areas based on the factors of TOE. Figure 4.1 illustrates the map of Saudi Arabia and the selected areas for the purpose of this research.

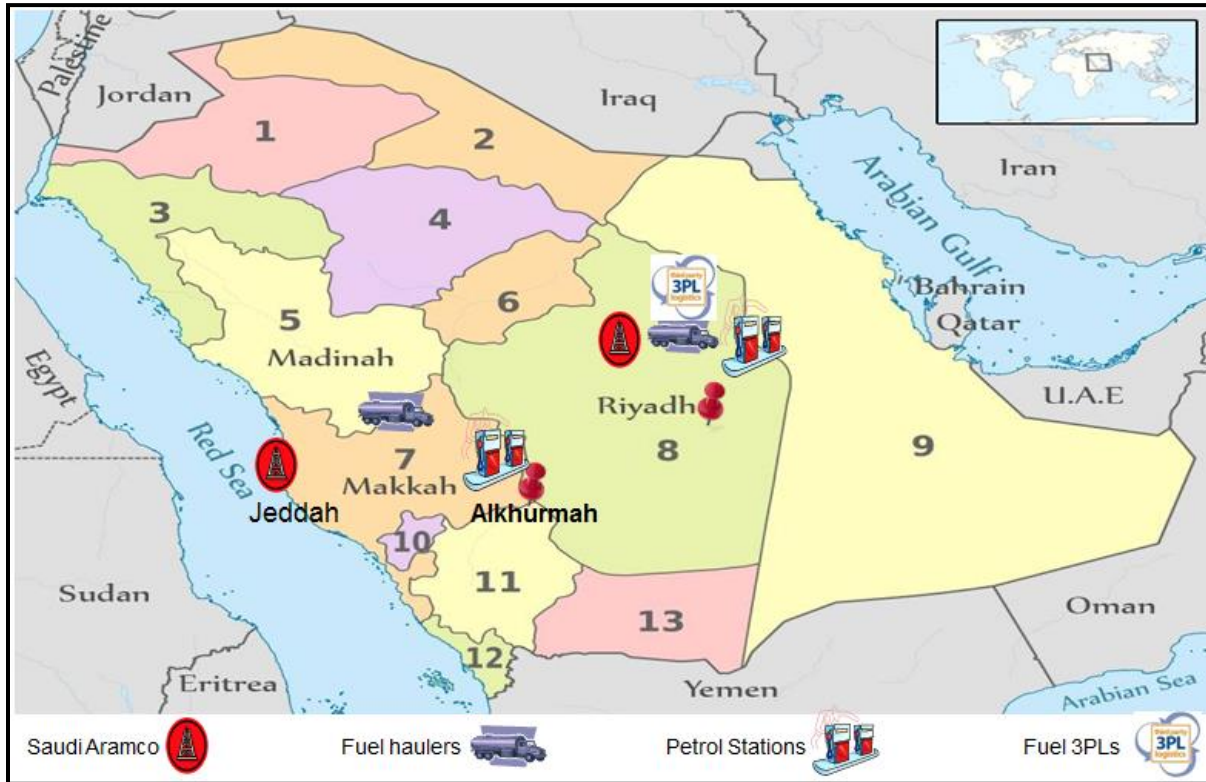


Figure 4.1: Units of Analysis of the Research

Between November 2011 and February 2012, twenty four participants were interviewed for the purpose of the research. The Theoretical saturation, was adopted with the petrol stations, fuel haulers, Saudi Aramco, and fuel 3PLs, because when the researcher got up to the fourth and fifth interviews, nothing further was being added to the data that had been collected, and any further interviews were not going to add any new findings. So, the researcher found that six petrol stations and four fuel haulers, were enough to build up the picture of the petrol stations, as representative of Saudi Arabia. In addition, the good representation between the rural and metropolitan was sufficient to highlight different valid points to understand the petrol supply chain in these respective areas of Saudi Arabia.

Subsequently, ten participants were interviewed from six different petrol stations; the participants were (the owners, managers, accountants and truck driver), who are the best people to explain the petrol supply

chain. Five of the participants were from three rural petrol stations in Alkhurmah village, located 450 km away from Saudi Aramco's distribution station in Jeddah city, and the other five participants were from three metropolitan petrol stations in Riyadh city.

Moreover, five participants were interviewed in respect to fuel haulers, two owners and two CEO of fuel hauling firms and one truck driver. Furthermore, five participants were interviewed from Saudi Aramco. These were the senior members representing the bulk plants, and were in the best position to explain the Saudi Aramco supply chain. They are petroleum engineer, process control system technician, loss prevention advisor, operations supervisor, and customer relationship manager. The final unit was fuel 3PL providers from which four participants interviewed. They were the CEO of F-3PL Limited, its marketing manager, operations manager, and a technician, who were best positioned to explain the role that fuel 3PL plays in petrol supply chain integration. All participants are listed in Table 4.2 based on the units of analysis. Petrol stations, hauling fleets and all participants have been given a pseudonym to protect their identities and that of their businesses.

Table 4.5: Characteristics of Interviewees

<b>Rural Petrol Stations / Alkhurmah</b>		
<b>Area</b>	<b>Name</b>	<b>Position</b>
MS Petrol Station	Mr Sami	Owner
	Mr Izhar	Manager
NS Petrol Station	Mr Ahmad	Owner
AS Petrol Station	Mr Faisal	Owner
	Mr Basheer	Accountant
<b>Metropolitan Petrol Stations / Riyadh</b>		
<b>Area</b>	<b>Name</b>	<b>Position</b>
AA Petrol Stations	Mr Majed	Manager
DB Petro Stations	Mr Mansour	Owner
	Mr Siraj	Accountant
	Mr Nahdi	Manager
ALO Petrol Stations	Mr Saleh	Owner
<b>Fuel Haulers</b>		
	<b>Name</b>	<b>Position</b>
NT Hauling Fleet	Mr Bader	Owner
NA Hauling Fleet	Mr Nawaf	CEO
DB Hauling Fleet	Mr Duhaim	Owner
AD Hauling Fleet	Mr Fares	CEO
	Mr Mahmoud	Truck Driver
<b>Saudi Aramco</b>		
<b>Area</b>	<b>Name</b>	<b>Position</b>
Riyadh Bulk Plant (Distribution Centre)	Mr Akram	Process Control System Technician
	Mr Aysar	Petroleum Engineer
	Mr Thamer	Loss Prevention Advisor
	Mr Mubarak	Operation Supervisor
	Mr Haitham	Customer Relationship Manager
<b>Fuel 3PL Providers</b>		
<b>Area</b>	<b>Name</b>	<b>Position</b>
Fuel Third Party Logistics Provider Company (F-3PL Limited).	Mr Saeed	CEO
	Mr Nayef	Marketing Manager
	Mr Arham	Operations Manager
	Mr Hani	Technician

The researcher approached the research units of analysis (i.e. petrol stations, fuel haulers and fuel 3PLs) by the Saudi Arabian Chambers of Commerce and Industry, which provided a list of these units based on the government permission to provide the required data that researchers need. These units were represented by key informants that were informed by sending them invitations through emails to

participate in this study, which described the study in plain Arabic language attached with a consent form that participants were required to sign for voluntary participation in this study. The Plain Language Statement and interview questions attached (Appendices A and B).

#### **4.7. Process of Analysing the Data**

A total of twenty four interviews were conducted in Arabic in Saudi Arabia with all interviews audio recorded. These audio recorded interviews were transcribed and translated to English by the researcher. The researcher transcribed the interview transcripts by himself for the sake of better data analysis and understanding the data during transcribing and translating.

Transcribing all the interviews by the researcher assisted in understanding the data and thinking interpretively during transcribing. This further helped the researcher to identify the themes useful for the coding and thematic data analysis followed in the research. After the researcher transcribed the interview transcriptions and had a better understanding of the data, sub-themes under each of the three main themes (technology, organisation, and environment) were generated using both deductive and inductive approaches (Boyatzis 1998).

When main themes and sub-themes were fixed and transcribed, the research followed thematic coding for each interview. The following approach was used by highlighting portions of data through a colour representing the main theme and also labelling the portion with a short description which belonged to one of the sub-themes. After following this approach for all interviews, a number of common as well as different short descriptions under each sub-theme and theme were collated. This assisted the embedded case analysis of the research, which involved analysing across each unit as well as analysing across the four units through looking at the thematic map of the analysis. This included the reduced data belonging to different themes and sub-themes. It should be noted that the entire analysis was done by the researcher manually and no data analysis software was used for the purpose of analysing the data. The complexity and diversity of data and the intricate analytical process were considered beyond the scope of utilising any of the existing qualitative data analysis software, figure 4.2 illustrates the analysis process.

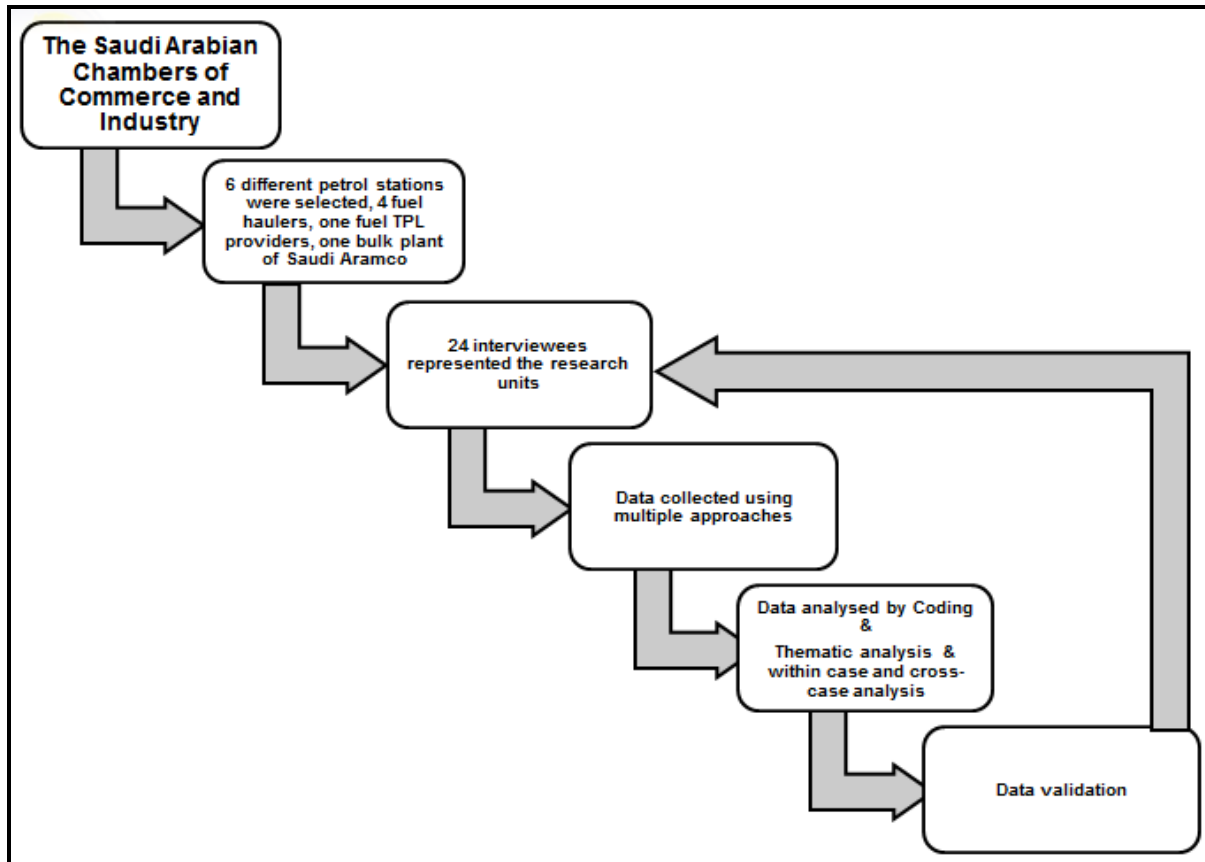


Figure 4.2: Data Analysis Process

This study used a reiterative analytical technique of taking the literature review and applying it to the data collected through a ‘hermeneutical’ analysis. Originating from German philosophical tradition, the hermeneutical approach was developed to express the manner by which meaning is constituted in human speech and actions (Dilthey 1976).

Hermeneutics is a means of textual interpretation or finding meaning in the written word through a process of ‘structuring of the manifest of what is said to deeper and more critical interpretation of the text’ (Kvale & Brinkmann 2009, p. 207). As an art and science of interpreting meanings, hermeneutics also emphasises the socio-cultural and historic influences on the way in which a certain phenomenon is perceived or interpreted. Walsham (1993, p. 9) suggests that ‘hermeneutics can be thought of as a key strand of phenomenology since the interpretation of texts is an important part of the search for meaning and the essence of experience’. Text is interpreted based on iterations of researcher own experience and existing literature and research. These interpretations are used to make judgments about text, creating

further reiterations and interpretations of that text until conclusions or theorising suggests further reinterpretation.

This research was undertaken in a series of progressive stages involving a literature review, exploratory interviews (phase one), and confirmatory interviews (phase two) to correspond to the cyclical stages of hermeneutical interpretation (Moustakas 1994). Figure 4.3 below illustrates the hermeneutic circle for the research with each cycle aligning with a separate objective of the research.

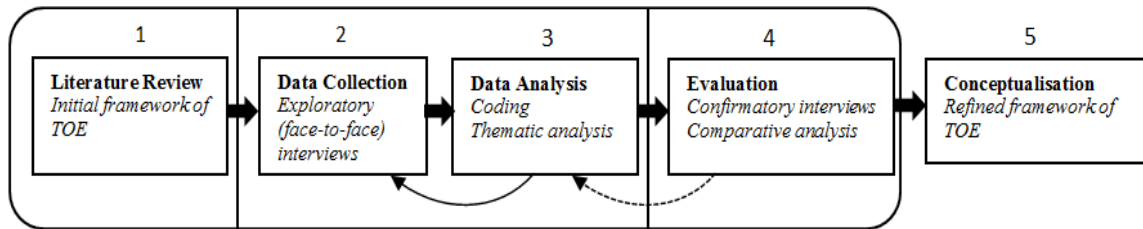


Figure 4.3 Hermeneutic Cycle of the Research

## 4.8. Triangulation

Triangulation is defined as the combination of at least two or more theoretical perspectives, methodological approaches, data sources, investigators or data analysis methods (Thurmond 2001). Easterby-Smith et al. (2012) highlighted that there are four different categories of triangulation in social research, namely, theoretical, data, investigator and methodological triangulation, as follows:

1. Theoretical triangulation involves borrowing models from one discipline and using them to explain situations in another discipline;
2. Data triangulation refers to research where data is collected over different timeframes, or from different sources;
3. Triangulation by investigators is where different people collect data on the same situation and data, and the results are then compared;
4. Methodological triangulation refers to using both quantitative and qualitative methods for data collection. For instance, using questionnaires, interviews, telephone surveys and field studies in collecting data.



Data triangulation is the triangulation method that was used in this research. The approach has been broken down in two phases. The first phase - exploratory interviews - was the significant data collection and analysis part. After that have been conducted phase two - confirmatory interviews - was followed to validate and triangulate the findings from the earlier phase. Chapter 10 discusses research validity by analysing the similarities and differences between the data collected in phase one and phase two in more detail.

The reliability and validity test is important in research as it ensures that the data collection is valid, and that a fair and accurate representation of the population is provided. Merriam (1995) highlighted that in qualitative research, rigor is a valid concern.

#### **4.9. Reliability in Qualitative Research**

Reliability in field research depends on a researcher's insight, awareness, suspicions and questions (Neuman 2000). In addition, the reliability of qualitative research is dependent on what the respondents tell the researcher. This makes the credibility of the respondents and their statements part of the reliability. Subjectivity and context are also taken into account when the researcher evaluates credibility (Neuman 2000). Merriam (1995) pointed out that it has never been easy to express reliability in social science, because human behaviour is never static. However, in qualitative research, reliability is concerned with ensuring that the results of a study are consistent with the data collected (Merriam 1995). Therefore, to help ensure the reliability of the findings of this research, the researcher conducted the study at different units based in the Saudi Arabian petrol SC. In addition, the inclusion of a number of respondents involved from each unit would ensure that the answers sought by the researcher were reliable. This is because different respondents would be likely to give different opinions when identifying the social issues that influence in petrol SC. This research used data triangulation whereby the data was collected from different sources, in order to triangulate the findings (Easterby-Smith, Thorpe & Jackson 2012).

## 4.10. Validity in Qualitative Research

There are two types of validity for qualitative research: internal validity and external validity (Merriam 1995). Internal validity queries if the data given is credible, eliminates human deception and ensures that the story given fits into a coherent picture (Peszynski 2006). By the time the researcher finished the twenty-four interviews, the researcher was able to narrate the story of their business operational processes in each of the four units due to the consistency provided by all participants, as they all gave similar operational processes in terms of petrol supply chain and operations management. This process promotes consistency in the research and serves to identify, and subsequently decrease, the bias of any particular actor involved in the research (Given 2008).

In addition, the researcher interviewed two experts in the petrol stations and land transport industries to maximise the credibility and truth of the data and the findings of this research, Mr Rawaf, the President of the National Committee of Land Transport in the Saudi Chambers and Mr Samer the President of the National Committee of Gas Stations in the Saudi Chambers. Participants have been given a pseudonym to protect their identities.

In terms of external validity which refers to the capability of the researcher to cross-check the observations of the participants interviewed with other divergent sources of data, peer examination was utilised (Merriam 1995; Neuman 2000). The researcher used different sources of data given by the participants interviewed, such as: publications, annual reports, operations processes instructions, health and safety instructions, government regulations and requirements, warehousing and distribution processes techniques and other publicly available information (e.g., press releases, financial statements, and trade press articles). The researcher used document collection to supplement the information given by participants interviewed to verify what they had said against the recognised documents. This also increases the rigour of the research and helps ensure that the information given by the participants interviewed was accurate, minimising the misinformation theoretically given by participants. Thus, the researcher believes that the notions of external validity and reliability, addressed from the perspective of the paradigm out of which this study has been conducted, confirms the external validity.

In terms of internal validity, the findings of this research are consistent with the data collected and this maximizes the internal validity by assuring rigorous control of all variables other than the intervention. In addition, the story revealed or constructed in one unit of this research is applicable to another, which confirms the external validity of this research because each unit has similar factors affecting operations management in the participants' respective business, but each factor affects each unit differently. The test

of the internal validity for this research was conducted through member checks. In this case, the researcher sent the interview transcripts, together with the coding and the interpretation of the data, to the interviewees. This ensured the plausibility of the interpretation of the material. The researcher's supervisor also checked the data findings in order to ensure the plausibility of the interpretation of data. This allows the research results to be applied to a greater range of other similar situations, although the goal of qualitative research is to understand the particular phenomenon in-depth. Furthermore, this research provides enough information or descriptions of the phenomenon under study.

In addition, the researcher had another round of data collection to conduct interviews with the President of the National Committee of Gas Stations in the Saudi Chambers and the President of the National Committee of Land Transport in the Saudi Chambers. The interviews confirmed the findings of the research from the perspective of the two key informants of petrol industry in Saudi Chambers. Consequently, the research incorporated an additional chapter (Chapter 10 Triangulation).

Considering the research problem, this research took a qualitative approach, using a single embedded case study to incorporate four units of analysis namely: Rural and Metropolitan Petrol Stations, Fuel Haulers, Saudi Aramco, and Fuel Third Party Logistics Providers (3PLs). Saudi Arabian rural and metropolitan petrol stations are encompassed in this thesis to explore the factors that hinder/assist Saudi Arabian petrol stations operations by way of collecting rich and diverse data to describe the phenomena in details.

In addition, fuel haulers were encompassed in this thesis to explore the role of transporters/intermediaries in the Saudi Arabian petrol supply chain. Saudi Aramco is incorporated to explore the role of the only fuel supplier in the country in order to identify the influence of a lack of competition in terms of fuel suppliers on the Saudi Arabian petrol supply chain quality and performance. Fuel Third Party Logistics Providers (F-3PLs) provide technical infrastructure and logistics services required by customers e.g. (petrol stations and fuel haulers) and are embraced in this thesis in order to explore the role of 3PLs to enhance petrol supply chain. Understanding these four units will help to diagnose Saudi Arabian petrol supply chain, and consequently this will lead to petrol supply chain integration.

In summary, chapter 4 discusses the philosophy that is applicable to this research, specifically exploring the Saudi Arabian petroleum supply chain. This chapter covers all aspects of conducting qualitative research based on relevant literature. This chapter also explains the research design, including the data collection and data analysis strategies. Finally, this chapter explains reliability and validity of this research. The next chapter discusses the case study of Saudi Arabian rural petrol stations.

# **Chapter 5 - Saudi Arabian Rural Petrol Stations Case Study**

## **5.1 Introduction**

The case study of Saudi Arabian petrol stations explores two different geographic areas namely, rural and metropolitan areas. Rural petrol stations consist of the petrol stations that are located in villages or on national highways and are considered far from Saudi Aramco's distribution stations. On the other hand Metropolitan petrol stations consist of petrol stations that are located in metropolitan cities and are near to Saudi Aramco's distribution stations (discussed in Chapter 6 metropolitan petrol stations). This facilitates the comparison to see if social issues in petrol supply chain are similar or different based on geographic locations of the petrol stations.

This chapter discuss the data collected from three Saudi Arabian rural petrol stations. The data collected by means of interviews with owners and managers of rural petrol stations in Alkhurmah in Saudi Arabia. The interviews were undertaken based on the TOE contexts (i.e. technology, organisation and environment) to diagnose and explore the Saudi Arabian petrol supply chain.

This chapter commences with a background description of the petrol stations in Saudi Arabia in general which is followed by an overview of petrol stations in the rural area, petrol supply processes, petrol measurement processes, petrol procurement processes, petrol unloading processes and accounting processes in the Saudi Arabian petrol stations. It then continues with an explanation of the findings gathered from the interviews regarding the technological, organisational and environmental factors that influence in the Saudi Arabian rural petrol stations from the participants perspectives. A total of five participants from rural petrol stations were interviewed in this case study.

## **5.2 Background of the Saudi Arabian petrol stations**

According to the US energy agency (EIA 2014), the Saudi Arabian crude oil reserves standing at 268.350 billion barrels. Furthermore, Saudi Arabia is the largest exporter and producer of oil in the world where the oil sector accounts for over 90% of total export earnings and over 75% of the country's total revenue (Squalli 2007). Moreover, petrol stations in Saudi Arabia are considered the lifeline of transportation in

Saudi Arabia because the only means of transportation in Saudi Arabia is either cars and trucks or buses. The major petroleum products to refuel vehicles in Saudi Arabia are petrol and diesel, pinpointing the importance of petrol stations in Saudi Arabia (Alhawas, Peszynski & Young 2013).

There are approximately 70,000 rural and metropolitan petrol stations across the Kingdom of Saudi Arabia (Dawood 2012). However, the real numbers of rural petrol stations and metropolitan petrol stations individually is unrevealed. Approximately 90% of these petrol stations fall in the 'Red Category' of the new Nationalisation program, which has been applied by the government and aims to employ Saudis into the private sector (Avancena 2011). The Nationalisation program came into effect as of 11<sup>th</sup> of June 2011 and classified firms into one of four categories, Excellent, Green, Yellow and Red according to the employment of Saudis. The firms considered Excellent or Green would be granted the most privileges in visa requests for non-Saudis. Yellow listed firms were given a period of nine months as of 11<sup>th</sup> of June 2011 to increase their rate of nationalization before restrictions came into effect, while Red firms were given six months to increase their rate of nationalisation within their firms. The aim of the Nationalisation program is to help solve the phenomenon of unemployment in Saudi Arabia. According to the Saudi Central Department of Statistics and Information, which is the official governmental department for the statistics and information in the Kingdom, the number of unemployed was 463,000 in 2009, which is the latest statistical report that has been published on the official website of the Saudi Central Department of Statistics and Information at the time of writing (CDSI 2009).

When interviewed on *the 8.00 report with Dawood* (2012) the undersecretary of Riyadh region municipalities stated that in the Riyadh region along the national highways, there were approximately 1,000 petrol stations, of which 400 petrol stations were not built in compliance with pre-construction regulations of the Ministry of Municipalities and Rural Affairs. These statistics highlight the obstacles in Saudi Arabian petrol stations, which will be reported in section 5.4 environmental factors. Petrol stations in Saudi Arabia have not reached the expected satisfaction from the perspective of customers and petrol station operators (Dawood 2012). Petrol stations in Saudi Arabia are supervised and directed by nine different government ministries/agencies namely: Saudi Aramco, Civil Defence (Fire Fighting Board), the Ministry of Transportation, the Ministry of Labour, the General Organisation for Social Insurance, the Department of Zakat and Income Tax, the Ministry of Commerce and Industry, Presidency of Metrology and Environment, and the Ministry of Municipal and Rural Affairs. This creates confusion amongst petrol station operators and owners because they have to adhere to nine government agencies' regulations. Moreover, the relationship of petrol stations with the respective governmental agency/ministry is unique, which causes repetition and unnecessary processes. This will be discussed in

detail in section 5.4.3 government regulations. The following section discusses the three rural petrol stations that participated in this research.

### 5.3 Rural petrol stations

Three petrol stations in a rural area of Saudi Arabia are presented here. Although, there are different definitions of what is considered rural and metropolitan, the classifications are typically based on the numbers of the population and location (Nicolaou, Siddique & Custovic 2005). Figure 5.1 illustrates the rural areas and metropolitan areas of the Kingdom of Saudi Arabia.

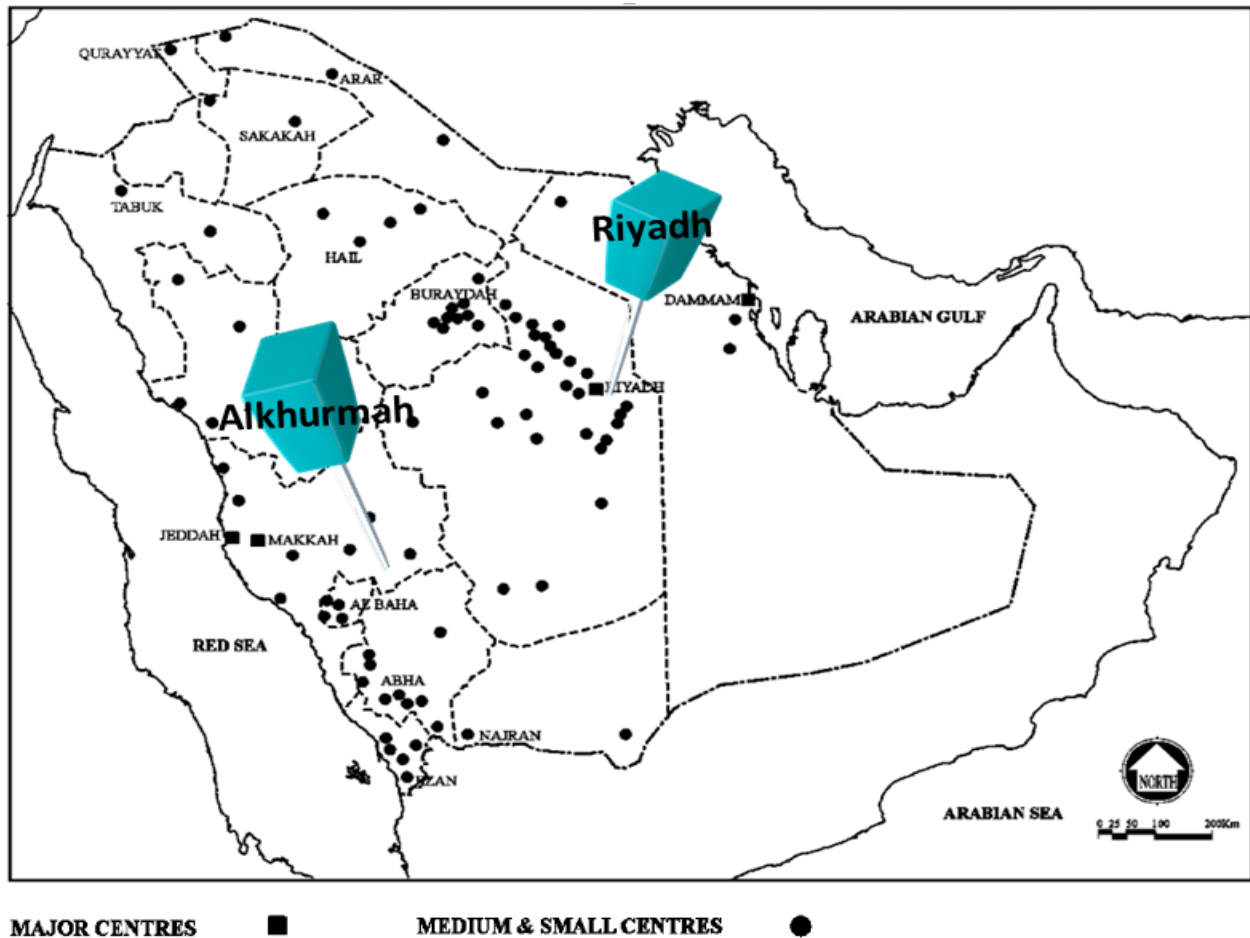


Figure 5.1: Modified map adjusted to illustrate the rural and metropolitan areas of the Kingdom of Saudi Arabia, (Al-Hathloul & Mughal 2004)

Figure 5.1 illustrates the rural areas that consist of the villages with a population of less than two million individuals occupying the most regions of the Kingdom. It illustrates the rural area, Alkhurmah, which contains the three petrol stations explored in this study. According to the Saudi Central Department of Statistics and Information (2010), Alkhurmah’s population is 42,223 individuals. However, the number of petrol stations in the rural area is not known, because there are many petrol stations that have been established without government permission. For example, in rural areas that located on the national highway of Riyadh region, there are approximately 400 petrol stations out of 1,000 that have been established without government permission (Dawood 2012).

The researcher investigated three petrol stations located in the rural area of Alkhurmah, which is a village located 450 km away from Saudi Aramco’s distribution station in Jeddah. Figure 5.1 above indicates the locations of Alkhurmah and Jeddah. The three petrol stations are owned and managed by Saudi citizens. The case petrol stations are MS petrol station, NS petrol station and AS petrol station. Pseudonyms have been provided to keep anonymity of the participants and petrol stations, Table 5.1 addressed the participants those interviewed for the purpose of this study. The following section will provide an overview of each of the rural petrol stations, then an explanation of the petrol supply process. This is followed by discussion of the Saudi Arabian petrol stations’ petrol supply chain according to the three contexts of the TOE contexts; technology, organisation and environment.

Table 5.1: Characteristics of interviewees (rural petrol stations)

<b>Rural Petrol Stations / Alkhurmah</b>		
<b>Petrol station</b>	<b>Name</b>	<b>Position</b>
MS Petrol Station	Mr Sami	Owner
	Mr Izhar	Manager
NS Petrol Station	Mr Ahmad	Owner
AS Petrol Station	Mr Faisal	Owner
	Mr Basheer	Accountant

## **Petrol station I: MS**

Mr Sami is the owner of MS petrol station that has been operating for 12 years. The MS petrol station is located on the national highway that links the Southern region with the Western region. There are four workers working consecutively; two workers for every 12 hours. The IT infrastructure within MS petrol station consists of one computer, one printer, and a Wi-Fi to connect to the Internet to order petrol online. The petrol pumps are mechanical pumps, which are described as old petrol pumps.

Mr Sami assisted the researcher to obtain an interview with the manager of MS petrol station. Mr Izhar has worked with Mr Sami as petrol station manager for ten years. His responsibility is to order petrol from Saudi Aramco based on the daily measurement of the petrol station's tanks. Mr Izhar illustrated the annual peak and off-peak loads of petrol supply for MS petrol station.

He mentioned that the peak loads are school holidays, which are normally the three months in summer. These include two important religious holidays celebrated by Muslims worldwide. The first is عيد الفطر 'Īd al-Fiṭr' that marks the end of Ramadan, the Islamic holy month of fasting. The second is عيد الأضحى 'Īd al-aḍḥā' the Feast of the Sacrifice that takes place in last month in Islamic calendar ذو الحجة Dhū l-Hijjah, in which the Haj (pilgrimage) takes place. Off-peaks are the remaining months of the year.

## **Petrol station II: NS**

Mr Ahmad is the owner of NS petrol station that is also individually owned station and has been operating for 15 years. Its location is also on the national highway linking the Southern region with the Western region, approximately one kilometre away from the MS petrol station.

There are four workers working consecutively; two workers for every 12 hours. Mr Ahmad owns three trucks that transport petrol to MS petrol station and other petrol stations around his stations in Alkhurmah. The use of technology is minimal in terms of infrastructure. Mr Ahmad orders petrol from Saudi Aramco website from home and the use of technology in terms of administration work and communication at NS petrol station is either phone or facsimile. The petrol pumps in this station are old mechanical pumps.

His responsibilities to manage his station are contacting the workers by the phone or in person every day. When he needs to send any paperwork to contact Saudi Aramco or any other government authority, he needs to use the facsimile.



### **Petrol station III: AS**

AS petrol stations consists of two petrol stations; one is located in the middle of Alkhurmah, and the other is located on the national highway. Mr Faisal is the owner of both AS petrol stations, he is contracted with the government to refuel government vehicles since his petrol station was the first in the area established 19 years ago.

The use of technology is limited within the premise of the petrol station as Mr Faisal makes his orders online from home. Although, Mr Faisal is contracted with government to refill their vehicles, his administration is human-based in accounting process and communication. He utilises mobile phones and facsimiles for communication with his workers and government authorities. His accountant utilises pocket calculators.

There is no evidence of automation as the responsibilities of the accountant, Mr Basheer, are to read tank meters twice daily and manually record the readings into his notebook while using pocket calculators to work out the readings. Mr Basheer also mentioned that he collects debts from government agencies that are contracted to AS petrol stations, via cheques or cash. It is noted that the petrol pumps used at these stations are old and mechanical. Table 5.2 provides an overview of the rural petrol stations in Alkhurmah selected for the purpose of this research.

Table 5.2: Selected rural petrol stations

<b>Name</b>	<b>Number of Petrol stations</b>	<b>Age of petrol station</b>	<b>Site of petrol station</b>	<b>IT infrastructure</b>
<b>MS petrol station</b>	1	12 years	Rural	PC/ Wi-Fi for internet/ printer/ mobile phones/ fax
<b>NS petrol station</b>	2	15 years	Rural	mobile phones/ fax
<b>AS petrol station</b>	2	19 years	Rural	mobile phones/ fax

## **5.4 Petrol supply process**

Supplying petrol to rural areas is considered a problem amongst petrol stations as they are situated a large distance from Saudi Aramco's petrol distribution stations. The rural area targeted in this research is Alkhurmah village located in the western region of Saudi Arabia. Alkhurmah is approximately 450 km

away from Saudi Aramco's distribution station, which is located in Jeddah, considered the major metropolitan centre of western Saudi Arabia. The nearest metropolitan city, Taif city, is approximately 180 km away.

In this section the process of petrol supply in rural petrol stations, which is a generic process across all petrol stations, will be described from talking to MS and AS stations, Mr Izhar authorised by the owner of MS petrol station to discuss the process of petrol supply in his petrol station. The researcher observed the process in MS petrol station from the petrol tanks inventory measurement process to petrol being delivered and unloaded. The petrol supply process includes the measurement process, procurement process, transportation process, unloading process, and the accounting process. Figure 5.2 represents the petrol supply process. It is important to highlight that the metropolitan petrol station supply process is exactly the same as the rural petrol station supply process. The only difference is that metropolitan petrol stations are close to Aramco's petrol distribution stations and therefore is considered as an advantage since it saves transportation costs and reduces delays. Rural petrol stations that are distant from Aramco's distribution centres experience increased transportation costs and delays owing to the distance and the expected disruptions that affect freight service.

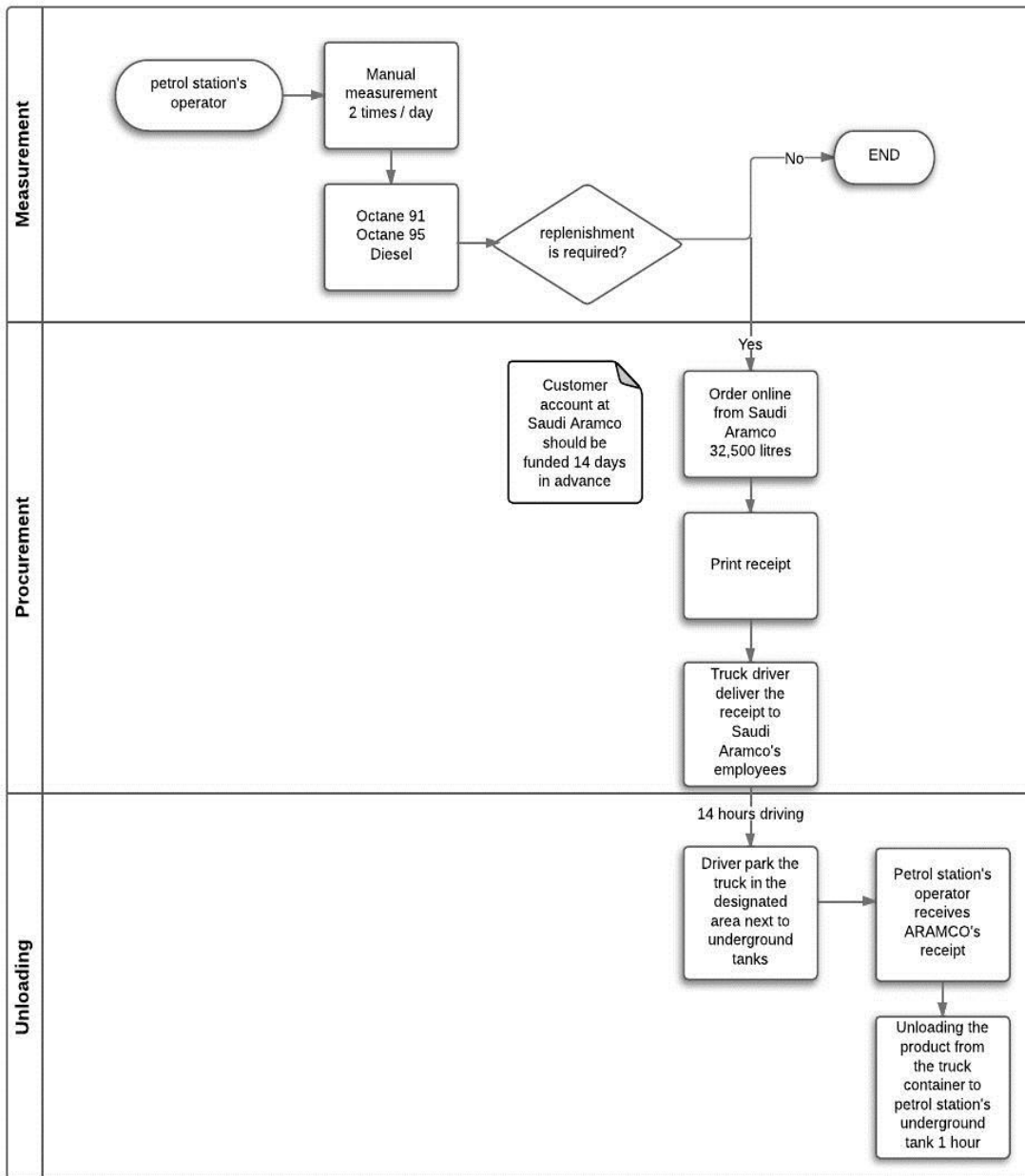


Figure 5.2: Petrol stations supply processes

### 5.4.1 Measurement processes

Mr Izhar discussed the process of petrol supply, which includes: petrol measurement, procurement and unloading petrol process. Mr Izhar measures the tanks at 7.30 am and 7.00 pm, daily. There are four underground fuel tanks - two tanks for diesel and two for petrol (Octane 91 and octane 95). Each tank has a capacity of 45,000 litres. However, this capacity is different between each petrol station, depending on the sales intensity. Mr Izhar is the manager of MS petrol station and his accountability is to measure tanks and collect the income of the petrol pumps from four refuelling workers. These workers' responsibility is to refuel customer's vehicles and collect the payment from customers. Two workers work on octane 91 and 95 and two workers for the diesel pumps.

Mr Izhar uses an aluminium ruler that is six meters in length, numbered by cubic meters, as a dipstick to measure the tanks. He sticks this ruler in the tank to measure the fuel. Mr Izhar takes the dip stick out to read litres remaining in the tank. He has a table that is attached to the ruler as a guide to show the conversion from cubic meters to litres. Figure 5.3 illustrates fuel tanks measurement by traditional rulers.

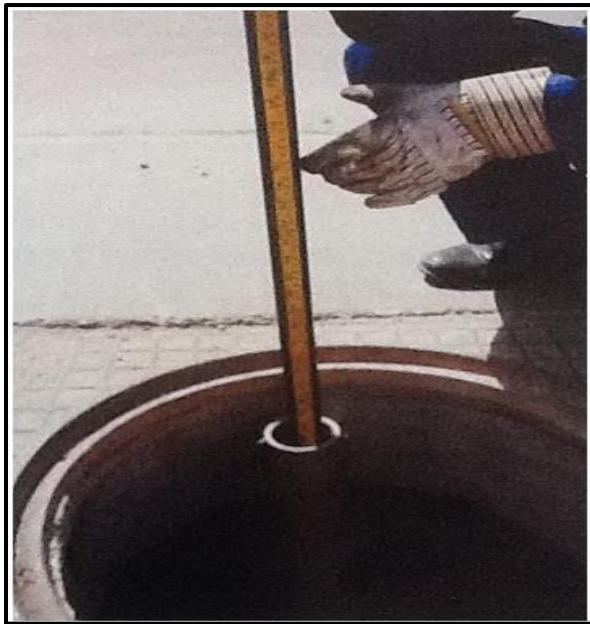


Figure 5.3: Traditional fuel tank measurement processes in the Saudi Arabian petrol stations.

Mr Izhar then records this reading and compares it with the night reading to know how many litres were sold that day and to identify whether the tanks reached the replenishment level of 6,000 litres, which would then trigger the procurement of petrol from Aramco's distribution station. Mr Izhar states that the pump that pulls the petrol from the tanks has a pipe that ends before 3,000 litres, which is because the remaining 3,000 litres contains sediments, which affect the pumps and vehicles' tanks. This process is applied in all petrol stations that were interviewed in this research. However, the replenishment balance is different between each petrol station based on the capacity of the petrol tank and sales volume.

#### **5.4.2 Procurement processes**

When the reading shows a balance of 6,000 litres, Mr Izhar makes an order online to procure from Aramco's website utilising a wireless network adapter to connect to the internet on a PC in his office in the petrol station. Saudi Aramco's website is designed in two languages: Arabic and English. Customers should register for petrol procurement online on Aramco's website. Customers will then have their unique user ID and password to access their accounts in order to procure online, customers must pay 14 days in advance to book the needed petrol quota. Petrol prices will not change during those 14 days because the government has fixed the petrol prices in Saudi Arabia, so that local petrol prices do not change at all. The quota payments should be made 14 days in advance so that Saudi Aramco can approximate the petrol needed in the local market 14 days in advance.

Petrol orders can only be made only online when the customer has the available funds. Hence, customers need to fund their account via bank payment methods including bank deposit made in person into Aramco's account, which is available at all banks in Saudi Arabia; direct debit; by phone, automated teller machines ATMs and online banking. However, credit cards are not accepted. Once a customer has funded the account 14 days in advance, he will be able to procure petrol online.

Mr Izhar ordered 32,500 litres of diesel which differs from station to station based on the truck container capacity and the petrol tank capacity. Mr Izhar states that the average amount of petrol sold is approximately 6,000 litres per day and 7,000 litres of diesel per day. The demand for diesel is higher than petrol because the petrol station is located on the national highway, which links the southern region with the western region, as customers are more traditionally truck drivers who require diesel. Consequently, 32,500 litres will last for approximately four to six days. The tank will have approximately 3,000 litres left before Mr Izhar procures more.

When the procurement process is completed, Mr Izhar has to print out a copy of the receipt and hand it to the truck driver who works for the MS petrol station (MS petrol station has its own truck). The truck driver then delivers the receipt to Aramco's distribution station employees. Mr Izhar then, informs the truck driver that he should travel to Jeddah the next morning and return at night.

### **5.4.3 Unloading processes**

When the driver returns to the petrol station the next day, typically at night, the driver parks the truck behind the petrol station where the tanks are located. It takes six hours to travel to Aramco's distribution station and eight hours to return. It takes longer to return because the truck is filled with diesel the driver needs to reduce the speed to the minimum speed as the truck is heavy and filled with a flammable product. He switches off the truck engine for an hour to let the truck cool down and informs Mr Izhar that the truck is parked next to the diesel tank handing Aramco's shipment receipt to Mr Izhar.

After that hour, Mr Izhar moves to the tanks location and opens the diesel tank's lid, which is the same size as the hose that comes out from the truck. He then unloads the diesel. Mr Izhar does not know how much is in the truck's tank, but he states that he trusts his driver and unloads the petrol in the appropriate tank. The unloading process is performed carefully because the product is dangerous, and the processes last an hour.

Once unloading process is complete, the driver will have a day off and then transport another order the following day. Mr Izhar states that peak seasons are school holidays in summer, the month of Hajj, Ramadan and weekends. Mr Izhar states that the driver supplies the petrol station with 15 shipments per month and rests for 15 days in the off peak season. In peak seasons, the driver supplies approximately 20 shipments and rest for ten days.

### **5.4.4 Accounting processes**

In this section, the accounting process in rural petrol stations will be described from talking to AS stations. This is a generic process across all petrol stations in terms of accounting. Mr Basheer is the accountant at petrol station, he discussed the process of accounting in AS petrol station. Mr Basheer reads petrol pump meters at 8 am and 8 pm, daily. He records the amount of sold petrol and how many litres of petrol were sold based on the reading of each pump's meters. There are six petrol pumps and one diesel at

AS petrol station. There is only one diesel pump because this petrol station is located in the middle of a village where the demand for diesel is not as high as a petrol station that is located on a highway. The government permits rural petrol stations to add five halalas (0.02 cents AUD) on metropolitan petrol prices owing to the distance that is considered far from Aramco's distribution stations. Figure 5.4 below presents the accounting process at Saudi Arabian petrol stations.

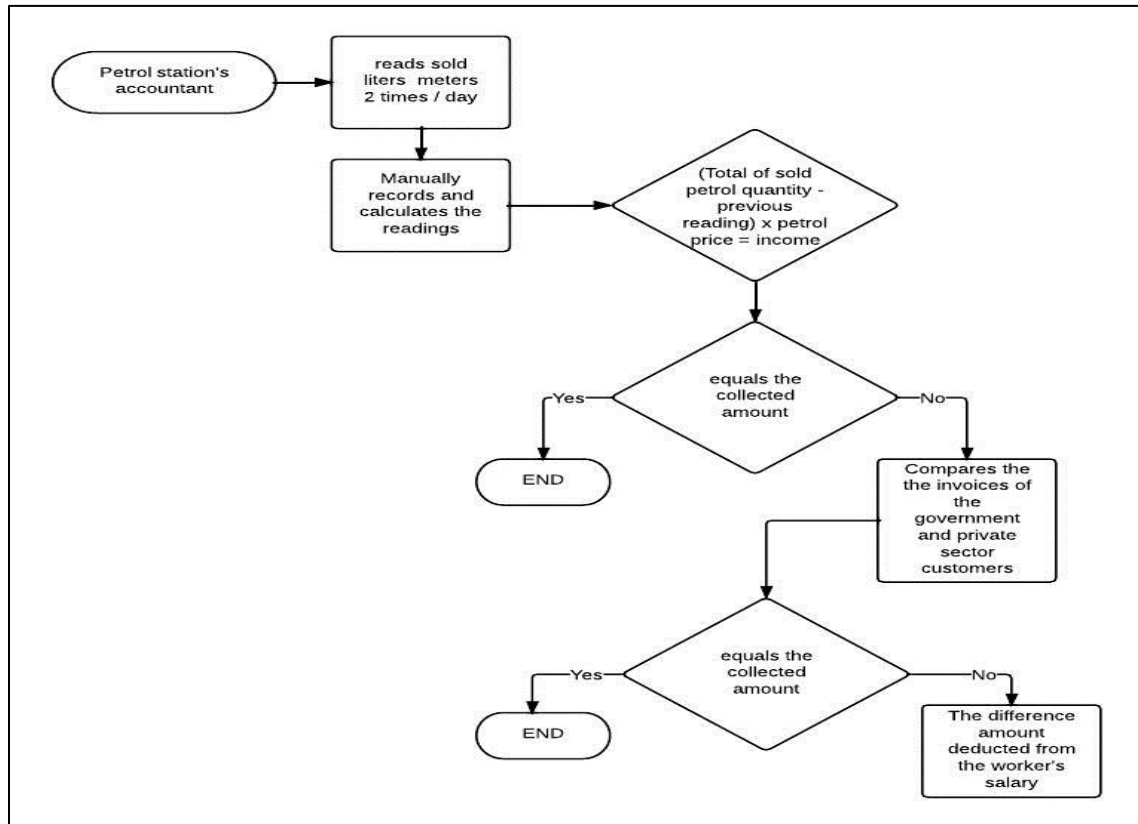


Figure 5.4: Accounting process at Saudi Arabian petrol stations

Mr Basheer states that AS petrol station is contracted with government agencies and numerous private sector organisations to refuel their vehicles. Thus, Mr Basheer collects payments from these agencies and organisations on a monthly basis. Mr Basheer states that when there is a shortage in the amount, the shortage must match the contracted government agencies receipts, which are manually filled by the petrol station workers. If it does not match the receipt this means there is fraud among petrol station's workers, which is rarely happen. Mr Basheer states that AS pumps meters are locked to prevent fraud. Only he has the keys for these locks, which cannot be opened unless for maintenance purposes.

To summarise, this section has provided an overview of the rural petrol stations in Saudi Arabia and explained the meaning of rural and metropolitan petrol stations with an overview of the participants in this research. Moreover, this section explained the processes of petrol supply which includes the measurement processes, procurement processes, unloading processes, and accounting process. The upcoming sections report the finding of the three contexts of TOE (Technology, Organisation and Environment) from the perspective of each participant.

## 5.5 Technological context

This section discusses the technological context of the petrol supply chain from the perspective of the petrol station owners, accountants and managers, who have discussed the factors that contribute to the role of technology in rural petrol stations. Those are, relative advantage which includes the types of technology (actual technology, traditional technology and Information Technology); and IT infrastructure.

Technology has been cited by participants as an important factor in petrol stations from different perspectives. Technology was an important factor for some participants in terms of machines, tools and other tangible technology, which is considered as actual technology. Other participants referred to traditional technology such as transferring technology, knowledge, skills, or even transferring solutions for problems occurring in petrol stations. Further participants hinted at information technology for example, Internet and information systems used in their stations.

All five participants explained that there is lack of technology utilisation in their petrol stations. In addition, within the rural petrol stations there is scarcity of IT infrastructure. Table 5.3 summarises the organisational profile and IT infrastructure at the participant's petrol stations in the rural areas. As such, IT relative advantage in Saudi Arabian petrol stations is limited based on the infrastructure in rural petrol stations. This will be discussed in the sub-sections 5.5.1 and 5.5.2.

Table 5.3: Organisational profile relating to use of IT infrastructure

<b>Name</b>	<b>Number of petrol stations</b>	<b>IT infrastructure</b>
<b>MS petrol station</b>	1	PC/ Wi-Fi for internet/ printer/ mobile phones/ fax
<b>NS petrol station</b>	2	mobile phones/ fax
<b>AS petrol station</b>	2	mobile phones/ fax



### **5.5.1 Relative advantage**

In this sub-section, the researcher analysed participants' citations based on the three types of technology (actual technology, traditional technology and information technology) to clarify the benefits of utilising technology in Saudi Arabian petrol stations, if any, and the issues that hinder utilising technology, and the technologies that participants would like to utilise to improve the petrol supply chain at their stations. Relative advantage refers to the perceived benefits that occur in petrol stations from utilising technology, such as minimising cost, reducing lead time and gaining competitive advantage.

#### ***5.5.1.1 Actual technology (refers to tangible technology)***

Actual technology refers to the tangible technology, such as machines, tools and other physical engineering equipment. The researcher found that all three petrol stations in Alkhurmah utilise old mechanical petrol pumps as actual technology. However, modern petrol pumps are utilised in some metropolitan petrol stations which will be discussed in Chapter 6 (6.2.1.1.). The difference between the old and modern petrol pumps is that the flow measurement in old petrol pumps is a reeled meter (moving wheels with numbers on the side) which is referred to as a mechanical encoder, whereas in modern pumps the flow measurement meter is connected to an electronic encoder. Moreover, modern pump variations are in the number of hoses or grades they can dispense, the addition of extra devices such as pay at the pump and RFID tag readers. In addition, modern petrol pumps contain an embedded computer to control the action of the pump, and drive the pump's displays, and communicate to an indoor sales system. Figure 5.5 presents the two types of petrol dispensers.



Figure 5.5: Types of Petrol Pumps (On the left modern petrol pumps and on the right old petrol pumps)

The participants' understanding of technology refers to these devices and machines, which are considered as actual technology. When asked Mr Sami what technology he has in his petrol station, he stated, 'We used to rely on petrol pumps to pull up petrol from the ground tanks, but now we are utilising a dynamo which pulls up petrol stronger and faster'.

Mr Sami hinted that petrol pumps are actual technologies that he utilises in his petrol station, but the pumps that he relies on to pull up the petrol from the underground petrol tanks are weak. Hence, he utilised a 'dynamo', which was installed in the underground tanks and linked to the petrol pumps through the steel pipes that transfer the petrol in order to convert mechanical energy from a moving electrical conductor into electromagnetic energy and thus generates current more powerfully.

When Mr Basheer (AS Station) was asked the same question he responded, 'We have old mechanical petrol pumps, but not electronic ones'.

All participants in Alkhurmah addressed that they use mechanical petrol pumps and they are happy with them because it is heavy duty and the workers and retailers are familiar with them in terms of maintenance, retail-parts and costs. Hence, they do not see the need to replace them with modern pumps. Moreover, maintenance is considered as an important reason that they do not want to replace the old

pumps with the modern ones, especially for rural petrol stations. Rural petrol stations claimed that petrol pump suppliers charge them for maintenance plus transportation to fix the current mechanical pumps, which typically has minor issues and cheaper parts, but if they use electronic petrol pumps the maintenance and parts cost will be more expensive. Mr Faisal (AS Station) stated: 'Petrol pump suppliers provide maintenance for the first year free of charge. After the first year each trip to the site will be charged for transportation plus labour and parts costs'.

Mr Faisal explained how he is influenced by the extra costs of petrol pump maintenance. Petrol pumps in rural areas are usually open areas and are likely to get disturbed owing to dust storms and the wind. Therefore, Mr Faisal argued that the cost of maintenance is considered as an issue that hinders him from utilising modern electrical pumps. The old mechanical pumps are likely to be more resistant to the weather conditions.

Mr Izhar, agreed with Mr Faisal that once a simple issue occurs in his old mechanical petrol pumps, he would be able to fix it himself, however he would be not able to fix the electrical pump and it is too expensive to call technicians to fix those issues each time they occur further considering the delay that would occurs till those minor issues were fixed.

In terms of measuring process, Mr Sami argued that technology would help improve precision in measuring petrol tanks: 'Our measurement is random, however technical devices will be really precise'.

Mr Sami hinted to actual technology as the solution to replace inaccurate measurements. For example, flow-meters would help petrol stations to be precise in petrol tank measurement because flow-meters measure the petrol tanks automatically based on a periodic schedule. This would help reduce the lead time in the petrol supply chain and reduce unnecessary organisational processes such as manual measurement twice each day and manual recording of measurement readings. In addition, automatic flow-meters could help petrol stations add value by utilising best practices in measurement processes that subsequently could provide a competitive advantage. Moreover, there are integrated systems to measure the tanks and detect leaks automatically such as leak detection systems and vacuum leak detectors for petrol stations. This highlights the relative advantage of actual technology utilisation in petrol stations and how petrol stations can benefit from technology utilisation.

In summary, relative advantage, which mainly consists of perceived benefits of IT utilisation, was limited owing to a lack of IT infrastructure in rural petrol stations. Moreover, technology cost was found to be an important factor that hinders rural petrol stations from utilising technology. Most participants argued that technology cost and IT infrastructure, which will be discussed in section 5.2.2, are issues that hinder the

use of actual technology. Maintenance cost is another factor mentioned that hinders rural petrol stations from implementing modern petrol pumps and new technology.

### ***5.5.1.2 Traditional technology (refers to organisational technology)***

Traditional technology refers to the knowledge that enhances organisational capability such as formal job descriptions, chains of command, lines of communication or organisation charts as administrative technologies. As discussed in sub-section 5.4.1, the measurement process is one of the problems in rural petrol stations, which do not rely on technology. When asked about how workers measure petrol tanks in his station, Mr Sami stated, ‘We actually rely on a traditional measurement method, not a scientific method; we use a ruler to measure the tanks’.

By ‘traditional method’ Mr Sami referred to the way the tanks are manually measured by ruler. The scientific method he hinted at is for actual technology, such as electronic devices to measure tanks automatically. As previously discussed, all petrol stations measure petrol tanks by rulers, which causes unnecessary delays in knowing whether the petrol tanks reached the replenishment lead to procure petrol from Aramco’s distribution station as this process need to be repeated twice a day. In addition, this process is not precise because there must be 3000 litres left in each petrol tank in order to procure more petrol without running out. These 3000 litres also keep impurities, such as soil and tiny stones at the bottom of the tank, to prevent petrol pumps from pulling these impurities, which could damage the pump, vehicle petrol tanks and engines.

In addition, Mr Izhar, the operator of the rural MS petrol station cited an important example of traditional technology, the transferring of skills. He claimed that he usually shares his knowledge to fix sudden disturbances in the fuel nozzles, hoses and meters with the workers in his petrol station. This helped to save maintenance costs and delays. He claimed:

If fuel nozzles, hoses and meters are disturbed, I can fix them myself and show the workers how to fix them. Owing to the high maintenance cost and expected delays, we cannot request technicians for each time that these parts are disturbed.

It is important to save unnecessary maintenance costs by sharing knowledge to fix minor issues at petrol stations. This is considered a traditional technology that influences the employee’s behaviour within an organisation and enriches their knowledge to build up an encouraging environment and should also help to reduce delays and save maintenance costs at the same time.

Mr Izhar argued: ‘Technology issues are always considered “big” issues, no matter how big or small they are in reality, because if I do not know how to solve the minor technical issues, other issues will develop’.

Mr Izhar argued that it is better to solve technology issues at an early stage, which will save unnecessary maintenance costs and will help to prevent the development of these issues to the extent that they only be fixed by technicians, who will charge the petrol station for transportation, labour and parts. It is important to share the skills to fix the technical issues among workers and employees to save money. In addition, this highlights that hiring skilful people in petrol stations is an asset for the station considering maintenance and training savings. Technology utilisation requires training. However, if the station hires skilful employees, those who share their skills with their colleagues, will save petrol stations in training costs and help increase the service quality at the station by reducing interruptions due to maintenance issues.

To summarise, people can save petrol station maintenance cost of minor technical issues that occur in petrol stations through sharing their skillsets. In addition, sharing employee’s knowledge and skills among employees can enhance petrol station service quality. The next section discusses the third type of technology information technology.

### ***5.5.1.3 Information technology***

Information technology refers to technology used intensively and to process information. Mr Sami stated that his petrol station, MS petrol station, utilises a desktop computer and Wi-Fi to connect to the internet to procure petrol and diesel from Aramco’s website and a printer to print Aramco’s invoices and receipts. Mobile devices are the communication method at MS petrol station. Mr Sami uses mobile phones to communicate between himself, petrol station operator and workers.

In addition, facsimiles are used to communicate with Saudi Aramco and to send alternative receipts if a delivery is cancelled for any reason. Mr Sami stated that the facsimile is the easiest way to communicate with Aramco’s distribution station in Jeddah because most petrol station operators and owners are uneducated when accessing and actioning emails.

Hence, it is remarkable that the current information technology at MS petrol station is for communication and procurement purposes. Importantly, the researcher found that most petrol stations in Saudi Arabia are similar to MS petrol station in utilising information technology.

When asked what role IT could provide to petrol stations, Mr Saleh stated, 'It will control corruption in petrol stations and fraud; it will control the accounting process as well'.

Mr Saleh was asked what he meant by corruption and fraud that occurs in petrol stations, he said,

Fraud occurs between accountants, petrol station workers and post-paid sales' customers. There are some organisations' drivers that ask for refuelling receipts despite not refuelling their vehicles and this has happened with us before. Thus, if there is an accounting system, it will fix such issues.

Mr Saleh hinted at the importance of accounting software or systems to prevent fraud in petrol stations. Accounting software or systems could automate or mechanise all receipts and invoices which will be stored in the petrol station's database. This data will then be available to share with the customer through secure online access on the website for authorised people only to insure that the data is secured. If mechanism in the accounting process is implemented, there will be no fraud among customers and workers.

Moreover, Mr Basheer reads meters to determine volume sold and thus income due, twice daily. When asked about the role of technology in the accounting process in petrol stations he cited, 'Definitely accounting systems that utilise computers will be very helpful. However, we do not have such systems because our income is insufficient to implement such systems. You may ask metropolitan stations as they are likely to utilize it'.

Mr Basheer utilizes paper-based records and calculators to count the income at AS petrol station. Mr Basheer calculates the income for individuals and post-paid sales for the contracted firms and government agencies based on paper receipts written by petrol station workers.

However, it is next to impossible to be precise without utilising computers in the accounting process. Human-based calculations have disadvantages such as human errors. Furthermore, there are seven petrol pumps at AS petrol station, for each petrol pump two columns needed to be recorded; that is, total price of sold petrol and total quantity of sold litres. This process is required twice daily and the owners expect human errors to be taken into consideration when recording the numbers manually and using calculators, as the numbers could be entered incorrectly into the note book or typed into calculators.

Moreover, it is difficult to be precise in term of recording and collecting post-paid sales based on hand-written invoices, because the petrol station's accountant needs to sum up the invoices for these post-paid sales and subtract them from the total amount to confirm that the collected amount is the right amount. In

addition, the time spent on these processes could be minimised by utilising computer accounting software or accounting systems.

However, Mr Basheer claimed that AS petrol station's income is not sufficient to implement IT. Mr Basheer stated that he expects the cost of an accounting system to be approximately 5000 to 6000 SR, although he concludes, 'If we have such an accounting system it would totally eliminate paper-based processes, save time and effort'.

This section discussed the current information technology that is utilised in Saudi Arabian petrol stations. The findings highlighted that there is a lack of IT utilisation in Saudi Arabian rural petrol stations. Accounting process is an example of the human-based processes where the accountant records the readings manually in his note book and calculate them by calculator. The participants highlighted the importance of IT to reduce time and reduce human error to achieve more accurate results.

### **5.5.2 IT infrastructure**

There is a lack of IT infrastructure, especially in rural petrol stations. As discussed in section 5.2.1.3, petrol stations rely on communication and procurement infrastructure, such as, computers and internet Wi-Fi to connect to the Internet to purchase fuel, facsimile is to communicate with Aramco's distribution stations, mobile phones are used to communicate with workers and truck drivers, and printers are used to print Aramco's invoices and receipts. Mr Basheer was asked if he utilizes computers to calculate the income for AS petrol station, he stated that he has a computer at the petrol station, however he uses it for printing documents only. The coverage of 3G internet networks is limited in rural petrol stations and goes through a number of black spots along national highways.

Most participants claimed that petrol pumps were a form of IT infrastructure. They believed that they utilise the mechanical petrol pumps, the old pumps, but not the electrical petrol pumps. They claim that modern pumps need frequent maintenance because they believe that modern technology is more sensitive, especially in rural petrol stations where the weather is hot and dusty. Mr Saleh claimed,

When we contact the pump suppliers to maintain our pumps, they come to the site a week later, sometimes they do not come at all. I am talking about the mechanical pumps here, the simple pumps; the situation become more difficult for electronic pumps.

Mr Saleh highlighted an interesting point in regards to the lack of technicians and engineers. When asked if he plans to implement technology in his petrol stations, he answered, ‘No. We should not forget that technology itself has issues also. For example, there is a lack of engineers and technicians across the country. So if one pump is disrupted it will remain unfixed for a long time’.

Mr Saleh stated an important and remarkable issue in Saudi Arabia when he addressed the shortage of technicians, which hinders the implementation of technology in petrol stations. This could be another reason for the lack of IT infrastructure in petrol stations because there is a lack of technicians and engineers who can fix the technological issues. This, in turn, means endless disturbances and delays, which leads to petrol stations owners’ frustration and a negative impression of technology. Petrol stations will not be keen to invest in IT infrastructure because they are not interested in IT utilisation. However, Mr Saleh stated that the typical reason is because Saudis rely on foreign technicians thus, ‘I will not utilize technology unless our young people master the technology, but as long as we rely on foreign technicians to fix the technology I will not implement it’.

Mr Saleh hinted that a lack of technicians is one of the most important infrastructure issues that hinders the implementation and utilization of technology in the country. After reflecting on the cause of the lack of Saudi technicians and engineers, he suggested that foreign technicians can master those jobs and normally people are not interested in serving at petrol stations. Mr Saleh went on to explain how the country is suffering from technology, he says:

Saudi Arabia is not ready for technology because banks, for example, as an important service for each country in the world, get disrupted for a day or two due to system shutdowns; in this case what will be expected to happen in the private business sector?

Mr Saleh was frustrated about technology maintenance issues and the lack of technicians, which lead to delays and petrol station disruptions for several days. This highlights that a lack of technicians is considered as an important IT infrastructure element that hinders the utilisation of IT. Eventually this influences the petrol supply chain causing petrol supply delays issues.

Overall, the technological context section discussed relative advantage, which highlighted the perceived benefits of IT utilisation, and discussed the limitation of technology utilisation in rural petrol stations. Moreover, technology cost and maintenance cost were found to be important factors that hinder petrol stations from utilising new technology.



In addition, traditional technology was discussed and the researcher highlighted that providing savings to customers, such as discounted petrol prices or promotional offers will help to increase the use of technology. Skilful employees can save petrol station maintenance costs for minor technical issues in petrol stations. In addition, sharing the employer's knowledge and skills among his employees enhances petrol stations' service quality. Information technology was the third type of technology and the findings highlighted that the IT utilised in Saudi Arabian petrol stations was for communication and procurement purposes only. Lastly, bad IT infrastructure highlighted the expected reasons behind IT utilisation in rural petrol stations. Moreover, underutilisation of technology was a reason for the lack of IT infrastructure in Saudi Arabia in general and in petrol stations specifically.

## **5.6 Organisational context**

There are several factors provided by the participants in terms of the organisational context. All participants highlighted the factors that either hinder or help the Saudi Arabian petrol supply chain. The factors reported in this section are culture, firm size and firm resources, which will be discussed the following subsections:

### **5.6.1 Culture**

Culture is an important factor in petrol stations. There are several issues that occur in Saudi Arabian petrol stations due to culture. However, one point resonated with all participants. Mr Saleh summarised the general consensus: 'No Saudi would accept work in refuelling vehicles in petrol stations'.

This was the most mentioned cultural factor, as most participants agreed that to work in a petrol station is considered a low class job in Saudi Arabia.

In Saudi Arabia, petrol station jobs are considered expatriates jobs not Saudis jobs. In Saudi Arabia, if a job is considered low class, the worker will be thought of as low class. Petrol station workers get paid a low wage, approximately 700 SR to 1000 SR per month. When asked, Mr Faisal stated, 'The workers come from India, Bangladesh, Sri Lanka and Nepal'.

Another issue for the rural area, stated by Mr Faisal when asked how customers treat his petrol station's employees: 'We are in a village, some people are uneducated, and this means there are issues in dealing with our petrol station employees'.

Mr Faisal stated that there are some people who treat his employees rudely and some customers leave without paying. Mr Faisal highlighted the issue of leaving occurs infrequently and this was agreed by all participants in rural areas. Mr Sami who owns a petrol station in a rural area stated that, 'Some teenagers refuel their vehicles and leave without paying, but such incidents rarely happen in my petrol station'.

The reason this does not happen in Mr Sami's petrol station is because he informs his workers that if they feel that the customer is nervous, then he has to pay in advance. Mr Sami thinks that this may help to minimise issues of non-payment and help to avoid arguments with customers. Moreover, it is important to highlight that the social relationships amongst the Saudis community are strong, specifically in rural areas owing to the small area and number of people. Hence, if issues such as leaving without payment happen in rural petrol stations, it is more likely that the community will know who did it as a result of the rapid spread of news amongst the community, which then affects the reputation of the offender's family.

### **5.6.2 Religion**

Another issue discussed by participants was religion. For example, Mr Sami argued that Muslims are ordered to make ablution before prayer, and also to make sure that places of prayer, such as mosques, are free of contamination and filth, which is of petrol stations' service quality too. However, some foreign workers do not care about this because there is no ROI for ablution utilities and mosques for them as employees, he stated, 'I have recently hired an employee just to clean the mosque and toilets because it is one of Islam's obligations to preserve such utilities at all times'.

This is due to the great size of Saudi Arabia and dominance of Islam, where most travellers stop at petrol stations for refuelling and use toilets for ablution, and then pray at the mosques, because there are five prayers obligated by Allah at five different times during the day.

As already mentioned, some foreign workers do not care about cleaning toilets and mosques. It is felt that there is no ROI on such utilities because of high costs of electricity and water. Hence, there are thousands of petrol station toilets in Saudi Arabia that are dirty and have not reached the customer satisfaction. Approximately 7,030,451 Muslims visit Saudi Arabia every year to fulfil their religious obligations (MOH 2011). These pilgrims and Umrah performers are likely to use Saudi Arabian petrol stations

because the only means of transportation in Saudi Arabia is either via cars or buses to get them from airports/their stay to Makah. Hence, service quality and customer satisfaction are required to satisfy those visitors and to provide a positive experience.

Mr Saleh stated another remarkable issue that occurs during prayer times in his petrol station. Customers park next to the pump and ask the worker to refuel their cars once the call for prayer, *أذان [athān]* the Muslim call to ritual prayer, is announced. However the Promotion of Virtue and Prevention of Vice (governmental agency) prohibits operating business once athan is announced. This commission is tasked with asking people to pray at mosques and close stores when athan is announced, because if people continue to trade they will not pray at the mosque, which is considered a religious transgression based on the commission rules.

However, this regulation has led to some customers getting upset and causing trouble with the petrol station workers, and in some cases physically hurting them. The issue starts when the petrol station workers serve a customer who is already parked next to the petrol pump to refuel the car, but once the worker starts to serve him the athan is announced, this means another customer will ask the worker to refuel his car like the first customer, because the second customer was queued behind the first one and so on. This leads to the employee not praying at the mosque, being subsequently interrogated by the commission, and potentially getting into trouble with customers, or by the commission.

When the researcher asked Mr Saleh why he did not allow his workers to close the entrance five minutes in advance of athan, he answered, customers will get upset, and they will say that athan will be announced in five minutes and not earlier. Therefore, Mr Saleh asked his workers that once athan is announced to shut down the electricity in petrol station and go to the mosque without talking with customers. Mr Saleh stated that he tried closing the entrance, some customers enter from the exit though, which is usually clear as customers are in prayers. Mr Saleh now informs the customers that he has shut down the petrol station and the workers have gone to pray. There are typically some insults and voices raised, but this seems to be the best solution. Mr Saleh struggled with the commission rules as this leads to conflict with his customers, but this regulation is supported by the government and applied to all organisations in the country.

### **5.6.3 Firm size**

Most petrol stations in Saudi Arabia have an average of six workers. According to Morrisson et.al (1994), this is classified as a micro-enterprise employer (one to ten workers, including independent workers). Some participants faced issues in regards to employee numbers.

In rural areas, Mr Sami stated that he only has two workers in his petrol station which contains ten petrol pumps and is required to operate 24 hours a day. This number of pumps is considered a problem if there are only two employees available to attend to customers. Mr Sami further explained that the two workers need to swap shifts every twelve hours. As such only one worker serves ten petrol pumps every twelve hours. This hinders Mr Sami from serving his customers appropriately. Mr Sami stated that the Ministry of Labour has not assigned a license to him to hire more than two workers for his petrol station. When asked why the Ministry of Labour does not allow him to hire more than two workers, Mr Sami answered that he did not know. On top of this, Mr Sami has only one driver to deliver fuel. If this driver gets sick or wants a vacation, the petrol station will be affected because no one can supply petrol to the station. Mr Sami stated in this case he then needs to pay petrol haulers to supply him with petrol. The number of workers in Saudi Arabian petrol stations is different from one petrol station to another. This addresses an issue in terms of differences in providing working visas by the Ministry of Labour.

### **5.6.4 Firm resources**

Petrol is one of the most important resources in the world due its necessity in the majority of transportation modes. Saudi Arabia is the second cheapest country after Venezuela, with prices at US\$0.15 per litre at the petrol stations. Therefore the petrol consumption is very high in Saudi Arabia. Thus, Saudi Arabian petrol stations need to preserve and control this important resource wisely, especially in terms of selling petrol, because petrol prices in Saudi Arabia are remarkably low, as a result, some people do not value these products. Mr Sami stated, 'Low petrol prices led to increase petrol consumption especially amongst youths who drive their cars just for fun'.

So, low petrol prices is one of the causes that increase petrol consumption in the country and this high consumption of petrol influence in petrol supply chain. However, high petrol consumption is not the only factor that influence in station's resources. Mr Sami added, 'My petrol station is old, it was built more than 30 years ago. At the time it was built, the underground steel pipes were the only good quality of construction materials for petrol stations'.

Mr Sami explained that the old age of these underground steel pipes led to iron corrosion, which led to frequent petrol leaks. He is keen to resolve leaks once he notices them immediately, but he will only be able to find the leaks by using traditional manual leak tests. However, this would be far too late because these tests are only conducted twice a year. When Mr Sami asked why he does not replace the steel extensions, he responded that the cost to replacing the underground steel pipes is expensive.

It is worth mentioning that from the perspective of all participants interviewed, petrol leaks were highlighted as a problem that increased the waste of petrol products and this may affect health, the environment, water and soil. Mr Ahmad said,

Inadequately protected pipes and tanks caused petrol leaks when the tank walls were in direct contact with soil, the reaction between the two caused corrosion of the tanks and the leaking of fuel, which in turn then contaminated the groundwater as well as the surrounding soil.

Furthermore, the waste of petrol products is considered a waste of the firm's resources and the country's resources.

## **5.7 Environmental context**

In order to understand the environmental factors that influence the Saudi Arabian petrol supply chain, the researcher explored three important factors (i.e. geographic location, competition intensity, and government regulations) in rural stations. Exploring these factors will help to diagnose the Saudi Arabian petroleum industry, thus will lead to petrol SC integration.

### **5.7.1 Geographic location**

Saudi Arabia occupies 80% of the Arabian Peninsula. The size of Saudi Arabia is approximately 2,217,949 square kilometres (Central Department of Statistics and Information 2010). Consequently, the large size of the country means challenges in petrol supply within the country. Hence, rural participants highlighted some issues that occur relating to the geographic size of the country and their petrol station location, which is addressed in this section.

According to Mr Sami, his petrol station is approximately 450 km away from Aramco's distribution station in Jeddah. Mr Sami claimed that this distance causes petrol supply delays because his driver needs to travel day after day to supply MS petrol station for the three different petrol products: octane 91, octane 95 and diesel. Mr Sami has only one truck and one driver who can travel daily. This process costs Mr Sami transportation expenses, such as driver's salary, food and accommodation.

Mr Sami states that he is lucky that he can buy the truck to save on hauler costs. However, he is aware of the road hazards that threaten his driver and his truck. The probability of bulk camels crossing the highway that links the Southern region of Saudi Arabia to the Western region is high. Furthermore, the driver is travelling day after day, which increases fatigue and the probability of road accidents. The driver needs to travel 15 days each month and needs to travel 14 hours (travel return) to supply each petrol product.

The regulation of the Ministry of Transport and the Ministry of Labour does not provide a maximum for driving hours for truck drivers. However, according to the provision of Article 44 of the Employment Regulations that has issued by Royal Decree number M/51, on seventeenth of September 2005, employees must not work continuously for more than five hours without pauses for resting, eating and praying, of no less than half an hour for each break or an hour and a half during work hours. Moreover, the worker should not work for more than ten hours each day.

MS petrol station is approximately 80 km from the main national highway (Makah national highway). The truck driver at MS petrol station, Mr Husni, claimed that robberies occurred on this road. For example, he said,

A truck driver was forced to stop by three masked people, who stole his money and mobile phone and ran away. However, the driver was lucky because when police came to report the incident they found the mobile phone and penalized the robbers.

Moreover, Mr Sami stated that, if there is a petrol distribution station at least next to Taif, which is approximately 240 km from Alkhurmah. This then will help minimise expenses, lead time and delays. In addition, road risks on the 80 km road such as robberies, car accidents and camels are likely to be minimised. Alkhurmah road that spans 357 km, which is being finalised by the Ministry of Transport in February 2022, will provide two separate double-sided roadways. This road is being upgraded due to the remarkable increase in accidents and traffic (Alsmait 2012).

In addition, some truck drivers that supply petrol from Jeddah's distribution stations need to pass through Makah entrance toward Jeddah city, which is overcrowded in Hajj and Umrah religious seasons. Pilgrims and Umrah performers who drive to Makah need to queue at the checkpoint at the entrance of Makah to prove that their purpose to visit Makah is Haj or Umrah. The custom checkpoint is to ease Hajj and Umrah for those pilgrims by minimising vehicles in Makah and to ease traffic during those seasons. This process causes unnecessary delays for truck drivers, hence Taif could be a strategic location for a new petrol distribution station to supply petrol stations located in nearby rural areas such as Alkhurmah, Trubah, Ranyah and many other villages and provinces.

Mr Faial discussed some issues that occurred when supplying petrol to his petrol stations and how he solved these issues. He also discussed how he prevented such issues from happening again. For example, he mentioned that he faced delays in petrol supply because he sent two trucks to Saudi Aramco's distribution centres at the same time. This is because if one of these trucks broke down on the road, typically the other one is full of petrol, thus it will not be able to assist the faulty truck by towing the fuel tank and this causes unexpected delays.

Moreover, Mr Faisal mentioned that there are errors in the accounting process owing to utilising manual readings and accounting. However, these errors are not significant issues because the accountant resolved them before he submits the final record by deducting the gap from the workers' salaries. This is only processed if the gap is caused by workers based on the daily records and meters' reading. Otherwise the accountant is accountable to pay the gap if it is his mistake in accounting process. The gaps are usually less than 100 Saudi Riyals for the total monthly income.

Mr Faisal and Mr Saad stated that weather-related issues are also barriers to the petrol supply chain in rural areas. For example Mr Saad claimed that: 'The desert extreme hot weather and sand storms disturb petrol dispensers' meters therefore dispensers are covered by plastic covers'.

Mr Saad and Mr Faisal explained that their petrol stations are exposed to dust storms and the extreme heat that idles around 40-50 degrees Celsius. Grains of sands can cover these dispensers during dust storms and the heat of those could cause faults in the meter gears. Therefore, Mr Saad covers the petrol dispensers with plastic covers, as shown in figure 5.6.



Figure 5.6: Petrol dispensers are covered due to the dust storms and extreme heat in Saudi Arabia

Mr Saleh experienced the same issue in his petrol station which is located in a rural area. However, when petrol pumps need to be fixed, Mr Saleh stated that, ‘Petrol pumps suppliers come to the station a week after being requested; sometimes they do not come at all’.

Rural petrol stations are located far from the petrol suppliers’ businesses, which can delay operations for petrol stations for a period of time that could reach a week or maybe more than a week. This affects customer satisfaction and provides them with a reason to refuel from another petrol station, which influences their business and maybe leads to loss as fewer customers leads to decreases in revenue.

In terms of the petrol leak issue that was discussed in section 5.5.1.1 and 5.3.4, Mr Sami explained how the leak test is actioned and maintained at his petrol station:

We normally close the petrol station and reset the petrol pumps to test if there is a leak. It is difficult to explore petrol leaks at petrol stations owing to its age and old steel extensions. Once we experience leaking issues, it will be too late for the soil and environment because we do this test only twice a year for maintenance purposes.

Mr Sami explained that leak test in his petrol station is manually processed. This process causes environmental issues such as soil contamination, because of the rareness of testing processes, which are only conducted twice each year for maintenance purposes. In addition, this traditional process in leak



testing causes unnecessary cost and delays for petrol stations. Petrol station closures last for approximately two hours to test the pumps and underground steel extensions. If a leak is found, then the closure of the station will take many hours and possibly days to fix it. Figure 5.7 represents the leak issues in Saudi Arabian petrol stations. The next section discusses competition intensity.



Figure 5.7: Petrol leaks issues in Saudi Arabian petrol stations

### **5.7.2 Competition intensity**

The participants discussed many issues that occur in rural petrol stations due to competition intensity. According to the petrol stations' owners, the significant issue that occurs in Saudi Arabian petrol stations is leasing stations to foreign workers. Moreover, Saudis lease stations to foreign workers under their Saudis names, and not in the name of the foreign workers, thus concealing that foreign workers operate

these petrol stations. This issue has been argued as a disaster according to Mr Sami, the owner of MS petrol stations in a rural area:

It is very rare to see a Saudi who owns and operates the petrol station himself. Most Saudis build a petrol station and lease it to foreign workers. It has reached the point that some Saudis rent a petrol station and lease it to them in secret. So in this case the foreign workers are the owners. At the end of each month the owner comes to those people and gets rent money.

This results in many issues such as dishonest competition in the Saudi Arabian petrol stations. For example, petrol stations in Saudi Arabia have several utilities such as ablution; mosques; motels; groceries; restaurants; car service and petrol pumps. Those utilities need to be maintained regularly to interest customers and provide them good quality of services. However, most petrol stations in Saudi Arabia lack of cleanliness and quality of services. Participants claimed that the commercial concealment is the main cause of this issue. Mr Sami stated: ‘Petrol station workers, who are in fact the owners based on the clandestine employment, do not care about service quality or the petrol station cleanliness, they are actually looking for money’.

Mr Sami further deliberated that this negatively influences the competitive environment, which many participants described as ‘dishonest’ due to the fraudulent practices of competitors in order to increase profit. This environment causes serious problems such as mixing petrol products to reduce petrol prices and thus, attract customers; defrauding petrol pump meters; wasting petroleum resources; and, petrol smuggling to nearby countries, leading to a shortage in petrol products in the domestic market e.g. petrol stations.

Mr Sami stated that mixing petrol products and defrauding meters are the main methods foreign workers use. They mix kerosene with benzene, which means that the colour will remain the same because kerosene is transparent. However, this results in many car engine failures.

Mr Sami highlighted that foreign workers reduce petrol prices to achieve minimum profit, by selling the deceived petrol for less than the price allowed by the government. In fact, the foreign workers sell octane 95 for 60 halalas (18 AU cents) which is not allowed by the government as the requirement is to sell no cheaper than 65 halalas (20 AU cents). Although the government supervises petrol stations, the foreign workers do not announce these prices to the public, they promote their petrol prices when customers come in to refill their cars as they will inform the customers that they sell octane 95 for 60 halalas. Given this price, customers will continue to refill their cars from these petrol stations because customers are looking for a saving and do not care whether these prices are allowed by the government or not.

Mr Sami told his story about his petrol station's motel, which is one of the utilities provided in rural petrol stations in Saudi Arabia those are on national highways. Due to the large size of the country, travellers prefer to rest in motels located on national highways for a couple of hours and then continue driving. Motels rooms leased are based on hourly rates, but there are some people who rent rooms for a night. Mr Sami spent thousands of riyals on the motel to satisfy customers and to provide the service quality that they are looking for. He charged between 25 and 35 SR per hour to hire a room in his motel. Mr Sami stated that his competitors in the same rural region reduced their rates to five SR per hour for a room in a motel but these rooms could not compare to his motel in terms of quality and service. However, customers are looking for the cheapest rate that provides savings. In this case, Mr Sami should reduce his prices to five SR, to compete otherwise customers will not hire his rooms.

By reducing his rate he loses, because five SR does not cover his expenditure on the room furniture, water supply and electricity bills, the salary of the employee who cleans the room and the supervisor of the motel to provide continuously high quality services. Foreign workers compete by reducing prices to a minimum rate because they do not spend on motels as Mr Sami spends on his motel. They provide low quality services in their motels. They do not have an employee to clean rooms because they clean it themselves but as they have other tasks in the petrol station, they do not clean rooms after each customer appropriately. Moreover, they do not purchase new furniture. They keep the same cheap furniture for the maximum time period.

Mr Sami stated that the issue of high quality petrol station service will not be solved. He stated that, as long as foreign workers monopolize petrol stations, this will result in dishonest behaviour in the environment. Mr Sami concluded that the most important reason for this dishonest competition is the absence of control by the government.

The researcher tried to interview foreign workers and the Saudi Chamber. Many renters responded to the researcher's phone calls. When the researcher asked them to speak to the owner they stated that they are the owner, before they knew why the researcher called them. When they found out that the researcher wanted to interview them (as owners) they responded that the owner is not available and terminated the call.

### **5.7.3 Government regulation**

The undersecretary of municipalities highlighted a list of regulations established in 2001 by the Ministry of Municipals and Rural Affairs in terms of the operations of petrol stations. However, petrol stations do not follow those regulations, because there is a lack of government surveillance and penalties (Dawood 2012).

When asked who is responsible for issues regarding fraud (i.e. mixing petrol products to reduce petrol prices; tweaking the petrol pumps meters; wasting petroleum resources; and petrol smuggling to nearby countries) most participants stated that it is due to a lack of control by the government. This section discusses the issues regarding government regulations in terms of operations of petrol stations supply chain based on the perspectives of participants.

Employee concealment is defined in the law as clandestine employment which covers a large variety of situations (Boswell & Straubhaar 2004). The term employee concealment refers, for instance, to cases where one performs work for which one expects payment, such as automobile repair, plumbing painting and the like, without reporting it. Such persons are acting as independent contractors who evade their legal obligations. They engage in unfair competition with regards to others working in the sector, these persons would be reported as concealing activity. According to Boswell and Straubhaar (2004), whatever the cause, illegal employment is a highly problematic issue for governments. On the one hand, it is clearly economically beneficial for employers of illegal labour and for the economy as a whole. On the other hand, governments are also under intense pressure to control the problem, and respond to concerns about competition with domestic workers, loss of fiscal revenue, or the exploitation of workers.

The Saudi government regulations are strict in terms of foreign concealment and consider it a breach of law. On 22nd of June 2004 King Fahad Bin Abdulaziz approved the Anti-Commercial Concealment Law, which imposes several penalties on those involved in commercial concealment.

When reviewing the Saudi Arabian Anti-Commercial Concealment Law and Foreign Investment Regime, there is inconsistency between those regulations. According to Article (1) of Saudi Arabian Anti-Commercial Concealment Law, it is not allowed -in all circumstances- that non-Saudis invest in petroleum business (MCI 2004). However, the Foreign Investment Regime state that it is legal for foreigners to invest in all businesses in Saudi Arabia, except for specific businesses. Those exception include: oil exploration, drilling and production (MCI 2000). Oil exploration, drilling and production are activities related to crude oil, which is Aramco's responsibility, but it does not mean that foreigners are

not permitted to invest in petrol stations. This highlights the inconsistency in government regulations that could be exploited by foreign workers to invest in petrol stations.

The Consultative Assembly of Saudi Arabia consists of a chairman and 150 members chosen by the King whereby the rights, duties and affairs of residents shall be determined by a royal order. According to Article (15) of The Saudi Arabian Consultative Assembly Law, the members tasks as following:

- Discuss the general plan for economic and social development and provide recommendations.
- Revise laws and regulations, international treaties and agreements, concessions, and provide whatever recommendations it deems appropriate.
- Analyse laws; and
- Discuss government agencies, annual reports and attach new proposals when it is deemed appropriate (Shura 1992).

On the conference of the Consultative Assembly that was held on the 15th of May 2012, some members argued that the current Foreigners Investment Law is a cover for foreigners that allows them to be considered as foreign investors in small businesses and compete with Saudis. Hence, those members recommended assigning a neutral agency to evaluate the quality of foreign investment and its advantages. For example, hiring Saudis in new business opportunities, which enhance the sustainable development of the Saudi economy (Alsalamah 2012).

According to the Saudi Arabian Anti-Commercial Concealment Law, the Ministry of Commerce and Industry is responsible to employ judicial officers to monitor all businesses and industries in the country to report infractions to the Authority of Investigation and Prosecution to penalise the guilty. However, the shortage in the number of judicial officers has caused an increase of fraud behaviour, which negatively affects the competition. According to Article (4) of the Anti-Commercial Concealment Law, a Saudi who conceals any foreigner by his name, commercial licence or by any other ways to invest in any activity that the foreigner is not allowed to invest in, is guilty and his penalty is jail for no more than two years and a fine that does not excess one million Saudi riyal or one of those penalties (MCI 2004).

Mr Sami stated that rural petrol stations are spreading across Saudi Arabia without control by the government. These petrol stations need to be re-organised and controlled by the government to enhance petrol station quality of services and competition. He stated that the recent issues of competition in stations are because of the unplanned spread of petrol stations and the lack of control by the government resulting in fraudulent and corrupt behaviour in petrol stations.

Mr Sami confirmed the spread of petrol stations in rural areas and national highways. He suggested that governments should impose regulations to control the operation of petrol stations on national highways because the current order has led to unfair competition, especially when petrol stations are located next to each other, or within 500 metres.

Mr Sami suggested that governments should outsource the operation and management of petrol stations to qualified petrol station companies to eliminate the domination on petrol stations by individuals. This will standardise prices, services and utilities of petrol stations along the national highway. The Saudi Commission for Tourism and Antiquities should impose regulations to unify and standardise petrol stations.

Mr Sami further explained that there are excessive number of old established petrol stations that are located next to each other and it is impossible to move them to other locations due to high costs. However, outsourcing the operations of these petrol stations to a qualified oil company such as Saudi Aramco, Emirates National Oil Company 'ENOC', General Petroleum Corporation 'Emarat' ...etc. to control of Saudi Arabian petrol stations would help to deliver high standard of service quality.

For example, on the 28<sup>th</sup> of August 2012, Aldrees, which is the second largest national company amongst the Saudi Arabian national petrol stations, signed a contract with the Emirate company ENOC, which is owned by the UAE government, at a cost of 45 million Saudi Riyals in order to take the control of petrol stations located on Saudi Arabian national highways. ENOC and Aldrees will build 40 petrol stations and they will rent several old petrol stations but the lease contracts are not less than 15 years because they will reconstruct these old petrol stations based on ENOC's standards, which will cost lots of money. This will help to provide advantage from foreign investment in Saudi Arabia because it will enhance current petrol stations and will utilise new technologies at the same quality that ENOC provides in the UAE (Albosaily 2012).

In terms of the issues related to the government regulations, Mr Saleh stated that because petrol stations are regulated by nine different government agencies, he faces the requirement of the same documentation needed by different government agencies. Thus, he needs to photocopy documentation many times to distribute to the different government agencies. For example, he needs to deliver his business registration to Saudi Aramco, Civil Defence, Ministry of Transportation, Ministry of Labour, General Organisation for Social Insurance, and the Department of Zakat and Income Tax, Ministry of Commerce and Industry, Presidency of Metrology and Environment, Ministry of Municipal and Rural Affairs. Figure 5.8 presents the relationship between the petrol stations in Saudi Arabia and the governmental agencies.

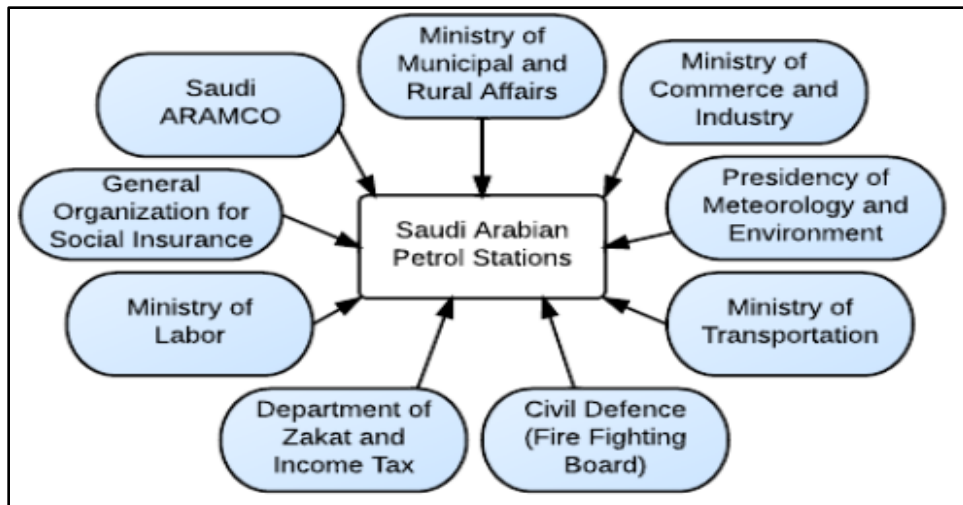


Figure 5.8: The relationship of petrol stations with the governmental agencies in Saudi Arabia

Mr Saleh stated that when issues reach the extent where he feels he should complain to the government, there is no value, because it will take time. This results in his business being disrupted until the matter is resolved in courts or police stations because he will need to attend the court or police station many times or send a representative as his proxy.

Saudi Aramco is a private company that is owned by the government and is the main provider of petrol within Saudi Arabia. As cited by all participants, there is a need to enhance the relationship between petrol stations and government through Saudi Aramco. The following states the issues raised by the participants in terms of their relationship with Saudi Aramco.

Mr Sami stated that the regulations of Saudi Aramco are difficult to apply: ‘Lack of products in Saudi Aramco is one of the reasons for petrol supply delay’.

Mr Sami, Mr Saleh and Mr Faisal confirmed that Aramco’s safety regulations causes delays in the petrol supply process, but as Saudi Aramco is the only provider in Saudi Arabia, petrol stations owners have to accept any delay because there is no choice. However, the participants claimed that Saudi Aramco should notify them instead of disrupting their petrol stations. Mr Ahmad believes that is an unacceptable and unreasonable regulations imposed by Saudi Aramco on fuel truck drivers and suppliers.

Moreover, Mr Sami and Mr Saleh claimed that they have to pay 14 days in advance for the delivery of petrol which slows their funds more. The participants revealed it is likely that Saudi Aramco requests the payment 14 days in advance to estimate the local market demand and refine petrol based on paid and

confirmed purchases. However, Aramco is sophisticated oil company that should know the demand in the local market based on the historical records of petrol purchases for each petrol station in the country. Domestically, demand for petrol is greater than supply which means cancelled requests (if there are any) would not become dead stock. Hence, it is more likely that Saudi Aramco is investing the paid money to reimburse petrol prices that were reduced based on the King's orders.

Mr Sami added it is important to highlight what government spends on petrol refining is more than the return on investment (ROI) from petrol sales within Saudi Arabia. This means that the price of octane 91, which is currently worth approximately five SR (1.5 AUD) per litre based on the global petrol prices in petrol stations, is worth only 45 halalas (0.15 AU cents) per litre in Saudi Arabia. This low-priced petrol does not motivate Saudi Aramco to enhance domestic supply chain and customer service because the refining process is more than 45 halalas per litre.

In summary, this chapter reported the issues and factors that influence the Saudi Arabian petrol supply chain from the perspective of rural petrol station owners and managers based on the technological, organisational and environmental contexts. The process of petrol supply was addressed, which included the measurement process, procurement process, unloading process, and accounting process. The researcher then explored the petrol supply process in the rural area highlighting that rural petrol stations rely on traditional and manual methods. Moreover, this chapter discussed the research findings of the Saudi Arabian rural petrol stations based on the interviewees' perspectives. Table 5.4 summarise the findings of chapter five based on the TOE factors.



Table 5.4: Research Findings in Rural Petrol Stations

<b>Petrol Station</b>	<b>Age</b>	<b>No. of staff</b>	<b>Technology</b>	<b>Organisation</b>	<b>Environment</b>
<b>MS Petrol Station</b>	12 years	4	Basic use in office administration but not for collection, distribution and service of petrol	The number of workers is not adequate - the petrol station has 10 dispensers, but the government granted the owner only four working visas	Dishonest competitive environment impacts his petrol station, so that once he tries to compete with expatriates' prices they reduce the prices until his business sinks into the red
<b>NS Petrol Station</b>	15 years	6	Minimum use in office administration and certainly no usage of IT in providing petrol service or infrastructure for the supply and receipt of petrol	No Saudis want to work in petrol stations owing to the low wages and wealth of the country	Lack of the railways to transport the fuel increases the delays and road accidents
<b>AS Petrol Stations x 2 branches</b>	19 years	4 in each petrol station	Minimum use in office administration and no usage of IT in terms of providing petrol service or infrastructure for the supply and receipt of petrol	Petrol stations must be closed during prayer times, which influences the supply of petrol to petrol stations.	Different regulations assigned by different government ministries led to irritation owing to unnecessary processes

In terms of the technological context, two factors were addressed as significant as discussed by the participants. These were technology and environment. Relative advantage included three types of technology i.e. actual technology, traditional technology and information technology, to distinguish the meaning of technology based on the participant's perspectives.

The organisational context reported three important factors that were involved in the organisational context: culture, religion and firm resources. However, firm size received less attention in Saudi Arabian petrol stations, because the average number of petrol stations workers in Saudi Arabia is eight employees which is considered a micro organisation. Therefore the size of petrol stations was the less important sub-factor that influence in Saudi Arabian petrol supply chain.

The last context reported in this chapter was the environmental context, in which the researcher highlighted the importance of the geographic location for the environment. The researcher then reported the most significant factor which was competition intensity that accounted for the majority of the participant discussion. For example, they discussed government regulation issues such as lack of supervision from the Ministry of Commerce and Industry and Ministry of Municipal and Rural Affairs to prevent fraudulent changes to prices and petrol mixing amongst petrol stations. Government regulation was reported based on participant's issues faced during their experience in petrol stations. The next chapter will address the case study of metropolitan stations.

# **Chapter 6 - Saudi Arabian Metropolitan Petrol Stations Case Study**

## **6.1 Introduction**

The previous chapter explored the issues and factors that influence Saudi Arabian petrol supply chain from the perspective of rural petrol stations owners and managers based on the technological, organisational and environmental contexts in order to diagnose Saudi Arabian petrol supply chain. This chapter (chapter 6 metropolitan petrol stations) discusses the petrol stations that are located in metropolitan cities and those considered near to Saudi Aramco's distribution stations. This helps the comparison to see if social issues in petrol supply chain are similar or different based on geographic locations of the petrol stations.

This chapter discusses the data collected from three Saudi Arabian metropolitan petrol stations. The data was collected by means of interviews with owners and managers of metropolitan petrol stations in Riyadh in Saudi Arabia. The interviews were presented based on the TOE contexts (technology, organisation and environment) to explore and diagnose the Saudi Arabian petrol supply chain.

This chapter commences with an overview of petrol stations in the metropolitan area in Saudi Arabia. It then continues with an explanation of the findings gathered from the interviews regarding the technological, organisational and environmental factors that influence the Saudi Arabian rural petrol stations from the participants perspectives. A total of five participants from rural petrol stations were interviewed in this case study.

## **6.2 Metropolitan petrol stations**

Three petrol stations in a metropolitan area of Saudi Arabia are presented in this research. Riyadh is the capital of Saudi Arabia, which is selected for metropolitan petrol stations data collection. Figure 6.1 illustrates the metropolitan areas of the Kingdom of Saudi Arabia and the location of Riyadh, which is located in the central of the country.



Figure 6.1: Metropolitan areas of the Kingdom of Saudi Arabia and the location of Riyadh

Figure 6.1 illustrates the metropolitan areas, included Riyadh, which contains the three petrol stations explored in this study. According to the Saudi Central Department of Statistics and Information (2010), Riyadh, which is the capital of the Kingdom of Saudi Arabia and also the largest city in the kingdom, is home to approximately seven million people. This accounts for 24% of the population of the whole country.

The researcher explored three petrol stations that are located in Riyadh. The petrol stations are located 44 km away from the Saudi Aramco bulk plant in the North of Riyadh and 27 km from the Saudi Aramco refinery and distribution centre in the South. Figure 6.2 below indicates the locations of Saudi Aramco bulk plant and the refinery. The three petrol stations are owned and managed by Saudi citizens. The petrol stations are AA petrol stations, DB petrol station and ALO petrol station. Pseudonyms have been provided to keep anonymity of the participants and petrol stations. The following section will provide an

overview of metropolitan petrol stations. This is followed by discussion of the Saudi Arabian metropolitan petrol stations' petrol supply chain based on the three contexts of the TOE contexts; technology, organisation and environment.

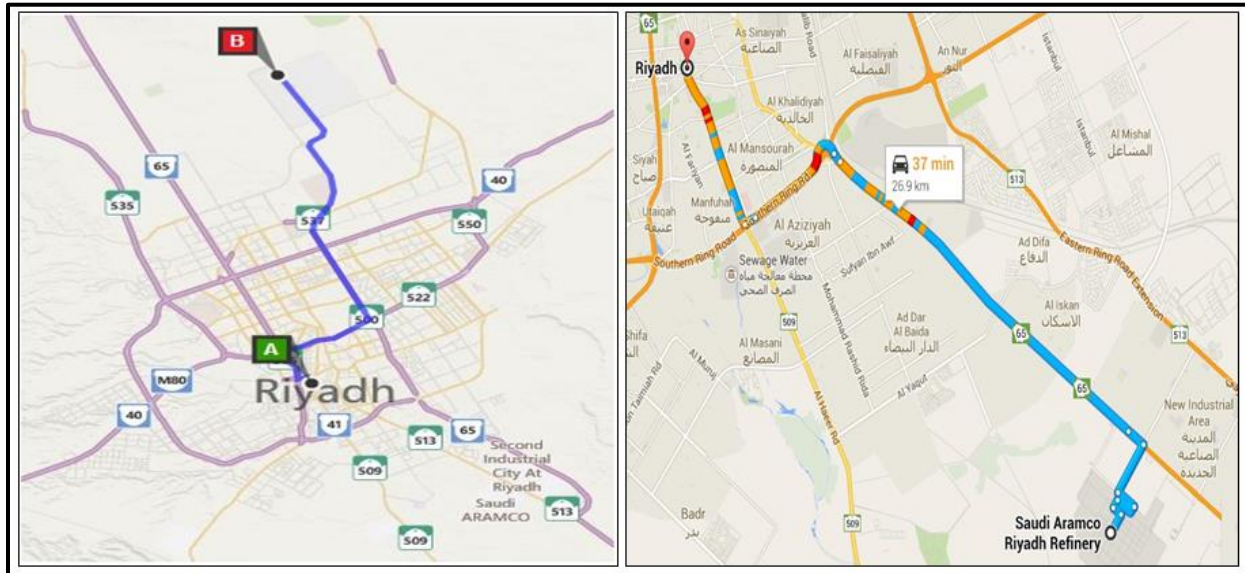


Figure 6.2: The location of Saudi Aramco petrol station bulk plant in the North of Riyadh (left) and Saudi Aramco refinery and distribution centre in the South of Riyadh (right)

### Petrol station I: AA petrol stations

Mr Majed is the general manager of the AA petrol stations that consist of a chain of 460 petrol stations spread throughout Saudi Arabia. These stations are owned by one family in Saudi Arabia. In 2006 the company became publicly listed. AA petrol stations have been in operation for 50 years. Approximately 4,000 workers work at AA petrol stations. Their IT infrastructure consists of Radio Frequency Identification technology (RFID), which costs approximately three million Saudi Riyals (~\$775,000 AUD). AA petrol station headquarters consist of more than 100 employees, to supervise the workers and make online orders, utilising 100 computers, a LAN, 30 printers, Microsoft Office software, and three main servers. The company has an IT administrator and IT support personnel. The petrol pumps in most of the metropolitan petrol stations are new electronic pumps. However, the pumps in AA petrol stations that are located in rural areas are old mechanical pumps.

## **Petrol station II: DB petrol station**

The DB petrol station is a wholesale petrol station owned by Mr Mansour also has another business which is fuel hauling. The business age of DB petrol station is 60 years. Technology infrastructure at DB petrol station in which the headquarters is located consists of ten computers, three printers, a LAN. The accountant, Mr Siraj, addressed that he utilises MS-Excel in terms of accounting processes. The petrol pumps are old mechanical pumps.

## **Petrol station III: ALO**

ALO petrol stations consist of four petrol stations, two located in the metropolitan city, Riyadh, and two located in rural areas, on the national highway, which links the Middle region with the Eastern region. ALO petrol stations are owned by Mr Saleh who also owns three trucks to transport petrol to his petrol stations only. The largest petrol station is located in the middle of Riyadh city. This petrol station contains ten petrol pumps and eight workers. ALO petrol stations do not utilise much technology within the petrol stations to receive, supply or distribute petrol. The petrol pumps at ALO are old mechanical pumps. Table 6.1 highlights the participant's details.

Table 6.1: Participants details

<b>Metropolitan Petrol Stations / Riyadh</b>		
<b>Area</b>	<b>Name</b>	<b>Position</b>
AA Petrol Stations	Mr Majed	Manager
DB Petro Stations	Mr Mansour	Owner
	Mr Siraj	Accountant
	Mr Nahdi	Manager
ALO Petrol Stations	Mr Saleh	Owner

### **6.3 Petrol supply process**

Petrol supply processes, which includes: petrol measurement, procurement and unloading in metropolitan stations were exactly the same of rural petrol stations. The petrol tanks were measured by traditional measurement dipstick twice daily. Unloading the fuel in metropolitan petrol stations was also the same unloading process in rural petrol stations.

In terms of the procurement process, all participants revealed that the only procurement method to order the fuel from the supplier (Saudi Aramco) is online procurement. They also revealed that they must pay 14 days in advance to book the needed petrol quota.

In terms of accounting process, the participants revealed that they utilize paper-based records and calculators to count the income. However, Mr Siraj the accountant at DB petrol station addressed that he utilises MS-Excel spread-sheets to calculate the daily income of the station, which is to be deliberated in sub-section 3.2.1.3. Mr Majed highlighted that he was determined to implement RFID technology in order to improve his petrol stations tally processes but at the time of writing Mr Majed was utilising the traditional accounting method. The upcoming sections report the finding of the three contexts of TOE (Technology, Organisation and Environment) from the perspective of the participants in metropolitan stations.

### **6.4 Technological context**

This section discusses the technological context of the petrol supply chain from the perspective of the petrol stations owners', accountants and managers, relative advantage which includes the types of technology (actual technology, traditional technology and Information Technology); and IT infrastructure. Table 6.2 summarises the organisational profile and IT infrastructure at the participant's petrol stations in the metropolitan areas.

Table 6.2 Metropolitan petrol stations organisational profile

Name	Number of Petrol stations	Age of petrol station	Site of petrol station	IT infrastructure
<b>AA petrol stations</b>	460	50 years	Metropolitan	PC/LAN/printers/RFID/ mobile phones/ faxes
<b>DB petrol station</b>	1 wholesale petrol station 120 Hauling trucks	60 years	Metropolitan	PC/LAN/printers/mobile phones/ fax
<b>ALO petrol station</b>	4	29 years	Metropolitan Rural	Mobile phones/fax

### 6.4.1 Relative advantage

As with the previous chapter, the researcher analysed participants' citations based on the three types of technology (actual technology, traditional technology and information technology) in order to diagnose information technology infrastructure and to improve the understanding of the issues that hinder technology utilisation of petrol supply chain integration.

#### 6.4.1.1 Actual technology

The findings revealed that two petrol stations of the three stations in Riyadh utilise old mechanical petrol pumps as actual technology. Modern petrol pumps are utilised only in AA petrol stations, whereby approximately 50 of 460 stations are utilising modern petrol pumps because they are going to implement RFID technology. Mr Majed, as the manager of AA petrol station stated, 'We use the modern petrol pumps only in 50 petrol stations because these stations were selected for first phase implementation of the RFID technology, whereby modern petrol pumps are important for better implementation'.

However, the petrol stations DB and ALO utilised old petrol pumps whereby the participants revealed that high-cost of modern petrol pumps is the cause they are not keen to buy the modern petrol pumps. Mr Saleh stated that the price for old mechanical petrol pump is approximately 10,000 SR, but the modern



electronic petrol pump is approximately 30,000 SR. Therefore Mr Saleh is not keen to buy the modern petrol pump in his petrol stations.

Another perspective, Mr Majed revealed that Radio Frequency Identification technology (RFID) was tested in AA petrol station. This test recorded a 25% savings in petrol spending on vehicles and was suitable alternative of paid-cards in terms of tally process.

Mr Majed explained how he made the decision to invest in RFID technology in AA petrol stations,

I have a bet on the success of investing in RFID technology.  
It will be a huge jump for the AA petrol station chain in the Kingdom of Saudi Arabia and it will be utilized in all of our petrol stations spread across the Kingdom.

Mr Majed tried pre-paid refuelling cards as a payment method to be utilized by the contracted private sector and government sector to refuel their vehicles in the AA chain of petrol stations. However, he experienced the following issues:

- Drivers lent their pre-paid card to friends to refuel as the workers at AA petrol stations could not identify contracted vehicles and drivers.
- There were two versions of the cards, the first was an individual card which was paid for by individuals, and the second was government and private sector cards. Individuals could pay and retain their cards when the amount was deducted at the petrol station. They keep the cards so they could recharge them at any time. However, government and private sector cards were retained at the AA petrol station to save transaction details and the debit was collected at the end of the month from the contracted private/government sectors. So they physically kept the cards at the station. This process caused confusion and drawn out processes because the cards had to be sorted by the operator into two different types, private and government. Moreover, station operators needed to meet the driver to get the details of the company, vehicle and driver.
- The cards were used by some people to pay off their debts. For example, a foreign person who works as a car park shade designer asked Mr Majed to pay him 2000 SR for the pre-paid cards that he had. Mr Majed asked the designer where he obtained the cards because the version that he had should only be carried by government drivers or private sector drivers. The designer answered that he got it from a customer of his who asked the designer to collect the amount from AA petrol station.
- Mr Majed stated that the worst dilemma he experienced was fake cards sold on the black market. He stated that the fake cards were worth approximately two million litres and were printed overseas but were impounded at an airport in Saudi Arabia.

Therefore, Mr Majed thought seriously to stop using pre-paid cards and replace it with a technology to solve the aforementioned issues.

As a result, Mr Majed decided to conduct a test of the RFID tags on one of his company cars. The RFID tag was installed in the vehicle and the reader was installed on the petrol pump at the petrol station. The amount approved for this particular vehicle was 300 SR. per month. The vehicle receipt showed that the car consumed petrol worth 200 SR. which means 100 SR. was given to friends or embezzled. This test recorded a 25% savings in petrol spending of this particular vehicle. Hence, Mr Majed made the decision to implement RFID because this technology would add value to the AA petrol station chain, help control petrol sales, and add value to the customers by monitoring their cars' petrol consumption. In fact, it will add value to private and government contracted customers and individual customers. Therefore, Mr Majed stated that he decided to sign a contract costing three million SR with an Indian firm to implement RFID technology in the AA chain of petrol stations.

Mr Majed stated that all contracted private and government customers would be able to use RFID at AA petrol stations. Even individual customers would be able to utilize RFID. However, individual customers could sign a contract with AA petrol stations for a specific quantity of petrol each month and the account is funded with the required amount of money in advance. Individual customers are families who have private drivers and want to control their vehicle consumption to avoid fraud by their drivers. They can prepay for the quantity of litres that they want to refuel on a monthly basis either online or on site to the petrol station's operator. The RFID tag is linked to the customer's account, which provides secure data transfer through AA petrol stations servers. The data will be sent over secured end-to-end 3G telecommunication networks. Receipts will be sent to the customer's mobile, email address and will be available online through the company website.

Mr Majed concluded there was only one fear that he anticipated in the implementation of the RFID technology which is,

Our workers in our petrol stations and the contracted organisations' drivers will fight to prevent the success (of RFID implementation). They may disrupt the tags or reader devices, because it will prevent them from carrying out embezzlement and fraud, as this technology is not in their interests.

The researcher had the chance to observe the RFID technology, which was implemented in Alyamamah petrol station in Riyadh. The workers at Alyamamah petrol station left the fuel nozzle on the ground where dust, dirt and leaked diesel from the nozzle covered the RFID reader, which was installed on the

nozzle, thus causing an interruption to reading the tags. The researcher observed the process of refuelling in one of the trucks where the reader device could barely read the tag. After several attempts the device finally read the tag. This substantiates the opinion of Mr Majed, that workers may fight against RFID's success because petrol sales values will be transferred automatically to the petrol station's account. Thus, RFID technology will prevent them from misappropriation and deception, which is not in their interests. However, AA petrol stations still implement RFID technology in approximately 50 petrol stations and have reaped the following benefits:

- Preserved the privacy of the AA chain of petrol stations' customers (private sector, government sector and individuals) and preserved the privacy of the amount of petrol that they purchase;
- Controlled sales by reducing loss of petrol sales and exploitation of petrol meters and receipts;
- Provided safety to the AA chain of petrol stations' management that the fuel has been procured from Saudi Aramco and has been unloaded in AA petrol stations' tanks in the right quantity; &
- Ensured that the contracted company's drivers refuel the right vehicle in the custody of the authorized driver.

Another issue that occurs in Saudi Arabian petrol stations is petrol leaking. Petrol leaks are tested manually in all rural and metropolitan petrol stations. This is attributed to the limited use of technology in Saudi Arabia in general, and the petrol supply chain, specifically. Mr Majed stated, 'Petrol stations are floating on lakes of petrol and diesel. Trust me, there is no supervision on this particular issue'.

Mr Majed stated that approximately 90% of Saudi Arabian petrol stations do not test for leaks in the tanks and underground extensions. He states that some of his petrol stations implemented leak detection systems to explore leaks every twelve hours. This system is linked to a network, which is linked by the internet and controlled by one operations department. He explained that this technology has not been implemented in all 460 petrol stations owing to the high cost of this system and it is not obligatory. Hence, there is inaction by Saudi Arabian petrol stations to utilize such technology.

In summary, relative advantage, which mainly consists of perceived benefits of IT utilisation in metropolitan stations was encouraging owing to the success of RFID implementation at AA petrol stations. This provides signs of gradually utilising technology in Saudi Arabian petrol stations, as many participants indicated, AA petrol stations will be seen as an example of either success or failure of technology utilisation. Hence, once actual technology, for example RFID is shown to add value to AA petrol stations, it is likely that other petrol stations will start to compete and utilise this technology. Moreover, technology cost was found to be an important factor that hinders metropolitan petrol stations from utilising technology.

### ***6.4.1.2 Traditional technology***

As discussed in chapter five (rural petrol stations) the measurement process does not rely on technology. When asked about how workers measure the inventory in petrol tanks in metropolitan stations, Mr Majed, Mr Mansour and Mr Slaeh confirmed that that they use the same traditional measurement method in rural petrol stations. For example Mr, Saleh said, ‘We use the ruler, which is the only method that we use in terms of petrol tanks measurement and all petrol stations are using this method’.

Mr Majed and Mr Mansour also addressed that the petrol tank measurement process at their stations is similar to other petrol stations in the country. The measurement process at their stations is human-based, which is useful and from their perspective saves costs. For example, Mr Mansour stated, ‘So long as traditional petrol tank measurement is useful, why do I need to replace it by technology that costs me money?’

Mr Mansour added that he is happy with the recent petrol tank measurement process because it helps to know the quantity in the underground petrol tanks; therefore he sees no need for extra costs for alternative technical methods.

In addition Mr Saleh, the owner of the metropolitan ALO petrol station cited an example of traditional technology, which is similar to the rural petrol stations, that is, the transfer of skills. He claimed that he used to work in petrol stations when he was young. This assisted him to acquire many skills in fixing the mechanical petrol pumps. Thus, he shares his knowledge to fix sudden disturbances in the fuel nozzles, petrol pumps, hoses and meters, with the workers in his petrol station.

To summarise, similar to rural petrol stations, the research findings of metropolitan stations revealed that people can save petrol station maintenance costs for minor technical issues that occur through the sharing of skillsets. In addition, the sharing of the owner’s knowledge and skills among employees can minimise delays and enhance petrol supply chain operations.

### ***6.4.1.3 Information technology***

Mr Saleh stated that his petrol station, ALO petrol station, utilises mobile phone and facsimile to communicate with Saudi Aramco and the workers at the stations. Mr Saleh uses mobile phones to

communicate between himself, the petrol station operator and workers. Mr Saleh uses a computer from his home to order petrol from Saudi Aramco. Hence, it is apparent that ALO petrol station is very low in the usage of information technology in terms of office administration and is hardly used to order or supply petrol from petrol stations.

In terms of using IT in the tally and accounting process, Mr Saleh and Mr Majed rely on hand-written invoices. However, the accountant of DB petrol station in metropolitan petrol station, Mr Siraj, utilizes MS-Excel spread-sheets to calculate the daily income of the station. He states: 'I utilize MS-Excel in the accounting process. MS-Excel helps me to access records of all previous calculations'.

The same manual accounting process at rural petrol stations also occurs at DB metropolitan petrol station. Mr Siraj enters the readings into an Excel spread-sheet to ease calculation process and minimize time and effort in the calculation process. Excel is useful and beneficial for petrol station accounting processes owing to its low price and complexity, in contrast with professional accounting software and systems. Mr Siraj stated that he uses separate sheets to calculate the contracted firms to ease the debt collection process. However, all participants highlighted the importance of IT to reduce time and reduce human error to achieve more accurate results in the accounting process.

## **6.4.2 IT infrastructure**

In metropolitan petrol stations, there are computers, facsimiles and LAN internet connections. The utilisation of these technologies in office administration is high. However, the utilisation of these technologies in procurement and supply chain operations is limited.

AA petrol station's IT infrastructure consists of Radio Frequency Identification technology (RFID), which costs approximately three million Saudi Riyals (~\$775,000 AUD). AA petrol station headquarters has more than 100 employees, to supervise the workers and make online orders, utilising 100 computers, a LAN, 30 printers, Microsoft Office software, and three main servers. The company has an IT administrator and IT support personnel. Most of the metropolitan petrol stations have new electronic pumps.

However, the use of RFID technology in AA petrol stations is in its second phase of RFID implementation. According to Mr Majed, the implementation project of RFID has three phases to bring RFID into AA petrol stations' operations. Phase one refers to being able to print, code, and ship RFID labels because the labels and it is possible that codes can be damaged or wiped in petrol stations. Phase

two: refers to finding efficiencies in the process. AA petrol stations is currently at Phase Two. Phase three refers to integrating the RFID environment into its enterprise resource planning system. Meanwhile, all IT infrastructure in AA petrol stations that entails computers, LAN, printers and facsimiles is used for office administration, such as petrol procurement from Saudi Aramco, typing contracts or for emails with customers.

Only Mr Siraj, the accountant in DB metropolitan petrol station stated that he utilises MS-Excel for the accounting process at the petrol station, and for access to historical records concerning petrol purchases from Saudi Aramco. Mr Siraj was the only participant of the ten interviewed who utilised computers for petrol supply based on the historical records and accounting purposes, rather than utilising it for procurement and printing only.

Section 3.1 diagnosed the technological context in the Saudi Arabian metropolitan stations. The findings revealed that the technology infrastructure in metropolitan stations is high in terms of office administration but low in terms of accounting and petrol supply process. Moreover, technology cost and maintenance cost were found to be important factors that hinder petrol stations from utilising new technology. In addition, skilful petrol owners who share their knowledge with employees can save petrol station maintenance costs concerning minor technical issues in metropolitan stations.

## **6.5 Organisational context**

There are several factors provided by the participants in terms of the organisational context that are similar to rural petrol stations. The factors reported in this section are culture, firm size and firm resources.

### **6.5.1 Culture**

Most participants agreed that to work in a petrol station is considered a low class job in Saudi Arabia. For example, Mr Majed stated, ‘When you go back in time, 35 years ago, all workers in petrol stations in the Kingdom were Saudis, but the reality has changed’.

Mr Majed stated that six years earlier, the Ministry of Labour asked him to interview some Saudis who wanted to work in petrol stations. When he met them they stated that they want to work in their region but

not outside it. Because, based on the low monthly wage they get, they can live with their families in their region to reduce living expenses such as rent and food. However, once they work outside their region, they need to spend money on rent, food and transportation because they will not live in petrol stations as some foreign workers do, which is fundamentally prohibited by the Civil Defence. The low wage and living expenses are considered obstacles that hinder Saudis from working in petrol stations.

When asked if technology can replace human-based petrol stations, Mr Saleh said, 'Sure, it will provide an alternative solution instead of workers and minimise people's effort, but will people accept it or not? This is the question'.

From Mr Saleh's perspective, he queries whether people will accept technology or not, which indicates the importance of people knowledge about technology utilisation in petrol stations and what customers will gain from technology. Mr Saleh provided an example of people's acceptance of technology: he stated the experience of one of his competitors in a metropolitan area (Riyadh) who had many issues when he implemented a form of technology in his petrol station. This competitor implemented self-service petrol stations in six of his stations. However, the initial analysis of this technology potentially showed that customers did not accept it for several reasons. One of the reasons is they see no point to visit self-service stations because there are other petrol stations that provide a full-service at the same cost. The self-service petrol stations are saving the cost of labour to dispense the petrol but some of those savings should be extended to the customer by reducing the price of petrol or provide promotional offers. This resulted in project failure because customers did not gain any value in visiting a self-service petrol station.

Hence, it is important to educate customers through the media and other educational channels about the importance of technology in petrol stations. For example, customers should know that technology will reduce the dependency on overseas workers, which will help to reduce corruption in petrol stations. In addition, customers should gain savings such as discounted petrol prices or other promotional gifts, for example, free clean of their cars once they reached a certain amount, or provide them with physical gifts. This could help increase the knowledge about technology advantages and enhance customers' awareness to accept technology in petrol stations.

In terms of self-service petrol stations, Mr Saleh hinted that AA petrol stations had self-service problems. This is one of the competitors in the Saudi Arabian petrol industry. Hence, the researcher asked Mr Majed about self-service petrol stations' efficiency for AA petrol stations. He stated that the company he managed was the first company that applied self-service petrol stations in the Kingdom 25 years ago. However, it did not succeed for the following reasons:

- Customers did not get out of the car to refuel their own vehicles in hot or cold weather.
- Some customers, after refuelling, reversed and escaped from the entrance gate without paying.
- AA petrol station installed traffic-spikes at the exit which could be controlled by the cashier, just in case someone wanted to leave without paying. Some customers suddenly gained access into the cashier's control room and injured the worker, because he damaged their tyres, which cost the driver more than 2,000 SR. whereas the amount they intended to steal by not paying was only 100 SR.
- There was a gradual decrease in the company's ROI.

Within two years, AA petrol stations went back to full-service petrol stations, where the workers fill-up the customer's car. Mr Majed stated that six petrol stations were designed for self-service in Riyadh city, however all failed. He stated that customers do not have the patience to wait for their car to be attended. For example, when there are only two workers in a petrol station and they are busy refuelling two cars, the customer is put into a queue but typically leaves that petrol station and looks for another one.

Although in the rural stations leaving without paying is not a significant problem, it is a significant problem in the metropolitan area. In the metropolitan area, Mr Majed addressed a different point of view and stated, 'Amongst our chain of petrol stations in most regions of Saudi Arabia, we have experienced the largest incidents of leaving without paying in Riyadh. It has reached an approximate loss of 2000 to 3,000 SR daily'.

Most participants confirmed non-payment was an issue in their metropolitan petrol stations. In addition, Mr Majed claimed that some of these reported incidents of non-paying customers have been fabricated by employees. Mr Majed stated, 'Approximately 50% of non-paying customers are fabricated by our workers because we are accustomed to hear about such issues in the country therefore, our workers are exploiting to this for their interests'.

Mr Majed explained that it is easy for these issues to be fabricated by petrol stations workers because the owners and managers trust their employees. Mr Majed stated that a week before the interview with this researcher, three workers at one of his petrol stations claimed that they were victims of a robbery where two of them were hurt. Mr Majed called the police who inspected the site and they found evidence of the robbery such as a broken door, torn clothes and injuries. However, two days later one of the three workers came and admitted to Mr Majed that it was a fabricated story. When Mr Majed asked him why they fabricated this story, the worker said that they wanted to portion the money amongst them and he is regretful about what he did. But Mr Majed said that this worker has spoken out only because the other workers did not give him his portion of the stolen money.



## 6.5.2 Religion

Similar to rural petrol stations, the participants highlighted that closing petrol stations during prayers was an issue in metropolitan petrol stations as well. For example, Mr Mansour stated that Riyadh's population is more than seven million where the customer intensity on petrol stations is high. Mr Mansour claimed that sometimes when he closed the petrol station during prayer time for approximately 20 minutes, customers parked outside of the station in queues because they also go to perform prayers and this led to traffic congestion. Mr Mansour stated,

Some customers park their cars outside the station because they want to refuel after prayers and they want to be served first when the station opens. This led other customers to queue behind the first customer and so on. This led to traffic congestion outside the station.

This has been confirmed by Mr Saleh, who owns two rural petrol stations and two metropolitan petrol stations. Mr Saleh agreed that the issues occurred in his rural petrol stations during prayer time, similar to that in metropolitan petrol stations. He stated that his metropolitan petrol stations are located in a busy area, in the middle of Riyadh city, which is Alsenayiah. This area includes hundreds of auto repair shops, with many people visiting these shops to repair their cars. However, some of these cars are on the verge of completely breaking down owing to mechanical or electrical issues and when these drivers came to the petrol station to refill their cars during prayer time, they park outside, wait until the station re-opens then they try to start their cars but find their car battery is dead. They need to be jump started or towed away, which, in turn, causes traffic congestion in the busy Alsenayiah area.

In terms of cleaning toilets and mosques in metropolitan stations, the participants also agreed that there are poor service quality issues in metropolitan stations owing to the lack of cleaning of toilets and ablution utilities. However, this issue is less serious in metropolitan petrol stations because in metropolitan areas the government inspects petrol stations more than rural areas. However, if drivers want to pray or use the toilets and ablution utilities they can go to mosques that are well arranged for ablution and prayers. People visit rural petrol stations to refill their cars and use toilets and ablution utilities because they are travelling long distances on national highways.

### 6.5.3 Firm size

Most petrol stations in Saudi Arabia have an average of six workers, but the number of workers in Saudi Arabian petrol stations differs from one petrol station to another.

In metropolitan areas Mr Saleh stated that he has eight workers in his petrol station that is located in Riyadh city, which contains ten petrol pumps. In the day shift there are six workers and in the night shift there are three workers. The shift starts at 8 am and ends at 8 pm, then the next shift starts at 8 pm and ends at 8 am. When asked Mr Saleh what were their tasks, he stated that they refilled customers' cars and do nothing else.

Different working visas are provided by the Ministry of Labour based on the area that petrol stations are located in. The Ministry of Labour stated that issuing visas is linked with employing Saudis in metropolitan petrol stations as supervisors of the workers (Alhazim 2005). The Ministry announced that it will not issue visas for petrol stations unless one Saudi is employed as a supervisor in each metropolitan petrol station to ensure that the foreign workers follow government instructions in terms of service quality and selling petrol (Alhazim 2005).

Although, this was announced in 2005, there were no Saudis employed in petrol stations at the time of writing. This announcement has not been applied to all participants. Furthermore, participants did not mention that the Ministry of Labour announced that Saudis must be employed in petrol stations as supervisors. Metropolitan petrol stations employed foreign workers and they are happy with the number of employees that they have. For example, Mr Saleh has eight workers and no Saudis employed in his petrol stations, Mr Majed manages 460 petrol stations, where an average of eight workers in each station, all workers are foreigners and he has no Saudis employed to supervise the workers in these petrol stations. He claimed that there were no Saudis wanting to work in his petrol station. This implies that there are inconsistencies in applying these visa rules.

To summarise, the firm size is an important factor that influences the petrol stations in serving the customers. If employee numbers are not adequate, customers will not be served appropriately. Inconsistencies in the application of working visas also appear as an issue that hinders petrol stations from providing good service quality to customers.

## 6.5.4 Firm resources

In metropolitan petrol stations the petrol consumption is very high in Saudi Arabia. The findings in terms of firm resources in chapter five revealed that petrol prices in Saudi Arabia are remarkably low; as a result, some people do not value these products. In metropolitan stations the petrol consumption is also considered very high, but there is another cause on top of low petrol prices, which is construction projects in Riyadh that led to significant demand on diesel. All participants stated that the demand on diesel is much higher than octane 91 and octane 95 owing to the giant construction projects in Riyadh. For example Mr Mansour stated,

Diesel is very economical for heavy duty machines - those used in construction operations that are used twenty four seven in King Abdullah Financial City in Riyadh. My petrol station is a wholesale station that refills diesel haulers to supply these machines with diesel because my station is on the way to KAFC Therefore, our sales of diesel is much higher than octane 91 and 95.

Mr Mansour, Mr Saleh, Mr Majed and Mr Nahdi confirmed that low price of diesel (25 halalas) and economical consumption of diesel encouraged most companies to use diesel trucks only. Therefore, the participants quickly noticed high demand on diesel where their petrol stations run out of this particular product.

Metropolitan petrol stations are also considered old constructed petrol stations. The newest petrol station was built more than six years ago, which was the other ALO petrol station in Riyadh. However, Mr Mansour has a wholesale petrol station which was built over 60 years ago. Mr Majed stated that 60% of AA petrol stations were built approximately 30 years ago. Therefore, they faced similar issues of rural petrol stations in terms of old underground steel pipes that led to iron corrosion, which led to petrol leaks. Similar to rural petrol stations, all participants interviewed stated that petrol leaks is a problem that increases the waste of petrol products, and this may effect health, the environment, water, and soil. The lack of leakage detectors was also found as the cause of this frequent issue in metropolitan petrol stations.

Section 3.2 diagnosed the organisational context in the Saudi Arabian metropolitan stations. The findings revealed that organisational factors influencing metropolitan petrol stations were similar to rural petrol stations. However, firm size based on the number of workers in metropolitan petrol stations was found less influential on petrol station operations than operations in rural stations. Moreover, diesel was highlighted as a high demand petrol product that run out quickly in metropolitan stations, owing to the significant construction and industrial operations in the Riyadh.

## **6.6 Environmental context**

### **6.6.1 Geographic location**

It is estimated that the size of Riyadh is 1,554 square kilometres (Central Department of Statistics and Information 2010). Consequently, the large area of Riyadh means challenges in petrol supply. The geographical location of Riyadh was found to have less influence in metropolitan petrol stations than rural petrol stations owing to the location of Riyadh, nearby Saudi Aramco's distribution stations. The petrol stations were located 44 km away from the Saudi Aramco bulk plant in the North of Riyadh and 27 km from the Saudi Aramco refinery and distribution centre in the South.

However, Mr Mansour stated that sometimes there is a delay or shortage in petrol products in Saudi Aramco's stations due to a lack of products in the refineries or refinery maintenance intervals. Lack of products is one of the important reasons, especially in summer, when petrol demand increases due to the school holidays. In summer school holiday most people travel by cars, which increases the demand on octane 91 and 95. However, the shortage of diesel exceeds that of octane 91 and 95 because trucks need to travel hundreds of kilometres and require regular refuelling to deliver or transport goods.

Mr Mansour stated that Saudi Aramco intends to establish a new distribution station 120 km from Riyadh. However, Mr Mansour stated that 120 km is still far from Riyadh and he wondered why Saudi Aramco does not establish a station 40 km from Riyadh. Mr Mansour explained that the size of the Kingdom is great and there is much land for sale on the Eastern national highway that could be invested to build distribution stations.

Mr Majed and Mr Saleh had no problems in terms of Saudi Aramco distribution stations and oil refineries. Mr Saleh addressed that both petrol stations in Riyadh are considered near to Saudi Aramco distribution stations, approximately one hour driving. However, the other two stations those are located in rural area are approximately 350 km from Saudi Aramco's distribution stations, which is approximately four hours driving and this cause problems more than his stations in Riyadh.

Weather-related issues were found as barriers to the petrol supply chain in metropolitan areas. Riyadh is classified as having a hot desert climate, temperatures during the summer months are extremely hot, approaching 50 degrees Celsius occasionally. The average high temperature in July is 44 degrees Celsius. Winters are warm with cold, windy nights. The overall climate is arid. It is also known to have many dust storms. The dust is often so thick that visibility is less than 10 m. Hence, all participants confirmed that

the weather is considered an issue that influence in petrol supply operation in Riyadh. For example Mr Majed addressed, 'The desert's extreme hot weather hinders the customer from stepping out from their cars. Most customers stay inside their cars and pay money inside their cars'.

Mr Mansour highlighted that dust storms in Riyadh frequently occur in summer and as a result petrol stations were affected by these dust storms. Dust storms caused petrol supply delays because the traffic department prevents trucks from accessing through the city during sand storms where the visibility is low in order to prevent truck accidents. The next section discusses competition intensity.

### **6.6.2 Competition intensity**

Mr Mansour who has over 60 years of experience in petrol stations and petrol hauling, confirmed that commercial concealment - which affected rural petrol stations, chapter five, (sub-section 5.7.2) - also occurs in metropolitan areas. He stated that more than 80% of petrol stations in Saudi Arabia are operated, managed and owned by foreign workers. There are only 20% of petrol stations operated, managed and owned by national firms.

In Riyadh, Mr Mansour used to own several petrol stations, but he cut back to only one wholesale petrol station and focuses his time and business on hauling business. He stated that the petrol station industry is now monopolised by foreign workers and it is impossible for Saudis to compete with them.

Mr Mansour stated that foreign workers are becoming managers and workers at the same time. They do not have expenses for employees, accountants, water and they save 70% on electricity bills. They only have to pay the rent of the petrol station and are able to save 70% of electricity expenses because they shut down 70% of the petrol station's lighting during the off-peak period. However, the actual owners pay for the utilities to maintain them and clean them as they believe that there is an ethical obligation regardless of whether they are supervised by the government or not.

Mosques and ablution cleanliness reflect the extent to which owners are keen to preserve these important utilities for prayers. Mr Mansour also added that the foreign workers actually live in the petrol stations. The Foreign workers also minimise any services. For example, there are no employees to clean and provide good petrol station utilities, such as toilets and the mosque because there is no return on investment for such services. This was confirmed by Mr Nahdi who stated that two of the most important

utilities in the Saudi Arabian petrol stations are the mosque and toilets, will help attract customers if they are clean.

Mr Mansour added that foreign workers also commit fraud by tweaking petrol pumps meters and prices. They are also known to mix low quality petrol products to increase profit. Mr Mansour cited, 'Personally, I had several petrol stations, I have tried to compete with foreign workers by not getting any profit from my petrol stations and reimbursing the loss from hauling income. But it did not work because they defraud everything'.

Hence, Mr Mansour described petrol station competition in Riyadh as being highly dishonest. This highlights that metropolitan petrol stations are similar to rural petrol stations in terms of dishonest competition owing to the issues related to fraud and concealment in metropolitan areas. This highlights that the competition is intense because of the lapse in regulations concerning foreign workers managing petrol stations and therefore, there are many foreign workers to compete against.

### **6.6.3 Government regulation**

Government regulation was diagnosed as one of the factors influencing metropolitan petrol stations in Saudi Arabia. The lack of government surveillance and punishment negatively influences Saudi Arabian petrol stations and has led the expatriates and individual petrol stations owners' to breach laws. Mr Saleh stated that people in Saudi Arabia have to deal with government regulations whether they are strict or flexible. However, people do not follow the rules most of the time. Mr Saleh stated that breaches of government regulations by both citizens and foreign workers should be not tolerated. Mr Saleh stated,

It is the responsibility of the government to control petrol stations and prevent commercial concealment represented in the Ministry of Commerce and Industry. If the Ministry of Commerce and Industry wants to fix such issues it will, however it is not keen to fix them because of the shortage in inspectors.

Mr Mansour noted that government working hours are normally between 8 am and 3 pm. Hence, foreign workers reduce the petrol prices between 3 pm and 7 am because they live in the petrol station and government inspectors only inspect during working hours, if they inspect them at all. Therefore, the foreign workers feel free to abuse the law.

Mr Mansour stated that sometimes foreign workers tweak the meters on the one or two of the busiest pumps. This enables them to reset the meters quickly at any time in case a government inspector suddenly arrives. In this way, they can get the profit that they are looking for and avoid penalties from the government at the same time. Government inspectors do not randomly spot or inspect stations, and this gives the workers the opportunity to do whatever they want with their petrol pumps. When Mr Mansour was asked which government agencies were responsible for preventing such issues from happening in petrol stations, he stated the Ministry of Commerce and Industry, and the Ministry of Interior. The Ministry of Interior is an executive government agency that helps the judicial officers to do their job.

Mr Saleh stated that metropolitan petrol stations are spreading across Saudi Arabia without control by the government. Newer petrol stations get licenses from the government though, which confirms that they are legal even if they are located within 500 metres of another station.

All participants suggested that governments should outsource the operation and management of petrol stations to qualified petrol station companies to eliminate the domination on petrol stations by individuals. The Saudi Commission for Tourism and Antiquities should impose regulations to unify and standardise petrol stations. Mr Majed stated,

The Ministry of Commerce and Industry exaggerates when asking us to be of the same quality of the UAE petrol stations, because those international petrol stations are operated, managed and controlled by the government via qualified national oil companies, such as, ENOC and Emarat.

In terms of the relationship of petrol stations with the governmental agencies in Saudi Arabia, Mr Majed stated that typically petrol station owners need to meet responsible people in the Ministry of Commerce and Industry to discuss their issues in order to enhance the petrol station services. However, the Ministry of Commerce and Industry does not have a specific division to oversee petrol stations. Moreover, the Ministry of Commerce and Industry is too busy to oversee all businesses and industries in Saudi Arabia.

In terms of the relationship between petrol stations and government through Saudi Aramco, Mr Mansour stated,

Saudi Aramco faults customers in terms of petrol supply delays, for example Aramco faults truck drivers for lack of commitment to safety conditions. However, we fault Aramco for petrol supply delays because Aramco has a deficiency in meeting the needs of petrol stations.

Mr Mansour stated that a shortage of petrol products occurs sometimes in peak-load periods, such as summer holidays and Haj. Such periods of peak-load cause disruption in Aramco's refineries and petrol

supply to distribution stations. Moreover, periods of maintenance process at Aramco's refineries led to delays in petrol supply owing to the shutdown of refineries during maintenance process. As a result, Saudi Aramco reduces petrol production, which led to shortage of petrol products in petrol stations.

Mr Mansour stated that recently, Aramco has established its strategic storage warehouses for refined petrol products. This will help to reduce the shortage of petrol products such as octane 91, octane 95, and diesel in Saudi Arabian petrol stations because Aramco will refine and store fuel for peak times.

All participants were not happy that they have to pay 14 days in advance to Saudi Aramco for the delivery of petrol, which impacts their cash flow. A similar perspective was felt by participants in rural petrol stations.

Section 5.3.3 diagnosed the environmental context in the Saudi Arabian metropolitan stations. The findings revealed that weather-related issues, such as extreme heat and dust storms influence operations in metropolitan petrol stations. Moreover, the geographic location was a less important influence on the petrol supply chain owing to the close proximity of metropolitan areas to Saudi Aramco's distribution stations. The factors negatively influencing competition intensity in metropolitan petrol stations is similar to those experienced in rural petrol stations. In addition, the relationship between government via Saudi Aramco was found to be an important factor that influenced operations in metropolitan stations.

In summary, this chapter reported the issues and factors that influence Saudi Arabia's petrol supply chain from the perspective of metropolitan petrol stations owners and managers based on the technological, organisational and environmental contexts. Table 6.3: Research Findings in Metropolitan Petrol Stations provides a summary of the findings.



Table 6.3: Research Findings in Metropolitan Petrol Stations

<b>Petrol Station</b>	<b>Age</b>	<b>No. of workers</b>	<b>Technology</b>	<b>Organisation</b>	<b>Environment</b>
AA Petrol Station – chain of 460 petrol stations	50 years	4000 8 workers in each station	Very high tech usage of RFID to provide service, supply and receipt of petrol within the station	No Saudis want to work in petrol stations owing to the low wages and cultural influence	Petrol stations are floating on leaked petrol owing to lack of government surveillance and lack of technical leakage detectors
DB Petrol Station	60 years	8	High IT use in office administration but low usage to receipt and supply petrol within station	Defrauding petrol stations only happens when the expatriates work in petrol stations, No citizens are involved in petrol station fraud	Petrol station business closed and transitioned to fuel hauling business owing to dishonest competition in petrol stations
ALO - 4 branches with 2 in the metropolitan areas and 2 in the rural areas	29 years 5 years 8 years 6 years	8 in each station	Very low usage of IT in office administration and hardly any use of IT infrastructure to receive, supply or distribute petrol	Petrol stations must be closed during prayer times, which influence the supply of petrol to petrol stations.	Geographical location of petrol distribution centres is considered and issue for the rural petrol stations

The findings revealed that the factors that influence metropolitan petrol stations were similar to rural petrol stations. For example, both rely on traditional and manual measurement methods. However, the metropolitan cases interviewed are keen to implement technology compared with the rural cases.

In terms of the technological context, IT infrastructure was diagnosed as a significant factor that may help improve petrol supply chain integration based on the case study to bring RFID technology to AA petrol stations.

The organisational context reported important factors that were involved in the organisational context: culture, religion, firm size and firm resources. Firm size, which was seen as an important factor influencing rural petrol stations was not seen as an important factor that influences metropolitan stations. This is because the metropolitan stations owners were happy with the number of workers at their stations.

The last context reported in this chapter was the environmental context, where the findings revealed that weather-related issues, such as extreme heat and dust storms influence metropolitan petrol stations. Moreover, the geographic location was perceived to be a less important factor influencing the petrol supply chain, owing to the close proximity of metropolitan areas to Saudi Aramco's distribution stations. Competition intensity was found to be similar to rural petrol stations where similar factors negatively influenced the metropolitan petrol stations. The relationship between government via Saudi Aramco was found to be an important factor influencing metropolitan stations. The next chapter discusses the case study of the haulers.

# Chapter Seven - The Saudi Arabian Fuel Haulers

## 7.1 Introduction

This chapter reports the findings that explore the role of fuel haulers in the Saudi Arabian petrol supply chain. The case study investigated four haulers and one truck driver. The reason behind investigating those five participants was to identify the role of the fuel haulers in the Saudi Arabian petrol supply chain and to explain fuel loading, unloading as well as the fuel transportation process. Moreover, this chapter identifies the TOE factors in the hauling sector from the participants' perspectives.

According to the Ministry of Transport, under the regulation of goods transportation on Saudi Arabian roads, a hauler is a licensed organisation that conducts a contract of carriage of goods or materials under the sender's name or by another person on his or her behalf, who is acting as authentic and responsible for the execution of the contract (MOT 1977). A fuel hauler should have at least five current model trucks, a warehouse with sufficient space based on the number of trucks and containers. In addition, the hauler should employ drivers and accountants and should contract with customers (petrol stations) to be supplied by Saudi Aramco. This will be discussed in detail in sections 7.3.2.

The participants shared their perspective in which the researcher derived the factors based on the TOE framework. Four fuel haulers who owned their own fleet were interviewed, as well as one truck driver to understand the fuelling and transportation process. It is important to highlight that the role of truck drivers is important in terms of fuel hauling in Saudi Arabia. This is because the distance across Saudi Arabia requires truck drivers to drive several hours to transport fuel products from the provider (Saudi Aramco distribution stations) to customers (petrol stations).

A truck driver's salary is low considering the amount and type of work truck drivers do, such as hours spent driving and road hazards such as unexpected bulk camels crossing highways, road accidents and dangerous flammable products that they transport. As discussed in chapter five, truck drivers are paid 150 SR in travel pocket money for each fuel transport and they get a salary of 1500 SR per month.

This chapter provides an overview of the importance of fuel hauling in the Saudi Arabian petrol supply chain, as well as a background of the four fuel haulers and one truck driver. An explanation of the

operational procedures of a fuel hauling firm, and the process of fuel loading and unloading are first discussed. This will be followed by a discussion of the factors that influence the fuel hauling firms according to the TOE framework. A conclusion section of this chapter will summarise the findings.

## **7.2 Case study of the fuel haulers in Saudi Arabia**

Fuel hauling is an important unit within the petrol supply chain in Saudi Arabia owing to the significant job that haulers provide, which includes driving for several hours to transport important and dangerous petrol and chemical products. In addition, managing hauling fleets and the delivery of orders are challenges facing fuel haulers in Saudi Arabia. There are several difficulties in managing hauling fleets such as, delays, trips scheduling, truck maintenance cost and scheduling plus safety regulations.

A hauler is an important member in the petrol supply chain in Saudi Arabia because, without licenced haulers, Saudi Aramco would not be able to distribute petrol and thus, petrol stations would not be able to supply petrol to consumers. Without a hauler, petrol stations would need their own trucks or need to request petrol from other petrol stations who own trucks and may have a surplus petrol quota to order fuel from Saudi Aramco. This becomes a long and complex process. Furthermore, the large size of the country also highlights the importance of hauling, given that the only means of transporting fuel to petrol stations in Saudi Arabia is by truck. The hauler is thus the link between Saudi Aramco and petrol stations.

The difference between fuel haulers and individual transporters is that fuel haulers must be licensed by the Ministry of Transport to transport petrol from Saudi Aramco, they should have five trucks or more, and have warehouses, offices, employed drivers and accountants to manage their fleets. However, individual fuel transporters - those having less than five trucks to supply their own petrol stations - were not included in the scope of research because, based on the Ministry of Transport regulations, individual transporters with less than five trucks are unable to get a hauling licence and are not considered petrol haulers.

The length of the existing road network in Saudi Arabia is approximately 60,000 kilometres. In addition, Saudi Aramco provides petrol to approximately 13,000 fuel hauling trucks each year. These trucks hardly stop and it has been estimated that these trucks run approximately 50 million kilometres per annum (Alalmai 2012).

The researcher interviewed the fuel hauling managers and owners of four hauling firms and a truck driver, the driver's job in all fuel hauling firms is the same, so one truck driver was interviewed to elucidate the

hauling process and the factors that influence fuel hauling in Saudi Arabia. The following section provides an overview of the participants in this research.

## **7.3 Participants**

There are four different managers and owners of the hauling fleets interviewed in this research. They were selected due to their extensive experience in fuel hauling and the size of their fleets to observe the substantive details. The following sections provided an overview of each participant and their company.

### **Hauler I: NT hauling fleet**

Mr Bader is the owner of the NT hauling fleet. NT has 150 trucks to transport fuel products (petrol 91, petrol 95, diesel and crude oil) from Aramco's petrol distribution stations to customers (petrol stations). NT has been in operation for 47 years and employs approximately 200 workers. NT is located in Riyadh, the capital city of Saudi Arabia, and recently become associated with a 3PL provider that has technology solutions for the petrol supply chain. Mr Bader stated the reason behind the association with 3PL providers is to expand NT's hauling fleet by providing high quality petrol hauling through the utilisation of technology.

### **Hauler II: NA hauling fleet**

Mr Nawaf is the CEO of the NA hauling fleet, which consists of 135 trucks and has 150 workers. NA hauling fleet processes between 100 to 130 fuel orders daily and transports three petrol products (petrol 91, 95 and diesel) to petrol stations, as well as private sector and government organisations. The age of the NA hauling fleet is 15 years. The location of NA hauling fleet is Riyadh. Mr Nawaf explained the government procedure to license a hauling fleet.

### **Hauler III: DB wholesale petrol station and fuel hauling fleet**

Mr Mansour is the owner of DB wholesale petrol station (Mr Mansour interviewed as part of chapter six, but he stopped retail petrol sales and invested in wholesale petrol stations). He now owns the DB fuel hauling fleet in Riyadh. Mr Mansour addressed interesting points that he had experienced in 60 years of operating this fleet, wholesale petrol stations and retail petrol stations. Mr Mansour explained that this wholesale petrol station sells daily more than 540,000 litres of petrol 91, 95 and diesel. He has approximately 120 hauling trucks to transport fuel to petrol stations and factories and he employs 135 workers.

### **Hauler IV: AD retail petrol stations and hauling fleet**

Mr Fares is the manager of AD hauling fleet with extensive experience over 28 years in fuel haulage. AD is a publically owned fleet with 1,100 trucks and 2,500 different containers. AD hauling fleet transports domestically and overseas to countries such as the Gulf Countries, Syria, Jordan, Lebanon and Turkey. AD transports; petrol 91, petrol 95, diesel and crude oil. There are approximately 1,500 workers at AD hauling fleet, which has been operating for approximately 51 years. However, because AD hauling fleet could not fulfil the demand, it outsourced hauling orders to individual transporters to meet all its customer obligations.

### **Truck driver: Mr Mahmoud**

Mr Mahmoud's experience extends more than seven years in fuel hauling as a truck driver. He transports fuel in both rural areas and metropolitan areas, travelling up to eight hours each day with a return journey in order to supply NS petrol station with fuel from Jeddah. He is an example of a fuel transporter who supplies fuel from Aramco's distribution stations. His job is the same as the fuel transport truck drivers in metropolitan areas in Saudi Arabia, except that the destination to Aramco's distribution stations is much further.

## **7.4 Fuel hauling process**

The process of hauling starts with petrol product orders procured via Aramco's website and the process ends with the unloading of fuel to the petrol stations' tanks. This section describes the standard process of fuel hauling, followed by the hauling licence procedures, which explains how to get a hauling licence based on government regulations, followed by operational process of hauling fleets, including hauling orders and fleet facilities.

### **7.4.1 Fuel loading process**

The hauling process is difficult. Truck drivers transport highly flammable petrol products such as petrol and diesel whilst being on the road up to eight hours per day. Mr Mahmoud explained the story of petrol transportation, which is the standard petrol transportation process in Saudi Arabia. He starts his transportation journey by performing a check-up on his truck, including meeting safety requirements. Mr Mahmoud prepares the safety uniform, which is a fire resistant uniform, consisting of a helmet, sunglasses and safety boots. The uniform is not supplied by Saudi Aramco. However, all fuel haulers must meet the requirements of Saudi Aramco to get the access to Aramco's distribution stations.

Once the truck is ready to travel, Mr Mahmoud receives a printed copy of Aramco's purchase order confirmation from the petrol station manager in which the loading time is specified. Mr Mahmoud decides to travel based on the travel time of six hours, as the distribution centre is approximately 450 km away, and the maximum speed of the truck must not exceed 80 kilometres per hour.

Upon arrival at Aramco's distribution station, Mr Mahmoud provides his ID, which allows him to access Aramco's distribution station, this check point is for security reasons and to let the driver access the main gate of Aramco's petrol distribution station. Mr Mahmoud stated that this security check is to prevent dangerous items from entering the station such as, gas cylinders, sharp tools and restricted devices. However, there is another check point which is an extra safety check. This check point is to check the driver's ID, which allows the driver to get in to the racks (fuel loading point) to load the delivered product. Mr Mahmoud stated that this ID is granted for truck drivers who complete Aramco's training sessions, which are provided by Aramco's safety specialists (truck drivers learn about driver safety and also to avoid all potential risks whilst in Aramco's properties or customer's trucks). The sessions teach the drivers the loading process and how to use technology devices installed in those platforms. The ID

needs to be renewed each year based on Aramco's evaluation of the driver's abilities when handling petrol products.

Aramco's safety specialists inspect a sticker, which is placed on the windscreen of the truck as proof of periodic maintenance. This also states the period for which a particular truck is allowed to transport petrol products. This period is specified based on the condition of the truck. For example, there are some trucks licensed for only three months because their models are old and need to be maintained more frequently than newer trucks. However, there are some trucks licensed for one year because those trucks are new and in excellent condition. The safety check point focuses on the presence of a fire extinguisher, the roadworthiness of the tyres, cleanliness of the truck containers and the general shape of the truck. Once the sticker approaches the expiry day, the truck driver should inform the safety specialist at Aramco to inspect the truck to highlight the issues that need to be maintained. This helps to avoid delays or prevent access to Aramco's petrol distribution station.

Once Mr Mahmoud has passed the check point he must make sure that the loading and unloading valves are closed properly and the pressure pipes are open on the truck. Mr Mahmoud then hands the printed Aramco purchase order to the station supervisor, who allocates the platform that Mr Mahmoud should load from. Mr Mahmoud stated here that making any errors whilst in Aramco will result in loss of his license to enter Aramco's distribution stations. Hence, Mr Mahmoud is keen to abide by all safety procedures, which includes the following:

- Parking the truck exactly next to the appointed petrol pump.
- Switching off the engine and take the key out and hang it on the designated place for truck keys.
- Placing a STOP sign in front of his truck.
- Engaging the two loading hoses in the container's holes and engaging another hose to pull the air pressure out.
- Engaging the electronic cable into an installed unit underneath the truck container, this should be connected to the pump to measure the quantity of petrol product loaded.
- Entering his driver ID number, purchase order number and the truck container number into the control panel of the petrol pump.
- Pressing the start button to commence the loading process.

Once the pump starts to load the product, the driver should stand next to the pump until the process is completed. The pump will not start if there is any mistake and it will show an error message. Then, the technicians would inspect the truck to find out whether the problem was with the truck or the pump. If it is the truck and potentially an electrical issue, the driver should cancel the order and leave the station to



fix the issue and book for another time. If the problem is caused by the pump, the technician should fix it on the spot. The loading process lasts for 45 minutes to load 36,000 litres. Once the pump loads the requested quantity, it will shut down automatically, and then the driver is allowed to remove the hoses and electronic cable from the truck's container and press the print button on the pump's control panel to get the receipt. The truck driver is then allowed to leave the station via the exit gate. Mr Mahmoud stated that the entire process from accessing Aramco's main gate to getting out takes approximately two and a half hours at off-peak times, but could take up to five hours during peak times. This process is the same for all haulers. However, the distance is different depending on the haulers or petrol station location. For example some haulers are located in the same city where Aramco's petrol distribution station is located, but some haulers are located in rural areas, some distance from Aramco's petrol distribution station.

#### **7.4.2 Hauling licence**

Mr Nawaf explained the generic government procedures that should be applied in order to operate as a fuel hauler. First, the owner should complete a business registration from the municipal ministry branch, which is located in most cities and villages, as well as pay the required fees to be granted business registration.

Second, according to the granted business registration, the owner should contact the Ministry of Transportation to issue a licence for fuel hauling. The Ministry of Transportation grants the hauling licence if the owner has at least five trucks with specific models, a warehouse for trucks and containers with a certain space, and employs the drivers and accountants.

Third, the owner draws up a contract with customers who need to be supplied petrol products, to document the required quota that will be purchased from Saudi Aramco.

Fourth, the owner should contact Saudi Aramco, which provides the quota of petrol based on the contracts between the hauler and his or her customers. However, Mr Nawaf stated that the hauler is not able to get the required quota based on the contracts because Saudi Aramco sees the quantity in contracts is much more than customers' need. For example, if the total of petrol quantity that is required based on the contracts between the hauler and the customers (petrol stations) is one million litres of diesel per day, Saudi Aramco rejects this quota because Aramco observes that this quantity is much more than the actual need. Hence, Aramco reduces the quota based on similar petrol stations' quota. However, Mr Nawaf argued that Aramco does not actually send inspectors to check the real customer's demand, and Aramco

does not communicate with the hauler's customers, therefore, the reduction of the quota is only based on predictions. This imprecision of petrol quota by Saudi Aramco negatively influences fleet hauling operations because the hauler must meet the needs of contracted customers, but he/she could not due to the imprecise petrol quota. This process is required for any hauler wanting to operate a hauling fleet in Saudi Arabia.

### **7.4.3 Hauling operation process**

Mr Fares explained the process of fuel hauling based on the fleet that he manages, which has more than 1,100 trucks to transport fuel and chemical products. This is considered a large sized fleet given that the minimum size of licensed fleets is five trucks. Mr Fares stated that every day he receives a detailed report stating the transportation plan for the entire fleet, which is provided by the direct supervisor and the managers via an intranet system and email. Mr Fares stated that customer's orders are known based on the contracts between the hauler and customers, thus there is no need to contact them via any system except email to update them or to receive enquiries.

Mr Fares stated that each type of vehicle in the fleet has a supervisor who monitors the trucks and customers' needs via phones and email. There are ten direct supervisors who update Mr Fares every day about hauling plans via email, with information such as the required quantity of petrol, type of petrol, location, and the schedule for available trucks and drivers.

Mr Fares explained that the fleet transports fuel to the AD petrol stations, which is owned by the company where he works. Every day, AD petrol stations report the required quantity of petrol. Those petrol stations measure fuel inventories by the same traditional methods discussed in Chapter five, 5.1.1. They then send their need to their supervisors via the email or by mobile phones. The AD petrol station's direct supervisor, who works under Mr Fares allocates the trucks based on the needs and the geographic location of the station. For example, when a petrol station in the north of Riyadh needs to be supplied with fuel, the supervisor sends the driver to load from Aramco's distribution station in the north to save time; if the petrol station is in the south of the city, the supervisor would send the driver to the southern distribution station. Sometimes the supervisor could change the driver's direction to a different petrol station due to the lack of product at that station and the urgent need for supply. This process is similar to supplying all petrol stations in Saudi Arabia. Mr Fares stated that his fleet does not cover all AD petrol stations due to the rapid expansion of AD petrol stations. Rather, his fleet is contracted with subcontractors to supply AD petrol stations.

Mr Fares stated that his fleet uses a database called Delivery Orders of Petrol (DOP). This database issues the loaded orders, drivers' names, their ID numbers, and truck information. This database help to distribute trucks based on the availability of trucks, and monitors the occupied trucks. This database is accessed by top managers and direct supervisors via limited access through a secured internet connection. Once the database extracts the tasks based on the available trucks and drivers, the direct supervisors then allocate the tasks to drivers via mobile phones. The delivery orders are then sent automatically to Mr Fares and the accounting department to prepare a receipt, which is forwarded to truck drivers as a hard copy and sent via email to customers. Mr Fares called this process the operation process. This operation process is based on AD fleet management and is not a generic operational process for all fuel haulers.

Mr Fares further explained that the fleet has truck workshops in different locations across the Kingdom. Each truck's information, such as vehicle model, vehicle registration number, container number, and vehicle history is saved in the database and linked via the internet with all branches. The fleet has different maintenance specialists to fix AD trucks. Each truck experiencing faults during its transportation task, is directed to the nearest workshop based on the nearest location. Once the truck arrives at the workshop, a job order is issued online, which states the truck's driver information, truck's information, a report of the issue, and the required time to be repaired. That information will be available for authorised personnel to update the truck information, and inform the customer if there is a delay in repairs. Mr Fares stated that most customers understand such issues, however, if the customer insists on receiving the delivery on time, another tuck is sent out to tow the container and continue the trip. Mr Fares said that, in order to avoid overstock issues, 'We have a database that links the warehouses to avoid duplication in purchasing truck parts. This helped us to avoid overstocking in our warehouses'.

Moreover, this helps to avoid duplication in buying auto parts because if the truck requires a part to be replaced, the workshop manager can check the warehouse database, which links all AD warehouses to order the part if it is in stock in any other branch. Mr Fares stated,

Mr Fares explained further, that there is another database called the tyre database in which each truck's tyre in the fleet is registered to be monitored from the day of installation to the selling or disposal of the tyre. This process is done via a valve installed on each tyre that calculates the distance that the tyre has travelled and the pressure in the tyre. The valve sends this information via 3G internet connection to the database updating the managers on the tyres condition. There are technicians that inspect the tyres frequently based on the truck history, which is saved in the database. The technicians decide whether the tyre needs to be forwarded to be recycled, fixed, dressed (to add another layer), sold or disposed. The workshops have machines to fix tyres, which is a preferred solution because tyres are the most expensive

and important part in the truck. Moreover, tyres are an important part of the safety inspection process at Aramco's distribution stations.

Mr Fares further explained that the AD hauling fleet has another database in which the truck's engine oil and filter replacement schedule is updated frequently and saved as part of the service history of the trucks. This database reminds the supervisors if the engine oil needs to be changed once the truck has reached 15,000 km based on the tyre valve calculator. Moreover, once a truck gets in the workshop, a total check-up service is reported to the workshop manager who records all updates in the database. AD hauling fleet has its own roadside service team who works 24/7 to provide any required assistance on the spot otherwise the truck will be towed to the nearest workshop.

Mr Fares stated that these processes to manage the fleet are crucial in order to keep the truck maintained, save costs, avoid delays in Aramco's stations and on roadsides, and to deliver orders on time. However, these processes are not advanced in all fleets. For example, Mr Mansour and Mr Nawaf manage their fleets based on a paper based management process in terms of operating the fleet to schedule deliveries as well as truck and tyre maintenance. Mr Nawaf stated that the fax and phones are the only method of communication with his customers (petrol stations). But he is planning to move to email and mobile phone in terms of management and communication process with the supervisors in his fleet, but not with his customers, because his customers are un-educated, as he stated:

Unfortunately I cannot use email to communicate with my customers because they are un-educated and most of my customers forward me to the foreign workers who operate and manage their petrol stations and they do not know how to use computers.

The next section discusses the findings of the three contexts of TOE (technology, organisation and environment) from the perspective of the participants.

## **7.5 Technological context**

This section discusses the technological context from the perspective of the fuel haulers' and truck driver's experience. Participants highlighted the importance of technology in the hauling sector and they discussed improvements they have noticed through the utilisation of technology. Moreover, they discussed the benefits that they aim to achieve by implementing further technologies within their fleets.

### **7.5.1 Relative advantage**

The participants discussed the advantages of technology from different perspectives. Participants' extensive experience in fuel hauling helped observe the role technology plays in improving fuel hauling quality and to increase customer satisfaction. Moreover, the utilisation of technology added value to the competitive advantage for their respective fleets. In this section the researcher analysed participants' citations based on the three types of technology (actual technology, traditional technology and information technology), as well as a technology wish-list for each fleet to clarify the advantages of technology in Saudi Arabian fuel hauling fleets, to improve the petrol supply chain.

### **7.5.2 Actual technology**

Hauling fleets face several issues in supply petrol to their customers. For example, Mr Bader stated that he faced several claims from his customers that fuel deliveries were incomplete. This is due to selling hundreds of litres of petrol by his truck drivers to some corrupt workers in petrol stations located on the way to the customer's petrol station. Given this issue, Mr Bader thought about technology to prevent truck drivers from selling petrol products to other stations. Mr Bader stated 'Real time GPS tracking system eliminated the fraud in my fleet'.

Mr Bader stated that once he faced the claims of his customers, he decided to install real time GPS tracking systems in all trucks in his fleet secretly. He contracted with a GPS technology supplier to install the devices in a secret place in trucks. No one knew where the devices were. Once Mr Bader installed the GPS system in his fleet, he monitored the trucks movements from his office. He realized that one of his drivers changed direction of his truck and spent approximately an hour in a place other than the customer's petrol station. Mr Bader investigated the issue with the truck driver and informed the driver that he was monitored on screen; the driver then admitted that he was selling about 200 litres to petrol stations other than the customer's petrol station, which was a regular issue occurs in NT fleet. Since that day all drivers in NT fleet know that they are being monitored, however nobody knows the device location. Delay and fraud incidents along the way, between Aramco's distribution station and the customer, were then eliminated. However, this technology is not utilised in all hauler fleets due to the lack of IT knowledge.

Mr Fares stated that GPS tracking systems were on a trial period for one year, and has been installed in 250 trucks with a target of 1,100 trucks within two years. Mr Fares also states that AD fleet installed electronic valves on each truck tyre to calculate the distance that the tyre travels. This valve sends data via a 3G network to the database in the Riyadh operations department to update the fleet managers about the tyre's condition. Moreover, Mr Fares stated that AD fleet has its own workshops with tyre machines such as, reamer machines and tyre sealing machines, utilised to maintain the trucks' tyres.

In terms of wish-list of technologies, when Mr Bader was asked about the technologies that he wants to install in his fleet, he stated that he would install flow meters to measure the fuel quantity that is loaded and unloaded from each trucks' container. This is because most customers do not know the quantity that is loaded in their tanks and because there is always fuel evaporation. Mr Bader plans to install these flow meters in his trucks to provide evidence of the exact quantity of loaded fuel and the level of evaporated fuel to give him a competitive advantage, and to increase loyalty with his customers. The cost of the flow meter has not been estimated at the time of the interview, but the process of installation would take approximately two weeks to be installed on 20 trucks as a trial period for six months, which would then be installed in the entire fleet within a year and half.

Mr Bader further explained that he faces uncertainty through customers (petrol stations) and their daily requirements of fuel because he relies on the history of customers' orders. However, the accuracy of this process does not exceed 30%. Thus, he asks his customers to inform him about their needs at least 12 hours in advance of delivery, so that he can order the fuel and transport it. When Mr Bader was asked how he contacts his customers and truck drivers he said, 'By mobile phone, we used to utilise two way radios but they are not useful in a sprawling country such as Saudi Arabia'.

Hence, Mr Bader stated that he is working on the automated fuel hauling project through a collaboration with an electronic fuel company, which provides electronic solutions for haulers and petrol stations. This collaboration will yield the 3PL provider based on electronic devices installed in customer's tanks. Those devices are flow meters and sensors, and will measure the tank's levels and then send a message to the 3PL provider via the 3G network. The 3PL provider will then be able to approach the petrol station based on the message that appears on the operation department's screen in which a map of the Kingdom is shown with a focus on the petrol station location and required quantity. Once the 3PL provider receives the message, the driver will be informed to supply the specific petrol station. Mr Bader stated, 'Those technologies will ease hauling processes, increase accuracy, add value and save time. We concluded trials in several petrol stations and it worked successfully'.

The successful combination of NT fleet and 3PL provider would increase the utilisation of technology in the hauling sector and petrol stations too. This is because the technology would be installed in petrol stations to be linked with operation centres at the 3PL provider and hence the technology would advance the petrol supply chain in terms of accuracy and time saving through petrol station supply chain automation.

### **7.5.3 Traditional technology**

Traditional technology has been discussed from different perspectives. For example, Mr Nawaf, the CEO of the NA hauling fleet, stated that he realised that technology is useful in most of the hauling process. That is, a fuel truck driver needs a flashlight in his pocket when he wants to inspect the container or various truck parts. Hence, Mr Nawaf purchased mobile phones with an integrated flashlight to be provided to all truck drivers in his fleet. Mr Nawaf stated, ‘This step increased the truck driver’s loyalty to the firm and it encouraged our drivers to check our trucks frequently’.

What Mr Nawaf meant by increasing the truck driver’s loyalty to the firm is that truck drivers barely save money for living expenses or much of their pay check goes to their families. Therefore, they do not have enough money to spend on phone calls or to even buy mobile phones. Thus, providing them with a mobile phone with credit to call their families encourages them to work harder because the firm shows that they value them. On top of this, they are able to contact the firm and supervisors at any time, which keeps them close to their managers and supervisors.

Mr Nawaf further stated that most truck drivers are un-educated, hence it is difficult for them to utilise the internet and emails. The only choice for contacting truck drivers in his fleet is mobile phones. Mr Bader supported this point of view and stated that most truck drivers in his fleet are un-educated and most of them cannot read and write, hence, it is not helpful to install devices that require reading and writing skills to respond to messages. Furthermore, Mr Mansour confirmed that his trucks’ drivers are also un-educated and this causes repeated mistakes in unloading fuel petrol at stations’ tanks. He explained that truck drivers occasionally get confused about what type of fuel they are transporting because of having several delivery jobs in each day. More so, because they are un-educated, they cannot read Aramco’s receipt and the petrol station worker cannot read it either. Thus, the wrong product could be unloaded into the petrol station tank, which then means the owner would need to pull up the entire 36000 litres from the tank. Although it is a mistake of the workers, Mr Mansour stated that he would not impose this cost on his workers.

As such, in terms of the technology wish-list; Mr Mansour, Mr Bader and Mr Nawaf highlighted the importance of technology, particularly Radio Frequency Identification technology (RFID), to solve the phenomenon of wrong petrol types being unloaded. They have knowledge about RFID because suppliers introduced this particular technology to them. They believe by utilising RFID technology, human mistakes in the unloading process will reduce because the RFID will read the product tags and the hose lid, and would only release the right product to be unloaded. However, only Mr Bader would apply the RFID in his fleet. Mr Nawaf and Mr Mansour stated that technology implementation is expensive and they would think about it carefully. Whereas Mr Bader said, ‘Technology is expensive to implement, however it is profitable for future outlook’

Hence, Mr Bader plans to spend approximately 60 million SR in technology implementation and fleet expansion over a period of three years. However, Mr Bader stated that he will increase transportation prices because he plans to provide an excellent service to satisfy his customers through the utilisation of technology, such as RFID technology, GPS and flow meters, which he plans to implement in his fleet. Mr Bader also discussed that if petrol stations do not accept the petrol transport price rises, he would not hesitate to change his focus to transport crude oil to manufacturers and government facilities only.

#### **7.5.4 Information technology**

Information technology (IT) is important in fuel hauling fleets for different reasons. Mr Fares, who uses IT in his fleet stated that he receives delivery order reports via email every day and his method of contacting his customers is via email. He further explained that the AD fleet is managed via an intranet database where all information is updated frequently. This reduces confusion in the fleet, particularly in the fuel hauling operations process, which aims to reduce lead time. Hence, the operation department receives orders via email and enters them into databases to appoint the available truck drivers and trucks to be directed to the right customer at the right time. Mr Fares claims, ‘Each day, I receive a detailed report explaining the delivery time, truck type, containers type, destination, expected time and drivers name by email’.

Mr Fares explained that this report helps him to correct any mistakes in directing trucks such as, the routes that drivers intend to take, and the time that they intend to move. Mr Fares stated that AD fleet has a database for each department and those databases are linked via secured intranet and internet networks. For example, AD’s workshop managers have access to a warehouse database to avoid overstocking. This helps to avoid duplication in buying auto parts because if the truck needs a part to be replaced, the



workshop manager should check the warehouse database, which is linked to AD warehouses to send the part if it is in stock. Moreover, AD fleet has databases for tyre management, oil engine and filter service schedules and truck maintenance reports and schedules. Mr Fares argued that information technology is crucial in order to keep the truck always maintained, save costs, avoid delays in Aramco's stations, and to deliver orders on time. Mr Fares said, 'We have databases for each department and this links me with the firm's department and helps us to find all information through a few clicks'.

Furthermore, Information and Communication Technology (ICT) was highlighted as an important factor in NT fleet. Mr Bader stated that he utilises BlackBerry mobile phones to manage and contact operation departments and Saudi Aramco. Mr Bader said, 'I usually use BlackBerry messenger to contact the operation manager and Saudi Aramco's complaints department'.

Mr Bader explained that he communicates with his employees and managers by BlackBerry messenger because in hauling firms, managers and employees are constantly moving from their office to warehouses to inspect trucks or meet drivers. Hence, they cannot respond to phone calls from their offices, but they can response to messages in their BlackBerry anytime and anywhere. Moreover, Aramco specified a BlackBerry PIN number, which is a unique personal identification number, to respond to customers' complaints in real time where possible. Additionally, Mr Bader hinted that BlackBerry messages are evidence of communication with Saudi Aramco or his managers and employees. He says that it is like sign off in formal management.

### **7.5.5 IT infrastructure**

Most devices utilised in the hauling sector rely on the internet via ADSL modems and 3G. Most of the metropolitan areas where the interviews were conducted have ADSL modems and are covered by 3G connections. The fleets that utilise IT are equipped with internet modems in the office. According to the interviewees, Mr Nawaf, Mr Bader, Mr Mansour and Mr Fares, internet access is available in metropolitan areas. However, in rural areas there are some areas that are not able to access the internet utilising 3G connections, particularly along national highways where truck drivers travel through regularly. Mr Bader said, 'We utilise walkie talkies to contact our drivers when mobile reception is weak'.

For example, Mr Mahmoud, a fuel hauler in the rural area, stated that the petrol station that he supplies is approximately 80 Km from the main national highway (Makah national highway). The full 80 km is not

covered by 3G and mobile phones lose reception in this area. However, in metropolitan areas the access to the internet is available on highways and in the cities because 3G networks are available.

Mr Fares stated that AD's fleet workshops are located in different regions of the country and their databases are linked via intranet and internet networks. Moreover, Mr Fares stated that all departments at AD fleet are linked to the AD main server in Riyadh.

Mr Bader stated that NT fleet corresponds with Saudi Aramco and customers via email. Mr Bader said, 'We usually contact our customers and Saudi Aramco by email for formal correspondences such as delivery orders and contract updates'.

In terms of computer software, Microsoft Outlook is the software that is utilized for delivery schedules and management appointments at NT fleet. Mr Bader stated that Outlook is the software in which all appointments and delivery schedules can be organised. Moreover, Mr Bader stated that his fleet utilises electronic invoices and receipts to avoid fraud which occurs with manual receipts. Furthermore, Mr Nawaf stated that recently he replaced 20 old PCs with latest PCs because he realised that the firm's PCs were old and slow. Mr Nawaf stated that he invests in technology to improve and speed up productivity.

Given this, the internet which is a form of IT infrastructure is generally available in hauling fleets and this assists them to save communication costs and reduce response times. In addition, the utilisation of IT in hauling fleets assisted the petrol supply chain by connecting with customers (petrol stations) and the provider (Saudi Aramco) because the IT infrastructure in the hauling sector has different ICT channels such as, internet, mobile phones and computer software. This potentially increases the linkage between the supply chain members based on the available IT infrastructure.

This section discussed the positive influence of technology in order to enhance fuel haulers' fleet operations management. Technology such as GPS helped to eliminate fraudulent behaviour among truck drivers. In addition, the databases were useful to minimise parts overstock and provided easy access to trucks' information that include a truck service check history. The IT infrastructure in the developed haulers' fleets indicated in rural area is obviously less than urban areas. The next section discusses the organisational context.

## **7.6 Organisational context**

According to the participants, there are several factors in regard to the organisational context. They highlighted the factors that contribute to, hinder, or help the petrol supply chain in the Saudi Arabian fuel hauling sector. The factors reported in this section are culture, firm size and firm resources.

### **7.6.1 Culture**

Culture is mentioned as a factor that influences the fuel hauling operations management. Mr Bader mentioned that some rural petrol stations that his fleet supply are not interested in applying technology in their petrol stations. This would be technology such as fuel automated systems, which are provided by 3PL providers and would be linked with the NT fleet to automatically update the fleet about the required quantity of fuel. Those petrol station owners are typically not educated or they have attained a low education level, thus, they are not interested in profits as much as they are looking for social interaction. These owners claim that owning a petrol station is a social interface for them, which reflects their wealth. Mr Bader said, ‘There are some petrol station owners that are not interested in profit; instead they are looking for wealth appearance amongst their community and this is due to the poor educational levels that they achieve’.

According to Mr Bader, most customers in the capital city of Riyadh are interested in technology as long as it is installed by contractors such as the NT hauling fleet. Mr Bader stated that his customers in Riyadh are petrol stations and cement factories where their demand on petrol is high, which obviously means that their revenue is high.

In addition, Mr Bader stated that Aramco’s employees treat his truck drivers arrogantly because the drivers usually do not understand Aramco’s employees. Language is an issue in dealing with foreign workers, therefore Aramco’s employees find some difficulties in dealing with non-Arabic speakers. However, Aramco’s employees try to explain it by saying that when there is a delay at the distribution centre it is not helpful in dealing with those foreign drivers. Therefore, Mr Bader stated, ‘Our drivers would understand if they were treated respectfully’.

Interestingly, Mr Mahmoud is an Arabian truck driver and confirms the arrogant way that Aramco’s employees treat him in the petrol distribution station, in the western province. He explained that he drives approximately 14 hours (return trip) to supply fuel to the MS petrol station in a rural area. However, if

there is a delay at the distribution centre and he wants to ask about the reason of the delay, Aramco's employees ask him to sit down and be quiet. When Mr Mahmoud asked if language is an issue between truck drivers at Aramco's petrol stations he said, 'I am an Arabian driver and I understand their language. All we need is good treatment'.

This highlights that language is not the only issue; however the treatment of truck drivers is an issue at Aramco's petrol distribution stations. When Mr Mahmoud was asked about the nationality of Aramco's employees, he said they are Saudis. This highlights that there is an issue of organisational culture within Aramco that impacts on how truck drivers are treated.

### **7.6.2 Religion**

Religion is one of the factors addressed by participants that influence the hauling process. Mr Mansour explained a story that occurred in his wholesale petrol station. He stated, once Athan (the Islamic call to prayer) is announced, petrol stations must be closed in accordance with government directives. However, DB wholesale petrol station must serve for 24 hours and supply fuel continuously because the DB is considered a wholesale petrol distributor. DB wholesale petrol station sells more than 3.6 million litres of petrol per day. This means that hauling trucks are expected to arrive at any time.

Once DB fleet's truck driver arrives to the wholesale petrol station during prayer time, he should switch-off the truck and park it in the designated unloading zone. Because it is prayer time, all workers should be in the mosque for prayer. The truck driver should also do so, because the regulation states that no one should stay in the working area during prayer time. After the prayer, which lasts approximately 20 minutes, has ended the petrol station workers return to the petrol station and then start to unload the fuel. However, they may not be sure of what fuel product is in the truck. They could ask another worker at the petrol station or they could guess the product type.

Therefore, there is a possibility that they could unload the incorrect fuel product into the tank because they could not read Aramco's delivery receipt, which is locked in the truck during prayer time, and they did not wait to ask the truck driver what fuel product he was delivering. This highlights that there can be delay or errors caused by closing the petrol stations for prayer time.

Mr Mansour further explained that the driver sometimes makes mistakes due to the length of hauling trips the driver spends most of his energy concentrating on driving, and some drivers being uneducated cannot read the receipts. In the case of errors, the unloaded fuel must be taken out of the tanks and resold to

Aramco's distribution station as diesel, and then, Aramco would ship it back to the refinery to be refined. However, the cost of unloading and refuelling would then be borne by Mr Mansour because he treats it as an honest mistake as his workers are trying to save time. Mr Mansour said, 'The workers cannot read the receipt and they did not mean to mix the products, this all happened accidentally. So it is not reasonable to afford the cost to them especially when the cost is thousands of Saudi Riyals'.

In addition, Mr Mahmoud argues that he faces a delay of one hour when he arrives at Aramco's gate. It was prayer time and everyone is praying (including himself). Although prayer time usually is half an hour, there is a regulation by the Ministry of Labour that requires employees not to work continuously for more than five hours. Employees are to have pauses in work of no less than half an hour for each break, or an hour and a half during work hours, for resting, eating, and praying.

### **7.6.3 Firm size**

The researcher focused on large haulers because, according to the Ministry of Transport, the transporters who own less than five hauling trucks are not considered haulers, based on the formal definition of haulers provided in chapter 7.2. However, individual transporters, that own less than five trucks, supply fuel to their own petrol stations and contract with one or two other nearby petrol stations to supply them with fuel.

Mr Bader considers the size of haulers in the Saudi Arabian petrol supply chain a strength because it is better for haulers to be bigger in size so that Aramco does not have to focus on hauling fuel because their focus is selling fuel. Petrol stations on the other hand would not be supplied if they do not own trucks. Furthermore, Mr Fares claimed that the firm size of the Saudi Arabian fuel haulers is still in its infancy because the demand is more than the supply. Mr Nawaf agreed that the demand is more than the supply because his fleet transports more than 540,000 litres per day but his fleet consisting of 135 trucks, was still unable to meet his customers' fast increasing demand for petrol products. Given that the demand on petrol is more than the supply, subsequently fuel haulers need to expand the firm size of their hauling fleets in order to meet this demand.

Owing to the increased demand on petrol products domestically, the present number of hauling fleets (including the number of trucks and employees) in Saudi Arabia does not meet customer demand and more haulers are needed. The size of the fuel haulers' fleet of trucks is an important factor that affects the petrol supply chain due to the intensity of demand on petrol products and the shortage of fuel haulers.

#### 7.6.4 Firm resources

Another important organisational factor is firm resources, which includes drivers and the valuable petrol products they transport. Moreover, these products are risky, flammable and subject to evaporation. On top of that, trucks are an important firm resource owing to their high cost. Hence, the participants agreed that firm resources, which includes petrol products, trucks and truck drivers, is an important factor that influences their fleet's performance.

Mr Fares highlighted that the AD fleet has been awarded the certificate by the International Organisation for Standardisation in safety standards (ISO). This is because Mr Fares is keen to protect his fleet and drivers as they are an important firm resource to him. When the researcher asked Mr Fares about the importance of truck drivers in his fleet he answered, 'I agree with Aramco's safety regulations because it helps to protect our trucks and drivers'.

Moreover, the periodic truck check-ups help to reduce truck maintenances and minimise the risk of accidents on the roads. Hence this helps to protect trucks, the petrol product and the driver's safety as firm's resources.

Mr Bader explained that evaporation of fuel is unavoidable. However, some haulers procure fuel from Aramco of the total quota that is allocated by Saudi Aramco and store them in a warehouse (truck containers parked in the fleet's warehouse) for a couple of days. This leads to an increase in evaporation which ranges from 100 litres to 500 litres for each truck within three days of summer. This means the delivery of 36,000 litres could be delivered to the customer as 35,500 litres. However, the customer would pay for the full 36,000 litres because the customer would not notice the shortage and the hauler would not inform him of the potential shortage.

Mr Bader expressed that this way is cheating and is not helpful into the fuel haulers sector because fuel must be procured and delivered from Aramco's distribution station to the customer on the same day, otherwise, it would be wasting the firms resources (petrol products) due to the evaporation of the product.

Mr Nawaf agreed and further explained the evaporation phenomenon as wastage of a firm's resources for the end customers (petrol stations). Mr Nawaf claimed, 'When the approximate evaporated quantity of fuel -each truck- is 500 litres in three days, this means 5,000 litres per month, which costs 3,250 SR. Hence, you can imagine how much money is paid for evaporated fuel from hundreds of trucks'.

In addition, Mr Nawaf and Mr Bader highlighted that the truck drivers are also an important firm resource in the hauling sector. Mr Nawaf argued the encouragement of truck drivers is crucial in the fuel hauling

sector because without them the work would not be completed and the entire supply chain would be disrupted. Hence Mr Nawaf visits truck drivers and asks them about their requirements, such as bonus. Mr Nawaf explained that he encourages truck drivers through bonuses and gifts when they achieve targets each month because he aims for more than 3,900 deliveries per month.

Mr Nawaf further explained that one of the drivers gained the certificate of the best truck driver in the middle region of Saudi Arabia. This certificate is awarded by Saudi Aramco each month for drivers that have abided by Aramco's rules and safety regulations. Mr Nawaf met this driver and encouraged him in front of his colleagues, gave him a mobile phone as a gift and posted his photo under the firm's logo on the entrance of the firm's gate. Mr Nawaf expressed that this way of encouragement would increase the driver's motivation to exceed the firm's targets and increase the firm's profit and at the same time it would provide the driver confidence in his work because his effort is appreciated by the firm. This highlights the importance of the drivers as a firm resource.

This section discussed the influence of the organisational factors in the Saudi Arabian petrol supply chain. Culture, which consists of educational level, language and unethical behaviour with customers are issues influencing the hauling sector. Religion has been linked to delays for truck drivers and customers by taking the required prayer breaks. Furthermore, firm size showed that demand for petrol is more than can be supplied in the hauling sector owing to participants not being able to fulfil customers' orders although they have more than a hundred trucks and employees in their fleet. Firm resources show that there are important resources that need to be considered such as, truck drivers, trucks and petrol products.

## **7.7 Environmental context**

In order to understand the environmental factors that influence the Saudi Arabian petrol supply chain, the researcher explored three important factors (i.e. geographic location, competition intensity, and government regulations) among fuel haulers. Exploring these factors will help to diagnose the Saudi Arabian petroleum industry, thus will lead to petrol SC integration.

### 7.7.1 Geographic location

Mr Fares explained that AD fleet utilises 1,100 trucks and 2,500 containers to transport different petrol and chemical products domestically and internationally. However, his fleet and the other haulers cannot fulfil the demand of the hauling services (internationally) because AD fleet and the other haulers are specialised in road transporting services only. Thus, they cannot reach long distances, especially to overseas countries. Hence, he contracted with a third party (sea hauler) to transport chemical products overseas. Mr Fares stated that the ship's capacity is approximately 70,000 tons and a small shipment boat's capacity is approximately 50,000 tons of petrochemical products. Mr Fares claimed:

We have contracted with 3PL haulers because I cannot fulfil domestic and international orders. But we should do this because the petrochemical companies that we are contracted with want to export their products overseas and we are committed to do so.

Mr Fares further explained that AD fleet allocated 94 trucks for the AD chain of petrol stations, however most petrol stations outsource to sub-contractor haulers, which highlights the shortage of fuel transportation providers domestically too.

Mr Fares stated that he prefers to haul petrol to manufacturers rather than petrol stations because petrol stations are located in a city, which is crowded and traffic jams cause delays, whereas factories are located outside of the city, which makes it easier to deliver shipments on time. Mr Fares said, 'Owing to the traffic that usually occurs on city roads, such as Riyadh city, we prefer to transport to large factories located outside of the city where roads are easier and faster and profit is higher'.

When Mr Bader was asked how far his fleet would supply, he explained that he transports to the borders of the UAE because AD fleet is licensed to transport up to the borders of the UAE (the middle and eastern regions) The distance to the UAE borders from Riyadh is approximately 550 km. However, he cannot supply other regions except for Riyadh region and related villages, and petrol stations that are located on the western highway through the western region right up to the borders of the UAE. If he went beyond his designated border he would be fined by the Ministry of Transport. Mr Bader explained that this is because there are fuel haulers in other regions licensed to haul petrol for other certain regions. However, these haulers in other regions were not able to meet customers demand. Hence, the designated borders were considered a geographic issue that influenced the petrol supply chain.

Mr Nawaf stated that one of the issues that influences the hauling sector is the geographical distance to Aramco's distribution stations, especially in rural areas. Great distances cause a reduction in the truck's



productivity. This would lead to the high cost of truck maintenance and tyres damage. Tyres cost approximately 2,300 SR per tyre and the truck has ten to fourteen tyres, depending on the truck and container size, so approximately 23,000 SR would be the cost of ten tyres once tyres need to be replaced. When the truck travels on the national highways tyres should be replaced approximately each year for the low quality tyres and approximately each two years for the higher quality tyres. Mr Nawaf says,

I wanted to establish a fleet in the north region, however the location of Aramco's distribution station in main cities such as Tabuk made me think again about the transportation costs such as, petrol, tyres and truck maintenance; thus I decided to not go for it. Tyres replacement would cost me about 23,000 SR.

Mr Nawaf stated that the destination of Aramco's station is approximately 530 km. This distance is considered as an obstacle for haulers owing to the long routes that trucks would run for each delivery, which in turn increases the cost of hauling, such as tyre wear and tear, fuel consumption, and truck life depreciation.

### **7.7.2 Competition intensity**

Competition intensity was an important topic discussed by all participants. They discussed the competitive environment from different perspectives, such as: the size of competition; hauling sector competitive environment; technology as a competitive advantage within haulers fleets; and the relationship with customers. On this subject Mr Bader stated that, 'There are approximately 15 large size hauling firms in Riyadh and several individual haulers who own two to three trucks to supply a petrol station or two'.

Mr Bader highlighted that his fleet had supplied 180 customers in Riyadh for 15 years. However, costumers are increasing and he would like to supply to them by increasing his fuel quota from the Saudi Aramco. However, Saudi Aramco rejected an increase to his quota to supply more than 180 customers because Saudi Aramco wanted to allocate the quota to fuel haulers evenly. According to Mr Bader, each hauler should have a certain quota that he cannot exceed without proof of contracts with customers. This would address the demand to Aramco who would then decide to accept to increase the quota or not, but Mr Bader said, 'I proved that I am contracted with several customers and addressed the demand of each petrol station, however Aramco declined to increase my quota and I really do not know why'.

Moreover, Mr Nawaf confirmed that there is a remarkable increase on the reliance on the hauling sector and his current capacity is approximately 130 deliveries per day and each delivery is 36,000 litres, but this amount can vary depending on the size of the truck containers in the haulers fleet. Mr Nawaf claimed that he is unable to commit to an obligation with several customers due to inability to increase his quota, thus these customers need to contract with individual transporters nearer to their locations, which leads to delays and a perceived lack of professionalism in fuel hauling. This then would affect the competitive environment by providing poor service quality, which eventually would lead to dishonest competition.

In terms of the issues that occur in the hauling sector competitive environment, all participants described it as an honest environment. Mr Mansour claimed that the hauling fleets are totally owned by Saudi investors because Saudi Aramco does not supply foreign investors to trade in petroleum products. Mr Fares explained that the hauling sector is a respectable environment and has no problems with competitors because competition is still in its early stages and competitors are barely fulfilling all orders to their customers. According to Mr Bader, in Riyadh city there are only 15 large size haulers. Therefore, the competitive environment is too small to have issues in terms of competition against each other.

On the subject of technology in haulers' fleets as a competitive advantage, Mr Fares stated that AD fleet has increased the quality of customer relationship by utilising technology. For example, the utilisation of emails to update customers about the status of scheduled deliveries has enhanced the relationship with customers. Mr Bader stated that NT fleet supplies one of the largest cement manufacturers in Saudi Arabia that orders 30 deliveries of crude oil each day to operate the factory. This manufacturer has been contracted with NT for nine years and will extend for an extra three years, due to the benefits that NT provides through technology utilisation. Technologies include, but are not limited to: GPS tracking systems; tyre valve control devices; and automated fuel systems to update the fleet about the required fuel delivery automatically. Therefore, Mr Bader described this step towards his success of adding value and maintains his valuable customers through technology.

Moreover, Mr Bader addressed that he is keen to deliver the required quantity with the minimum rate of evaporation by delivering orders immediately from Aramco's distribution station to his customers. Mr Bader claimed that his trucks' containers are isolated by thermal insulation to reduce heat, and as a result the evaporation rate is kept to a minimum. Hence, his customers are satisfied about the service he provides as long as the evaporation quantity is reduced as much as possible.

Furthermore, Mr Bader claimed that large haulers are keen to sell old containers to containers manufacturers as second hand to be recycled, but not to individual transporters. This is because when the individual transporters utilise these old containers for fuel hauling, Aramco would be stricter on the safety

regulations because the containers are not suitable for fuel hauling. This affects the haulers and may cause an increase to the safety requirements at Aramco's end, which may cause extra delays within the petrol supply chain.

### **7.7.3 Government regulation**

A government regulation is a significant factor that influences the fragmented fuel hauling sector in Saudi Arabia. Participants focused their discussion on Saudi Aramco as a state owned company, which is the only fuel provider in Saudi Arabia. All participants claimed that the monopolisation of fuel distribution in Saudi Arabia is not reasonable because Saudi Aramco is busy with exporting crude oil to meet the international demand. This causes poor quality customer service in term of local fuel distribution stations.

Mr Bader stated,

If someone has a flower in his farm would he take care of the flower or the farm? Definitely he would take care of the farm because it has the greatest benefit. Similarly, Saudi Aramco is busy with the international market and neglects the local market.

Mr Nawaf also agreed that Saudi Aramco's success in terms of operations management and supply chain excellence is obvious globally but not domestically. Mr Nawaf claimed, 'Saudi Aramco's excellence in oil production and exporting is not comparable with the local market'.

The focus of Saudi Aramco on crude oil and the advanced exploration, production and exporting transactions, has led the company to be one of the leading companies in the oil industry, oil production reaching approximately 9.4 billion barrels per day. Hence, the reputation of Saudi Aramco is seen as excellent, internationally. However, Mr Bader and Mr Nawaf also hinted to the issues that occurred in the Saudi Aramco's domestic management and regulations that negatively influence the hauling sector.

The participants described the issues that they face when dealing with Saudi Aramco. Mr Bader claimed that the centralised management in Aramco causes delays in terms of contact and response between Aramco and haulers. For example, Mr Bader stated that he needs to contact the sales department in the middle region, which is allocated to Riyadh for any request or inquiry such as increasing the quota or fleet documentation enquiries.

However, Saudi Aramco's department in Riyadh then needs to contact their headquarters, which is located in the western region where the decision is made. This process takes between several weeks and months to be completed. When Mr Bader asked the Riyadh department about the reason for the delay he gets forwarded to a chain of employees' phone numbers to approach the appropriate person. Then he found that the appropriate person is on a vacation and the decision would not be made until the employee gets back. This led him to send an employee to Aramco's department in Riyadh to follow their requirements personally to avoid unnecessary delays. Hence, one of the big issues is centralisation and the lack of communication between Saudi Aramco and the haulers.

All participants claimed that they are not satisfied with the allocated fuel quota by Saudi Aramco. Mr Nawaf claimed that Aramco predicts the required quota though he provides the contracts with the customers as proof of the needed quota. Therefore, Mr Nawaf suggested linking petrol station meters with Aramco to be precise in judging the required quota or to employ people to read meters instead of predicting the required quota, however he stated, 'I cannot argue with Aramco because it is the only provider of petrol. So I do not want to lose them'.

Mr Nawaf claimed that he would prefer not to argue with Saudi Aramco because this would involve more delays or obstacles in regards to fulfilling his requirements or requests from Aramco. Therefore, he prefers to be flexible with their regulations and management processes because he has no choice given that Aramco is the only provider of petrol in Saudi Arabia.

Another issue that participants highlighted was the procurement process that must be paid 14 days in advance. Mr Bader stated that he froze approximately one million SR each day to book his allocated quota 14 days in advance because he delivers fuel for one million SR each day. He argued that he thought that the reason for an advance payment is to allow Aramco to predict future demand on each petrol product and help them identify the quantity that should be refined and distributed. However, sometimes his drivers call him and state that there is a delay due to a shortage of products which causes a six hours delay. Mr Mansour confirmed the same issue in his fleet. This indicates that the payment in advance is not to predict the domestic demand. In addition, there is a gap in communication between top management and workers, which is caused by the centralised management style in terms of domestic operations management. This appears the reason behind these issues in Aramco's stations

Mr Mansour explained that Aramco's centralisation causes a gap in communication between the haulers and the decision makers at Saudi Aramco. For example, the CEO of Saudi Aramco would not know that there is shortage of fuel products in Riyadh or at any distribution station elsewhere unless someone calls him and informs him of the issue. However, it is next to impossible to reach him because of his

responsibilities with international oil trade and production; hence it is reasonable that he does not know what happens in Aramco's distribution stations.

In terms of issues related to management system, bureaucracy was considered an issue that hinders fuel haulers and influence in petrol supply chain in Saudi Arabia. Mr Bader explained that in 1988 the Saudi Arabian Marketing and Refining Company (SAMAREC) was established by the government to organise the oil industry in Saudi Arabia, focusing on local production, refining and sales. Aramco's responsibilities at that time (1988) were producing crude oil and marketing that crude oil internationally. SMAREC responsibilities were to manage and operate the refineries and supply the local and international market with petrol, diesel and kerosene, minimising production cost where possible. SMAREC were also to distribute petrol products in Saudi; to oversee the refineries shared between Petromin and global oil companies, such as Shell in Jubail city, Petromin and Mobil in Yanbu city, Petromin and Petrolla in Rabigh city (Alsaud 2012).

All refineries were merged and centralised with one management department reporting information about the quantity, product type and location of the refineries. SAMAREC's reputation increased internationally and new buyers approached the company due to the good reputation achieved (Alsaud 2012). However in 1993 SAMAREC was terminated by a Council of Saudi Ministers' decision to allow Saudi Aramco to take the control of the oil industry in Saudi Arabia as a State-owned oil company. All oil processes and operations management, including production, refining, hauling and distribution domestically and internationally was given to Aramco to be the only company responsible for the oil industry in Saudi Arabia (Alsaud 2012).

This highlight that bureaucracy caused unnecessary processes, such as centralisation, that led to delays in petrol supply chain and operations management in fuel hauling sector.

In summary, geographic location, competition intensity and government regulation have been observed by haulers as environmental factors that influence the hauling sector. This section deliberated the environmental issues that haulers face owing to the geographic location of Aramco's petrol stations. Moreover, the geographic location of customers (petrol stations) is another issue that haulers stated. In addition, Mr Fares explained how outsourcing some orders to sub-contractors helped him to maintain his customer obligations, which highlighted the role of 3PL providers in fulfilling the demand that exceeds the supply as confirmed by all participants.

This section discussed the competitive environment, which haulers described as an honest environment. Owing to the large size of the haulers' fleets, in contrast with individual fleets, the competition is

positively influenced because individual haulers are able to fulfil the shortage that is accrued by large hauling companies that outsource deliveries that they cannot fulfil.

The influence of government regulations especially Aramco’s regulations on haulers and the issues that occur in the hauling sector due to Aramco’s regulations were discussed in this section. A shortage in petrol products and delays at Aramco’s distribution stations were highlighted as significant issues in the fuel hauling sector. In addition, participants claimed that they wanted to increase their quota of petrol to fulfil the increased demand on petrol products. However, Aramco rejected these requests because Aramco decided they have provided the necessary quota. Moreover, this section discussed the bureaucracy including management hierarchy and centralisation as issues influencing operations management and SCM in fuel hauling sector in Saudi Arabia.

To summarise, this chapter investigated four haulers and one truck driver to explain 1) the role of haulers in the petrol supply chain, and 2) the hauling process itself. Moreover, this chapter deliberated many different factors, Table 7.1 summarises the major findings of chapter seven.

Table 7.1 illustrates the major findings of fuel haulers.

<b>Technology</b>	<b>Organisation</b>	<b>Environment</b>
Technology influences large hauling fleets owing to the complexity of hauling fleet management	The demand for fuel transportation exceeds firms’ readiness, so that fuel haulers outsource fuel transportation and logistics operations to other fuel haulers and transporters	Geographic location identified as an issue for haulers due to the large land area of the Kingdom which results in minimising the trucks efficiency and maximising the maintenance costs
Technology has been found as an important competitive advantage for NA fleet when contracted with technology TPL providers	Lack of knowledge in business management and IT amongst the fuel haulers is considered an issue that hinders petrol supply chain integration	Competition among fuel haulers has been described as straightforward competition
IT infrastructure in hauling sector in rural areas is less formed than metropolitan areas; this is similar to petrol stations	Language and uneducated truck drivers were found to be issues influencing the operational performance in hauling fleets	The centralisation of Saudi Aramco’s management causes delays for customers and leads to a lack of communication between top level management and lower level management

Technology was highlighted as an important competitive advantage for fleet operations management. The IT infrastructure in the developed haulers fleets indicated in rural area is less formed than urban areas, which is similar to petrol stations. Then the organisational context which explained the factors that influence the hauling sector, and included culture, religion, firm size and firm resources. Each factor of the organisational context was significant in the hauling sector with the most significant finding that the demand on petrol products domestically is more than supply.

The last context associated with the findings is the environmental context in which the participants addressed the issues relating to the factors of geographical location, competition intensity and government regulation. The geographic location was stated as an issue for haulers due to the huge size of Saudi Arabia, which results in reducing the trucks' productivity and increasing the maintenance costs. Competition environment between fuel haulers was described as honest. However, given that Saudi Aramco is the only provider, this highlighted the lack of competition between providers. The researcher addressed government regulation in which all participants addressed dissatisfaction with Aramco's customer service. They explained that the reason is the centralised management of Saudi Aramco. Centralisation causes a gap between Aramco's top management and workers. The next chapter discusses the case study of Saudi Aramco.

# **Chapter 8 - Saudi Aramco**

## **8.1 Introduction**

This chapter outlines the research conducted through five interviews with managers, supervisors, technicians and engineers in the primary petrol supplier in Saudi Arabia (Saudi Aramco). The findings of these interviews are presented as a case study to represent how petrol is provided by Saudi Aramco to the haulers and petrol stations. Moreover, the findings demonstrate the issues that influence the petrol supply chain in Saudi Aramco, in the daily operations management.

Additionally, this case study diagnoses the factors of technology, the organisation and the environment that influence the petrol supply chain of Saudi Aramco operations management. This chapter starts with a background of Saudi Aramco which is followed by an overview of participants. Then the findings of the three components of TOE are discussed from the perspective of participants, followed by a summary of this chapter.

## **8.2 Background of Saudi Aramco**

Saudi Aramco's origin goes back approximately eight decades. In 1933, one year after Saudi Arabia's unification in 1932, the government of Saudi Arabia granted a concession to Standard Oil of California (SOCAL), the parent company of Chevron. Moreover, there was a joint-venture with several major oil companies besides SOCAL such as, California Arabia Standard Oil Company (CASOC) which is one of SOCAL's companies. In 1936 Texas Company (Texaco) was a 50 per cent joint-venture with SOCAL. After two years of the concession in 1938, oil explorations increased dramatically and in 1939, oil was discovered commercially, with the popular well named Dammam Number Seven. Then, King Abdul-Aziz visited Ras Tanura to inaugurate the first shipload of Saudi crude oil ever exported.

In 1944 the joint-venture became known as ARAMCO - the Arabian American Oil Company. However, in 1948 Standard Oil of New Jersey and Socony-Vacuum Oil Company, which nowadays is known as ExxonMobil, made a joint venture with ARAMCO too. Nonetheless, the Saudi Arabian government owned 25 percent of ARAMCO in 1973, which it increased to 60 percent in 1974. Eventually, in 1980 the Saudi Arabian government owned 100 percent of ARAMCO's assets. In November 1988 the Saudi Arabian government announced the foundation of Saudi Aramco which undertook the responsibilities of



exploration, production, refining, distribution, shipping and marketing. Therefore, Saudi Aramco became a state-owned oil company of the Kingdom of Saudi Arabia (ARAMCO 2013a; MOPM 2013).

However, due to the attention of the government towards petrochemical and oil derivatives Saudi Aramco formed a joint-venture with several oil and petrochemical companies. For example, in August 2005, Saudi Aramco formed a joint-venture with Sumitomo Chemical to construct and operate a large refining and petrochemical complex in Rabigh, which is an industrial city along the Red Sea coast, in western coastal region of Saudi Arabia, to expand the diversification of petrol production and therefore Saudi Aramco was recognised as a crucial business partner for the Japanese energy industry (Kobayashi 2007).

Nowadays, Saudi Aramco is a fully integrated global petroleum and petrochemical enterprise. It is a world leader in oil exploration, production, refining, distribution, shipping and marketing. Saudi Aramco has maintained the top position in The Petroleum Intelligence Weekly's annual world oil company ranking since the ranking began in 1988 and it is perceived as the most powerful oil company globally, given the fact that Saudi Arabia is the largest oil producer and holder of oil reserves in the world (Kobayashi 2007).

The daily production of crude oil in 2011 was 9.1 million barrels per day based on the latest statistic on the Saudi Aramco website. There are more than 55,066 employees in Saudi Aramco, which is headquartered in Dhahran, in Eastern Province of Saudi Arabia, bordering the Arabian Gulf (ARAMCO 2013a). Table 8.1 demonstrates the Saudi Aramco's refineries and Joint-venture refineries.

Table 8.1: Saudi Aramco's refineries and Joint-venture refineries (Saudi Aramco, 2010)

<i>Refinery</i>	<i>Owner</i>	<i>Capacity</i>
<b>Ras Tanura</b>	Saudi Aramco	550,000 bpd
<b>Rabigh</b>	Saudi Aramco	400,000 bpd
<b>Yanbu</b>	Saudi Aramco	235,000 bpd
<b>Riyadh</b>	Saudi Aramco	120,000 bpd
<b>Jeddah</b>	Saudi Aramco	85,000 bpd
<b>Saudi Aramco Mobil Refinery Company Ltd.(SAMREF)</b>	Saudi Aramco/ ExxonMobil	400,000 bpd
<b>Saudi Aramco Shell Refinery Company (SASREF)</b>	Saudi Aramco/ Shell	305,000 bpd
<b>Jubail refinery (operational in 2013)</b>	Saudi Aramco/Total	400,000 bpd
<b>Yanbu refinery (operational in 2013)</b>	Saudi Aramco/ ConocoPhillips	400,000 bpd

Table 8.1 demonstrates that Saudi Aramco has nine refineries located in different main cities in Saudi Arabia. Moreover, table 8.1 also illustrates how many oil barrels per day each refinery produces.

In terms of logistics operations at Saudi Aramco, in 1984, Saudi owned Vela International Marine Limited Company was established as a subsidiary of Saudi Aramco to transport the exported crude oil. Nevertheless, in 1988 Vela's responsibilities expanded when Saudi Aramco partnered with Texaco to refine and market petroleum products in the USA. Therefore, Saudi Aramco needed to increase the volumes of crude oil across the oceans and hence Vela was the major transporter for Saudi Aramco's international exported crude oil. Furthermore, in 1988 Vela charters increased following the merger of Saudi Aramco with Saudi Arabian Marketing and Refining Company (SAMAREC), which led Vela to add operational responsibilities of shipping Saudi Arabian domestic costal crude oil and refined products. Vela used four product tankers, previously operated by SAMAREC, however the merger of SAMAREC and Saudi Aramco did not continue and they broke up the joint-venture in 1993 as explained in chapter 7, sub-section 7.6.3

The remarkable jump of Saudi Aramco's logistics processes occurred in June 2012 when Vela became a joint-venture partner in the National Shipping Company of Saudi Arabia (Bahri) which would become the fourth largest owner of very large crude carriers (VLCCs) in the world (Vela 2012).

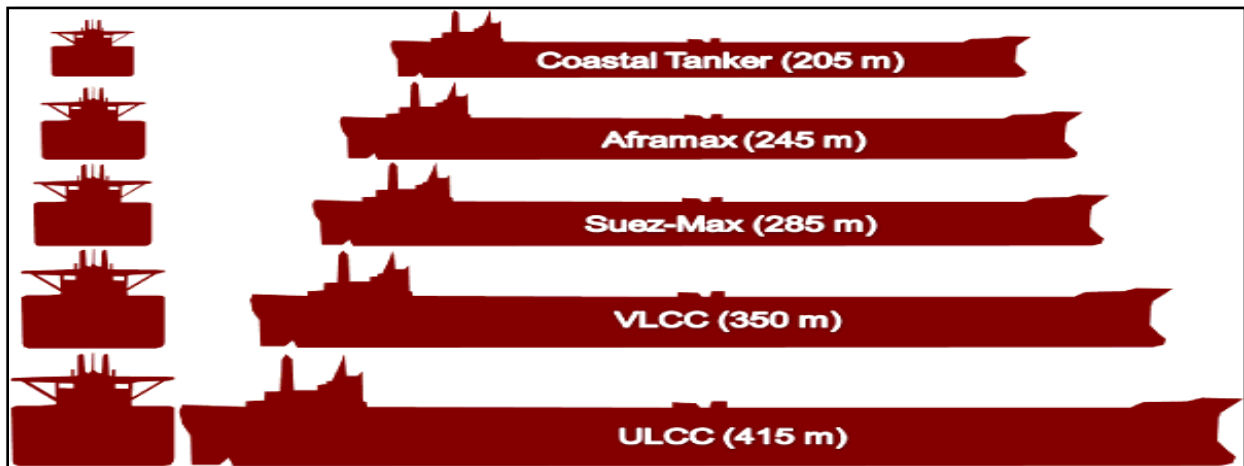


Figure 8.1: Size of the different tankers (Rodrigue, Comtois & Slack 2013)

In order to understand the size of Bahri's tankers Figure 8.1 above illustrates different sizes of petrol tankers: coastal tankers, the length of the tanker is 205 metres; Aframax tanker, 245 metres; Suez-Max,

285 metres; VLCC, 350 metres; and ULCC, 415 metres. Bahri owns 77 Suez-Max, 32 VLCC, 22 Aframax for chemical products, 5 coastal tankers, and 16 VLCC under-constructions. This would create a foundation for the continued demand on oil and would help to meet the expansion of downstream operations of Saudi Aramco while continuing to reliably serve the current customers of Saudi Aramco (Vela 2012). The next section discusses the participants who were interviewed for the Saudi Aramco case study.

### **8.3 Participants**

The researcher interviewed five participants at Saudi Aramco. The first participant was Mr Aysar, who was interviewed because he works as the petroleum engineer at Saudi Aramco, and is able to explain the process of the petrol supply chain, from the process of extracting the oil from wells until the refined petrol products delivered to Aramco's distribution stations (bulk plants). Mr Aysar's experience is approximately 15 years at Saudi Aramco headquarters in Dhahran, Saudi Arabia

The second participant, Mr Akram, is a process control system technician at Aramco's bulk plants. He was interviewed to explain the advanced level of Saudi Aramco in terms of technology utilisation in downstream operations and how he as a technician is required to solve any technical issue right away once it has occurred. He explained how Saudi Aramco is keen to educate employees based on the needs of each employee.

The third participant, Mr Thamer, is a loss prevention advisor in bulk plants. He was interviewed because of his experience in this field of safety and loss prevention over approximately twenty years. He discussed important factors, importantly how Saudi Aramco's safety regulations are regulated and why it is accepted or not accepted by customers.

The fourth participant, Mr Mubarak, an operations supervisor in the bulk plant, was interviewed because of his experience in operations management over approximately 20 years. He explained the process of petrol unloading by the haulers who supply Saudi Aramco's bulk plants with refined fuel and the process of loading into customers' trucks.

The fifth participant, Mr Haitham, is a customer relationship manager with extensive experience in CRM of approximately 34 years. He explained how organisational context influenced the petrol supply chain.

The following sections will provide a discussion of the extent of IT utilisation in Saudi Aramco according to the participants in terms of the technological context.

## **8.4 Technological context**

This section discusses the technological context from the perspective of Saudi Aramco's employees who have discussed the two factors that contribute to the role of technology in Saudi Aramco's operational process. Those factors are: 1) relative advantage which include the types of technology (actual technology, traditional technology and Information Technology) and 2) IT infrastructure. All five participants emphasised that Saudi Aramco is very dependent on technology in terms of the operations management and bulk supply chain operations and scheduling. This is discussed in the next sub-sections.

### **8.4.1 Relative advantage**

In this sub-section the researcher analysed participants' citations based on the three types of technology (actual technology, traditional technology and information technology) to clarify the benefits of utilising technology in Saudi Aramco and the issues that hinder technology utilisation, especially operations and supply chain management. Relative advantage refers to the perceived benefits that occur in Saudi Aramco from utilising technology, such as meeting customer requirements, minimising operations processes and reducing lead time which would maintain the supply reliability of Saudi Aramco domestically and globally.

#### ***8.4.1.1 Actual technology***

In this case study, the participants' knowledge of technology is greater than petrol station owners and haulers. The participants explained the importance of technology based on their respective jobs. For example, Mr Akram, as process control system technician at Aramco's bulk plants addressed that Saudi Aramco provides training sessions for employees on technology when needed and this enhances employees' knowledge and updates them about the latest technologies in bulk operations. Mr Akram started with explaining the role of Systems, Applications and Products in Data Processing (SAP) system which is an Enterprise Resource Planning (ERP) system implemented in Saudi Aramco, he said, 'SAP is an easy and adaptable system which controls many important business processes such as: sales, HR, cost of maintenance, procurement and orders. All operations are available for managers and authorised people in the company to take decisions accordingly'.

On the other hand, Mr Aysar discussed the importance of technology in all departments of Saudi Aramco, but as petroleum engineer, he explained how both hardware and software are important in the oil supply chain from the refining processes through operations control to distribution processes. He said, ‘Our company is highly dependent on both hardware and software from the operations management to refining and distribution processes. We have more than 20,000 people working just in IT, which is called the IT business line’.

Mr Aysar explained that the planning and control unit or Saudi Aramco Command Centre is directed by respective experts who receive the information and data updates from the refineries and bulk plants on the screens. This unit has a facility equipped with approximately 224 digital screens, which can be seen in figure 8.2. This unit monitors all processes starting from oil exploration and extraction from the underground until tankers, pipelines and trucks supply the crude oil or petroleum products. Tankers and vessels owners, such as Vela, which transports the crude oil and petroleum products domestically and internationally, receive shipping approval orders from this unit, because this unit is concerned with the operational level scheduling of marine voyages.



Figure 8.2: Saudi Aramco Command Centre (Ratti 2012)

Moreover, during the period of delivery for domestic and international coastal crude oil, this unit tracks the tankers and vessels in seas and oceans by GPS. For example, shipping oil to China takes approximately

20 days, so the control and planning unit tracks the vessels on the water until the shipment arrives in China. This is to assure the right kind of products are provided at the right time, and for the correct price.

The local distribution is similar in terms of tracking the marine voyages that transport the refined oil to Saudi Aramco's ports and terminals, or transport the crude oil to the refineries in different regions of Saudi Arabia. However, there are several haulers who are subsidiaries for Saudi Aramco and transport Saudi Aramco's oil and petroleum products from the harbours to terminals and bulk plants by truck. Those haulers are 3PLs, private haulers contracted with Saudi Aramco for a period of time, and they are monitored by their fleet operations managers not by Saudi Aramco.

Moreover, Saudi Aramco uses an ERP system for control and planning. When Mr Aysar was asked about the systems used by the control and planning unit, he stated: 'Since a decade Saudi Aramco uses SAP as an ERP system. Saudi Aramco connected SAP with the Hydrocarbon Supply Chain system, which shows the level of each petrol product in each bulk plant and terminal to the last drop'.

Therefore, the control unit requests the refineries to refine the crude oil and produce the needed quantity of each product based on the Hydrocarbon Supply Chain system, which informs the control unit by alarms. For example, when X bulk plant tank is less than 20 percent this means it needs to be supplied by crude oil immediately. So the Hydrocarbon Supply Chain system informs the control and planning unit that X bulk plant needs to be supplied immediately. Therefore, the Hydrocarbon Supply Chain system alerts the needs of each bulk plant, in each region in the country in real time.

Moreover, Mr Aysar further explained that the SAP system helps Saudi Aramco forecast petrol in terms of the international crude oil demand. However, the control and planning unit should get the orders from customers a month or two in advance. The planning and control unit should contact the engineers in the plants and refineries to enquire if they have the required quantity of crude oil or petrol products.

In terms of Saudi Aramco coastal terminals, they are located in five coastal cities along the Red Sea. These cities are: Jizan, Jeddah, Rabigh, Yanbu, and Dhuba. Each coastal terminal has a big tank for each product (i.e. octane 91, octane 95, diesel, and kerosene). The control unit usually supplies coastal terminals when the balance of the products in each tank is approximately 20 percent. The 20 percent level is specified to make these tanks ready to meet customer demands in case of shut down at a refinery or in case pumps are disrupted.

When refineries refine the crude oil, petrol products are stored in huge tanks based on the product type in the refineries. Then the products are distributed by three ways, ships, trucks (haulers) and pipelines to the coastal terminals or to bulk plants (distribution stations). Some terminals and bulk plants are linked with

refineries through pipelines such as Riyadh and Jeddah bulk plants because it depends on demand and the geographic locations near to the refineries. However, there are some bulk plants that are not linked by pipelines, such as Tabuk and Al-Jawf due to their geographical location in the far north of Saudi Arabia, distant far from the refineries. Therefore, they are supplied by trucks. Figure 8.3 shows the refined products supply chain, costal terminals and bulk plants in Saudi Arabia.

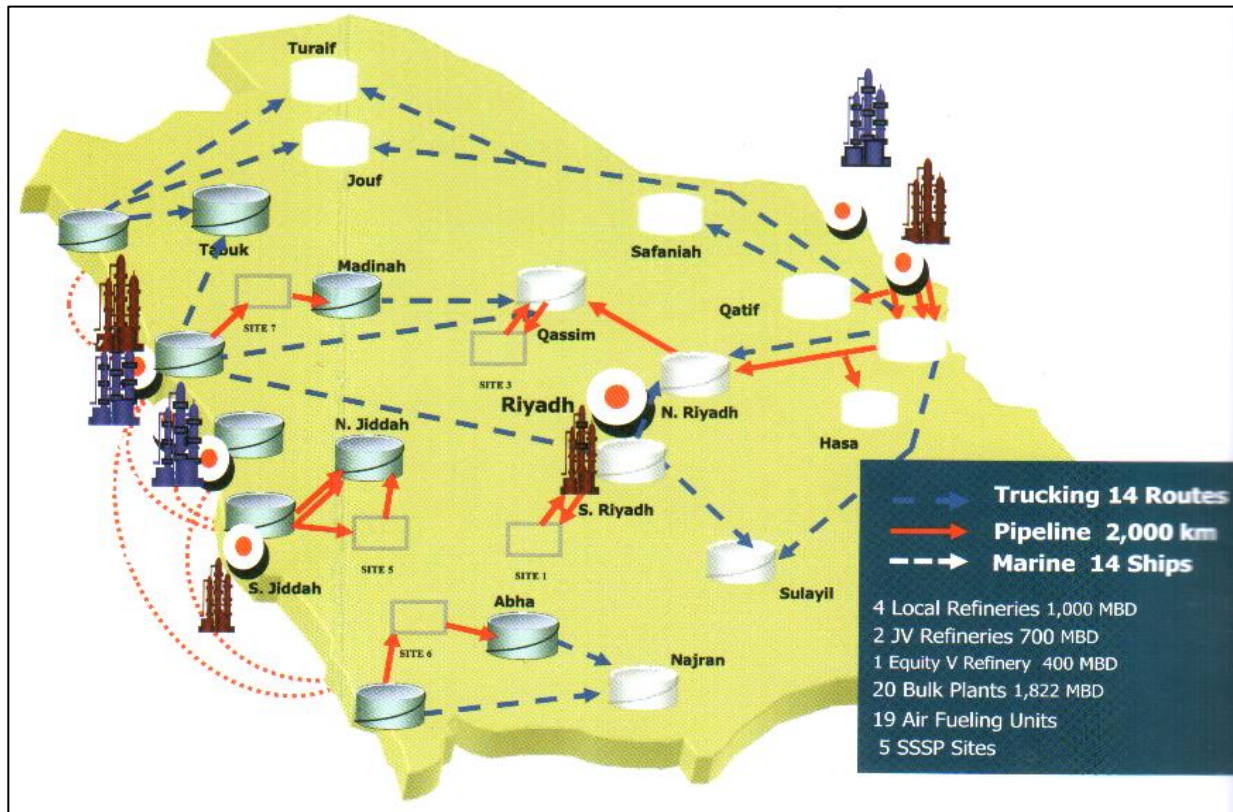


Figure 8.3: refined products supply chain (Zahrani et al. 2010)

On the other hand, Mr Haitham, who works as customer relationship manager at one of Saudi Aramco's bulk plants explained how technology utilisation, such as the SAP system, is useful to determine the real petrol quota that customers need. He said,

To evaluate the need of petrol quota of each customer, we rely on an SAP system, which records the history of sales to each customer based on the last three months, so we can approve the quota or reduce it accordingly.

He explained that the quantity that the customer (petrol station owner) sells in his petrol station is not important for Saudi Aramco, but the quantity that the customer buys from Saudi Aramco is important.



This is because Saudi Aramco relies on SAP records which demonstrate the actual demand that customers need and then provides them the petrol quota accordingly.

However, Mr Haitham claimed that he does not agree with Saudi Aramco in terms of the logistics operation management processes. He explained that terminals to unload refined petrol products and then upload it again into customer's trucks are not efficient. Because of increasing lead times and unnecessarily costs such as safety and bulk plants operation costs, this increases complexity of logistics operations. He said, 'So long as Saudi Aramco has third party logistics providers, why doesn't Saudi Aramco outsource the process of transporting petrol products from refineries and bulk plants to petrol stations directly?'

He explained that by doing this, Saudi Aramco would minimise the unnecessary operational management processes in the petrol supply chain such as, building terminals in several regions of the country. By doing this it would save the cost of terminals operations, employees and it would also minimise the cost of transportation on the customer's side. More so, the direct transportation would minimise the fraudulent behaviour such as truck drivers re-selling petrol products to unknown parties on the way to petrol stations. Furthermore, it would help to more accurately know the demand in the domestic market because Saudi Aramco is the provider and transporter at the same time. Mr Haitham claimed that it would probably need to apply technologies to monitor the trucks and drivers, however this can be required from third party logistics providers in the contracts, so technology can be outsourced too.

When Mr Haitham asked, why Saudi Aramco does not apply or try this idea? He said,

We as customer relationship managers have suggested this to Saudi Aramco managers in our steering meetings. However they responded that they have respective people hired for such operations. Therefore, we have no choices to accept or reject, and we should apply what they ask us to do as it is always up to them.

Mr Akram and Mr Thamer, added that Saudi Aramco's greatest concerns are about the safety in the terminals in order to prevent any accidents from occurring. Therefore, Saudi Aramco is keen to apply compulsory training sessions and courses to educate the employees and truck drivers in terms of safety procedures. Mr Thamer, the loss prevention consultant at one of Saudi Aramco's terminals claimed that out of the safety issues that occurs inside Saudi Aramco terminals, he stated, 'Some truck drivers want to enter the bulk plant with unclean bottom box, in which the circulation of petrol hoses should be kept clean to avoid a builder of static electricity otherwise, it may spark a spark or block the loading machines'.



Therefore, Mr Haitham explained that these worries can be reduced if Saudi Aramco outsources the logistics operations to third party logistics providers (3PLs) to supply petrol products directly from the bulk plants and refineries to customers. However, there is always a need for education sessions for truck drivers and petrol stations workers, but this can also be outsourced to 3PLs. Mr Haitham hinted that Saudi Aramco distribution stations are busy with petrol supply and operations management, therefore it would help if 3PLs are given the responsibility to educate the truck drivers on fuel loading and unloading process and supply customers, as a result unnecessary processes would be minimised. For example, 3PLs would not be interrupted and petrol would be supplied just-in-time because they would be linked and overseen by Saudi Aramco directly.

#### ***8.4.1.2 Traditional technology***

This section addresses how knowledge sharing amongst the employees and customers increases the efficiency and effectiveness of technology utilisation in Saudi Aramco.

When Mr Mubarak, the operation supervisor at one of Saudi Aramco's terminals, asked how truck drivers deal with technology at the bulk plants and why Saudi Aramco needs the hard copy of receipts from the drivers when they arrive at the bulk plants. Mr Mubarak answered:

Most truck drivers have weak knowledge about technology utilisation, even in writing and reading. Therefore we ask them to provide us the hard copy of receipts, so that we or other drivers can help them to type the digits on the control panel.

Mr Mubarak explained that they do not need the hard copy if a truck driver remembers the ID number on his badge or can type on the keypad. However, most truck drivers have difficulties in reading and writing numbers and letters on their ID badges and purchases orders. Moreover, because they cannot read or write in English or Arabic, they cannot remember the numbers and how to type them on the keypad in the bulk plants to activate pump machines to start pulling up petrol products.

Furthermore, Mr Mubarak explained, There are other truck drivers who speak the same language as those who cannot read or write in English or Arabic, and these drivers are able to help them (the illiterate drivers) type the required data in the keypads. They can transfer this knowledge of dealing with technology to their colleagues by explaining it to them. He said, 'For example, they approach numbers or letters by approaching the shape of the letter or number one by one and searching for it on the keypad to type it'.

Therefore, Mr Mubarak was asked why Saudi Aramco does not use technology, for example, barcodes technology to solve such issues. Mr Mubarak responded that he knows that there are readable cards that can be swiped allowing data to be transferred and analysed by computer units. However, he thinks that the cost of technology is the reason that Saudi Aramco did not utilise such technologies. However, he thinks that it is not very important to apply technology in terms of this particular process, typing in numbers and letters, because he thinks one minute is enough to enter all information. He claimed that, 'Truck drivers need to enter only three groups of numbers; driver's ID number, truck number and load confirmation number'.

Mr Mubarak explained that one of the requirements that Saudi Aramco regulated in terms of truck drivers who were allowed to obtain Aramco's licence is comprehensive knowledge of communication in Arabic or English. However, Saudi Aramco realised that only 30 percent of truck drivers in the country know English or Arabic, which would mean approximately 70 percent of truck drivers would not actually be allowed to enter Saudi Aramco bulk plants. This would mean thousands of petrol stations would not be supplied, which is an obvious loss of value for Saudi Aramco, fuel haulers and petrol stations. Therefore, Saudi Aramco dropped this regulation and allowed licensed truck drivers, who know little or no English or Arabic, to enter the bulk plants.

Mr Thamer emphasised what Mr Mubarak claimed. He added that, in terms of safety knowledge, Saudi Aramco posted instructional guidance pictures to guide those drivers who do not know English or Arabic. He said, 'For example, there are flame signs to notify them that a certain process or area is dangerous and should be handled with attention and care'.

In addition, Mr Thamer added that technology utilisation is crucial in Saudi Aramco's bulk plants. For example, Terminal Management System (TMS), which is a control system connected with the SAP system to record the time of a truck's arrival and departure, prints the final receipts which address the uploaded quantity. Hence, truck drivers should know and share the knowledge of utilising technology to benefit from it, because the final receipts would help them to defend themselves that they arrived at the determined time to increase their work bonuses. More so, Truck drivers can benefit from TMS to know what type and quantity of petrol product was uploaded in their trucks to avoid mixing petrol products in petrol station's tanks.

Despite that potential use of technology, language is an issue that hinders truck drivers from recognising technology and its benefits in the first place. Therefore, the researcher sees that the importance of readers, tags and barcodes could potentially help drivers use of technology, and then share in the perceived benefits.

### 8.4.1.3 Information technology

The description of information technology (IT) in this category is the intensive use of technology. For example, computer and internet including applications software for computers can fundamentally reshape the way business is conducted.

Participants emphasised that IT is available for all staff within Saudi Aramco or at their homes. For example, Mr Mubarak as operation supervisor in a Saudi Aramco's bulk plant said, 'Saudi Aramco provided IT at work and home, for example, the SAP system is available at home, however we are not keen to work from home due to our responsibilities towards our families'. This will be discussed in detail in sub-section 8.5.1.1 culture. Mr Mubarak explained further that emails, intranet and internet are available for employees to contact the other departments and customers; figure 8.4 demonstrates the E-services on Saudi Aramco's website. However, most employees prefer to contact each other by the phone because they find it faster to reach the respective person and get his response on the phone instead of typing the enquiry and sending it by email or searching for the appropriate person on database or website.

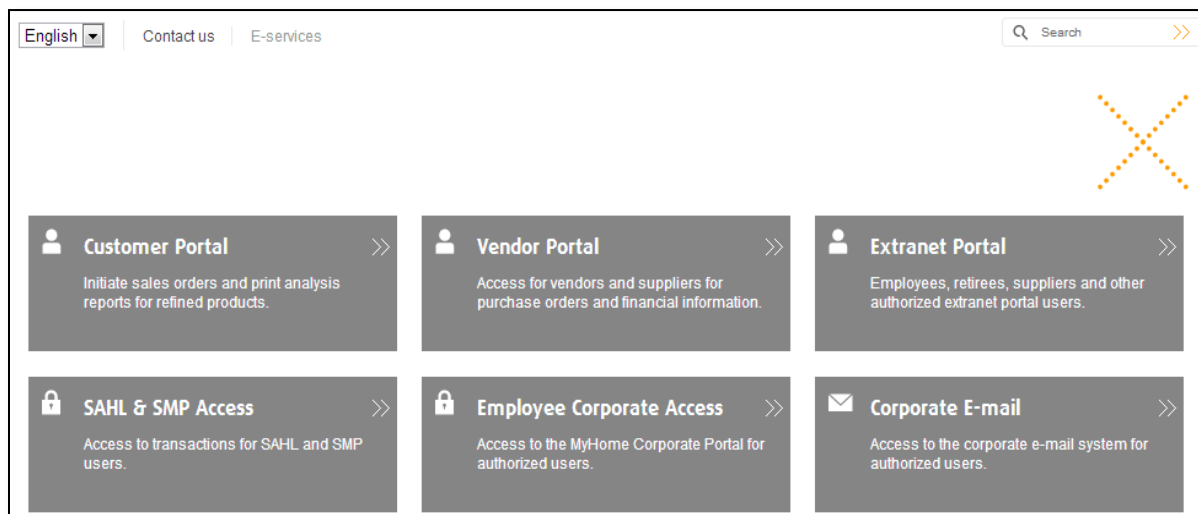


Figure 8.4: Saudi Aramco E-services (ARAMCO 2013b)

Figure 8.4 illustrates customer electronic services that are accessible for Aramco's staff and customers. E-services is a secure, reliable and convenient way to access a range of transactions and services. Aramco's E-services include; Customer portal that allows customers to initiate sales orders and print analysis reports for refined products; Vendor portal is accessible for vendors and suppliers for purchase orders and

financial information; Extranet portal is provided for employees, retailers, suppliers and other authorized extranet portal users; Simple Mail Transfer Protocol (SMTP) Access, Saudi Aramco and clients utilise SMTP to send and receive mail messages; Employee Corporate Access allows employee to access the MyHome Corporate Portal for authorised users to complete work from distance; and Corporate E-mail allows access to the corporate for e-mail system for authorised users. Given this, Saudi Aramco is keen to simplify the business transactions and services for customers, vendors and Aramco's employees.

In terms of customers contact channels, Mr Mubarak and Mr Haitham emphasised that the phone and fax hard copies are preferred by their customers. This is because customers also are not keen to use emails to contact Saudi Aramco. When asked why, the response was that most customers are not familiar with internet and email correspondences. They are used to the fax or the telephone, otherwise they come to the bulk plant to discuss their matters face to face. However, Mr Haitham, based on his extensive 34 years in customer relationship management, said, 'Actually it depends on the regions that customers come from. For example customers who live in metropolitans are keen to use and contact by IT more than rural customers'.

This addresses the influence of culture and tribal community on operations management which will be discussed in detail in sub-section 8.3.2.1 culture.

However, all customers follow the unified way of purchasing online, ordering through Saudi Aramco's online purchase orders website, which is linked with the SAP system. This is a sign that customers are able to use IT. Nevertheless, they need to be directed to the channels that they can use to contact Saudi Aramco instead of using traditional communication channels. Mr Mubarak added an interesting perspective: 'Basically our customers cannot order online unless they have an email address to register in Saudi Aramco's purchasing website'.

This highlights the fact that customers are able to utilise emails to contact Saudi Aramco or at least they have the facility to email. However, Mr Akram stated that customers can use IT; it is just that they need to be educated to learn how to use IT appropriately and to access internet resources that are available for them. Once customers learn and are guided on how to use IT appropriately, they will be able to search online, enquire online, communicate by emails, and they will be able to share their perspectives through Saudi Aramco's website.

#### ***8.4.1.4 IT infrastructure***

Information technology infrastructure is one of the important factors that helps to enhance the utilisation of technology within an organisation to improve the operation management. Saudi Aramco is one of the companies that utilise IT in most businesses and operation processes. All participants emphasised that IT infrastructure at Saudi Aramco is available. For example, each administration employee has a desk top. Moreover, internet and intranet are available for all employees, but the access is limited, dependent on the employees' job position. For example, financial department employees are permitted to access the SAP system in respect of financial operations. Furthermore, Saudi Aramco hired approximately 20,000 employees in IT business line as Mr Aysar addressed in 8.4.1.1 actual technology. Moreover, in terms of the security of data, Mr Aysar said, 'Saudi Aramco is keen to apply the most advanced and secured servers and network connections due to the importance and sensitivity of the information flow on its servers'.

So, Saudi Aramco is aware about the privacy of the flow of information and is keen to have secure IT infrastructure. For example, the cyberattack against Saudi Aramco in August 2012, was aimed at stopping oil and gas production in Saudi Arabia and infected approximately 30,000 computers (Reuters 2012). This attack was a challenge for Saudi Aramco to prove that it had secured IT infrastructure, because the flow of information, domestic and international sales were safe and this was confirmed by interviewee participants concerning IT infrastructure.

The cyberattack was attributed to the group of hackers called Cutting Sword of Justice from four countries (unnamed in the report). The hackers sent a virus known as Shamoon which infected Saudi Aramco's workstations on 15<sup>th</sup> of August 2012. Shamoon spread through Aramco's internal network and wiped computers' hard drives clean. Therefore, the company shut its main internal network for more than a week (Reuters 2012). However the CEO of Saudi Aramco, Khalid al-Falih said in a statement 'We would like to emphasize and assure our stakeholders, customers and partners that our core businesses of oil and gas exploration, production and distribution from the wellhead to the distribution network were unaffected and are functioning as reliably as ever' (Fineren & Bakr 2012). Accordingly, information technology experts have warned that cyberattacks on countries' energy infrastructure could disrupt energy supplies (Fineren & Bakr 2012). Therefore, secured IT infrastructure is crucial, at Saudi Aramco.

In addition, Mr Akram mentioned that Saudi Aramco accepts only online payments through the online purchase link, which is a secured internet website licensed to Saudi Aramco and linked to the SAP system to allow financial departments to monitor sales operations. Moreover, it helps the CRM department to

supervise customers' demand and assure that customers' quota is based on their actual need. Hence, Mr Akram said, 'This also highlights that Saudi Aramco is keen to improve its relationship with customers through the secured online payment and eliminate the traditional cash payments'.

In terms of infrastructure and how Saudi Aramco can preserve it, Mr Akram gave the example that Saudi Aramco terminals have multimeters to read pumping power of the pumps, quantity of unloaded and uploaded petrol products and the temperature of the truck's containers. However, these multimeters need to be maintained every three months to ensure accurate readings and to avoid mistakes that may cause loss of value or risks. For example, the meters read the quantity of unloaded and uploaded petrol products, so any mistake in the readings would increase or decrease the quantity of petrol products and here we can see the loss of value. In addition, if the meters mistakenly read the temperature of trucks' containers this may result in fire hazards or explosion especially in very hot weather conditions such as in Saudi Arabia. Therefore, Saudi Aramco outsourced periodic maintenance of meters to a respected company that undertakes the role of meter maintenance every three months. Hence, the infrastructure should be always maintained to reach the maximum efficiency and effectiveness.

In this section the researcher discussed the technological context and the related factors that influence the operational management in the petrol supply chain at Saudi Aramco. The results demonstrated that Saudi Aramco is very keen to utilise technology in terms of actual technology, for example, the 224 digital screens in Saudi Aramco command centre demonstrates that Saudi Aramco depends on technology in most of its operations. In terms of traditional technology, Saudi Aramco is trying to be effective by providing courses and sessions to educate the employees and truck drivers. However the lack of knowledge amongst Saudi Aramco's customers such as truck drivers due to language barriers has caused communication gaps between Aramco's employees and truck drivers. Therefore, technology utilisation has the potential to narrow the gaps between the two parties. For, example, swipe cards or barcodes may reduce the reliance on language. In terms of information technology, Saudi Aramco with more than 20,000 employees in its IT business line proves that IT does matter. Lastly, Saudi Aramco's IT infrastructure proves that the company has been aware for some time about expected cyberattacks. Therefore, Saudi Aramco has made and maintains secure strong networks and servers, while some PCs suffered hard disk failure, the company's enterprise withstood the cyberattack that occurred in August 2012.

## 8.5 Organisational context

Saudi Aramco representatives in this case study have provided a rich source of information about the untold stories that can influence the operations management in Saudi Aramco. The participants mentioned various organisational factors in the interviews, i.e. culture, religion, firm size and firm resources and discussed their influence on Saudi Aramco's operational management.

### 8.5.1 Culture

All participants emphasised that culture is a very important aspect in the organisation. Mr Mubarak found that work pressures and his family responsibilities have an influence on his work efficiency. He said, 'I am one of the people who do not even think to work from home, because I want go back to my home to rest after work pressures, and eventually I do not have energy to work from home'.

Moreover, Mr Akram and Mr Mubarak added that Saudi Aramco provides training courses and sessions in different aspects such as work ethics, organisations safety, risks and more. However, some employees feel indifferent about what they are taught by lecturers or trainers. When Mr Mubarak was asked why some employees felt indifferent he said, 'because they attend mainly for financial and promotional features not to benefit from the course itself'.

Furthermore, Mr Akram related technology to the culture and work stress, he said, 'Some employees do not feel the sense and benefits from technology utilisation, and therefore they see it from a particular angle and ignore the other important angles'.

Mr Akram explained that some employees use computers for entertainment just to perform the routine work instead of understanding why they should use computers in their work. Therefore, some employees lack knowledge and, as a result, they cannot maximise their benefits from using technology.

When Mr Mubarak was asked if language is a reason that employees felt indifferent at training courses, he said,

There are training courses in Arabic. Someone may say that the language is the reason, but it is not the problem. The problem is they do not know how to benefit from training courses, which needs to be explained to them in an interesting way.

Mr Mubarak further explained, employees should understand that training courses will increase their knowledge and, as a result, help achieve their targets. In addition, they could be approached by their supervisors based on the efficiency and productivity that they noticed to reward them. However, some employees perceive that these courses, for example IT courses, are important only to ease the work or finalise the work faster, which eventually pours into company's benefit only.

Mr Haitham added that Saudi Aramco has approximately 21 bulk plants, all located in metropolitan areas, as demonstrated in figure 8.5.

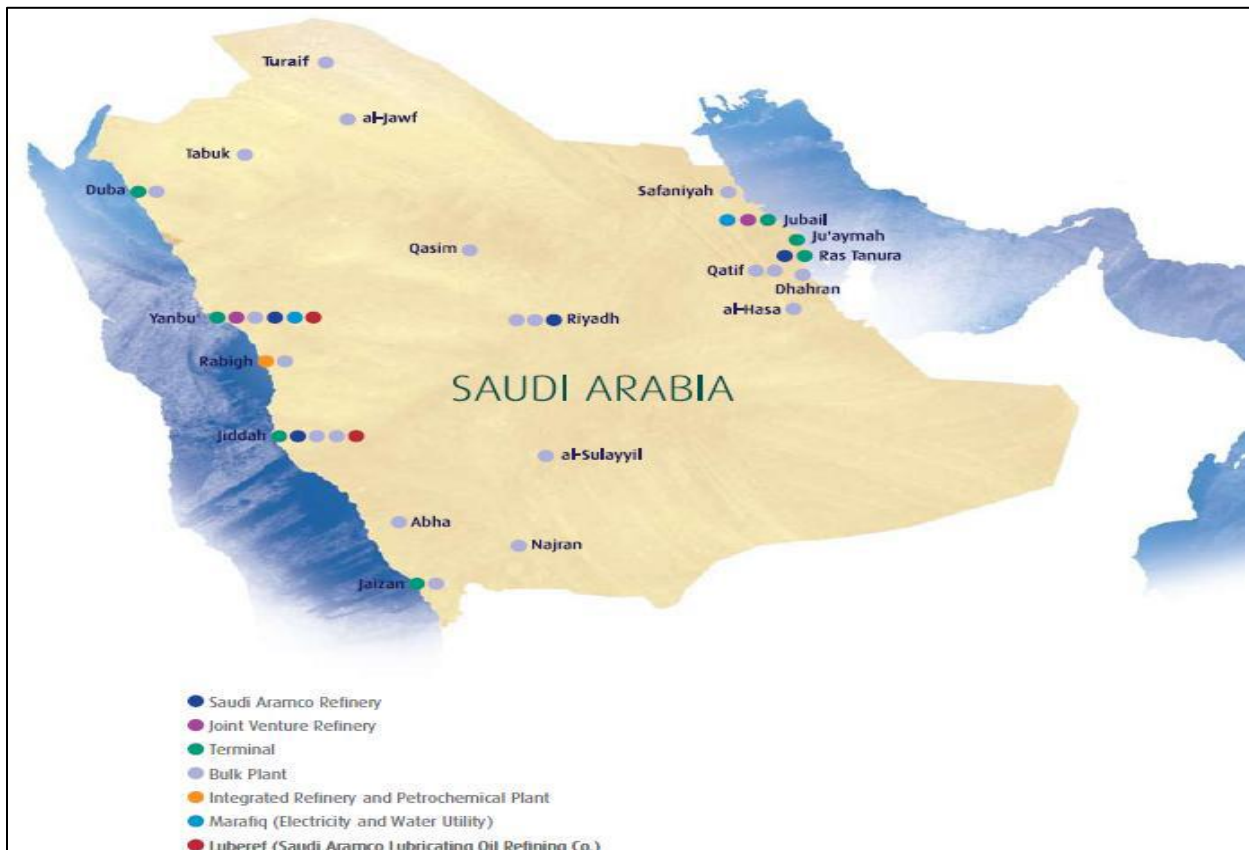


Figure 8.5: Saudi Aramco' facilities (Saudi Aramco, 2013)

Mr Haitham, customer relationship manager at Saudi Aramco, emphasised that all distribution stations are located in metropolitan areas. However, these distribution stations sell petrol to customers from both areas (rural and metropolitan areas). Thus, there are different norms and cultures amongst these areas. For example Mr Haitham said, 'In terms of rural areas it is more likely that clients come personally to my office to discuss an issue and they are more likely to use hard copies carried with them'.



Mr Haitham explained that people in rural areas are not keen to utilise ICT for communication, because they think a personal touch is more likely solve issues. This is because the norms of the tribal community in Saudi Arabia rely on face to face negotiation. And hence, this way is the most likely to end up with a positive outcome. Sometimes managers become more flexible in applying regulations when customers meet them face to face, showing a kind of appreciation for their visitors. Therefore, it is unlikely that customers use ICT to communicate with the employees in Saudi Aramco in rural areas, and because this may end up with negative results due to applying the regulations strictly, no matter who is the customer.

Mr Haitham further explained that in the metropolis, the norms play a similar rule, however not continuously. This is because the metropolitan population is greater than the population in rural areas, therefore managers try to be strict otherwise most clients would prefer to come personally to solve their issues.

## **8.5.2 Religion**

Religious obligations for Muslims, such as fasting in the blessed month (Ramadan) is an important perspective that needs to be considered as one of the factors that influence working hours in organisations.

Muslims fast in Ramadan from sunrise to sunset because it is the month that Allah revealed the holy Qur'an to the heart of his prophet Muhammad (peace be upon him). So the main aim of fasting in Ramadan is to worship Allah and ask him for forgiveness. Hence, the Saudi Ministry of Civil Service announces each year that the government official working hours in Ramadan would be six hours daily, from 10 a.m. to 4 p.m. The ministry said the working hours have been set as per a Royal Order to help people manage their times between the work and the worship (Government 2011).

Women claim that starting work at 10 a.m. and ending at 4 p.m. leaves very little time when they return home from work, therefore, women requested from the Minister of Civil Services to imitate Saudi Aramco's working hours in Ramadan, which provides the employees the choice of working in Ramadan from 7 a.m. to 1 p.m. or from 9 a.m. to 3 p.m. (AL-Jalahma 2002).

However, concerning Ramadan, Mr Aysar emphasised that Saudi Aramco does provide their workers the choice of working in Ramadan from 7 a.m. to 1 p.m. or from 9 a.m. to 3 p.m. He found that working hours from 7 a.m. to 1 p.m was a good choice for him and this encouraged him in terms of work productivity especially during fasting time and helped him to manage sometime for worship once he

comes back to his home. Mr Aysar said, 'this kind of flexibility let us feel that we have choices instead of coercion, and this could prioritise our obligations towards Allah and increases the employees' loyalty towards the company'.

It is important to mention that Saudi Aramco employs woman and men, and hence Al-Jalahma (2002) claimed that priorities are confusing amongst women and therefore, women working in public sector of the government requested from the Minister of Civil Service to apply Saudi Aramco's working hours during Ramadan on all women working in public sector of the government. So, women are looking for a space for their families and priorities towards the religion. Similarly, men such as Mr Aysar think that the flexibility in working hours during Ramadan increases the loyalty towards the company and provides sometime to fulfil the obligations of the religion and work.

Moreover, Mr Haitham mentioned that non-Muslim workers in the company understand that Ramadan is the month of fasting therefore; they avoid eating or drinking in front of their colleagues to show respect to their colleagues and Islam. He said, 'This behaviour is known by most non-Muslims employees in the country long time ago, which is sign of religious acceptance and tolerance amongst Muslim and non-Muslim employees in Saudi Aramco, and in most organisations in the country'.

On the other hand, Mr Akram, addressed that weekends also have an influence on Saudi Aramco's operations management. He said, 'most of the Western world and industrialised countries hold the weekend over Saturday and Sunday, however Saudi Arabia holds the weekend over Thursday and Friday'.

Moreover, Gulf Countries, such as the UAE, Bahrain and Qatar hold the weekend over Friday and Saturday and this is officially announced by those countries in 2006. As a result of the arguments, economists and religious people in the country agree that Saudi Arabia should think seriously to hold the weekends on Fridays and Saturdays instead of Thursdays and Fridays because the gap in working hours lost between Saudi Arabia and Western countries have amounted to about approximately a month per year (Aloaid 2006).

Friday and Saturday are the most appropriate days for weekend in Saudi Arabia as Friday is known as (الجمعه Aljomoah) in Arabic, the spiritual day of the week in Islam because Muslims need to prepare and gather for the big prayer, which is Aljomoah prayer. More so, in Aljomoah, which means (gathering) in English, Muslims are keen to benefit from Allah's mercy, Muslims are keen to gather for Aljomoah prayer and visit their relatives and parents this day. Therefore, Friday is the gathering day for Muslims and the spiritual day in Islam and hence the most appropriate day for weekend.

On the other hand, the meaning of weekdays in Arabic indicate that working days of the week should start from Sunday to Thursday, table 8.2 represents Arabic names and meanings of week days, which indicates the order of week days based on the meaning of each day.

Table 8.2: Arabic names and meanings of week days based on the meanings

Day name in English	Day name in Arabic	Translated meaning of the day in English
Saturday	Alsabt	Rest
Sunday	Alahad	First
Monday	Alethneen	Second
Tuesday	Althulatha'a	Third
Wednesday	Alarbea'a	Fourth
Thursday	Alkhamees	Fifth
Friday	Aljomoah	Gathering

Table 8.2 illustrated that Saturday (Alsabt) should be one of weekend days because it means (rest) and this meaning of the day was mentioned in the Holy Quran nine times. Last but not least, Saturday is one of weekend days in most countries around the world. Saudi Arabia adopted Saturday a business day but Thursday and Friday weekend days, which hinders business operations and cooperation with other countries around the world, such as gulf countries i.e. the UAE, Qatar and Bahrain and Western and industrialised countries. Hence, it is obvious that the gap of weekend days not only influences Saudi Aramco, Saudi Arabia's economy and operations management is influenced by this gap of days too.

Furthermore, as mentioned in chapter two, literature review, Saudi Arabia became a member of World Trade Organisation (WTO) in December 2005 (Aloqlah & Alankeri 2010). Hence, the vision of global competition requires Saudi firms to utilise all their obtainable resources to survive and succeed in the global economy (Mellahi & Wood 2001). Thus, Saudi Arabia needs to shorten the gap of business days with Western countries and industrialised countries to enhance business operations management and cooperation between Saudi Arabia and Western countries and industrialised countries.

### 8.5.3 Firm size

Previous literature claimed that when a firm has more than 200 employees, then the firm is classified as large-sized (Herrera & Sánchez-González 2013; Nieto & Santamaría 2010). Hence, Saudi Aramco which

has approximately 55,066 employees is categorised as a large enterprise according to the scale of employee numbers (ARAMCO 2013a).

Participants claimed that the size of Saudi Aramco influences its operations management. For example, when asked why he does not discuss his ideas and suggestions with the top managers in Saudi Aramco, Mr Haitham claimed, ‘Who I am to discuss operations processes with the top-level managers in the company?’

Mr Haitham, the CRM manager in one of Saudi Aramco bulk plants explained that the top management levels in Saudi Aramco have the power on policies and decision making, which is sometimes reasonable. However, he explained further that the size of the company and the managerial hierarchy, which included top manager, middle managers and lower-level managers, influenced the operations processes. For example, he discussed in sub-section 8.4.1.1 actual technology, that the processes and costs of the petrol supply chain can be minimised by outsourcing the logistics processes to third party providers. However, the top management responded that they have respective employees hired for these particular processes already. Therefore, Mr Haitham expressed that he felt disappointed because his advice was not at least appreciated.

Moreover, Mr Akram addressed that each region in Saudi Arabia has its top managers of Saudi Aramco’s departments i.e. northern, southern, eastern, western and middle region departments. However, the bureaucracy in Saudi Aramco influences decision making. Mr Akram said, ‘The bureaucracy in Saudi Aramco influences decision making, because the decision that needs only one day, lasts for one month’.

Mr Akram explained that the lack of employee empowerment hinders the decisions and obscures the management processes, because the decision depends on respective top-level managers that have the authorisation to approve or reject these decisions. However, top-level managers are not always aligned in taking the managerial decisions in terms of employees’ or customers’ requests. Sometimes their personal views overrule their own interests. Hence, the relationships with these empowered employees or the middle-level managers, those that are close to empowered employees, help to speed up the process of decision making and it is likely that the decision can positively influence an employee or customer request.

Saudi Aramco is a state-owned company and the bureaucracy regime is discussed in previous literature as the common managerial type applied in Saudi Arabian public and private sectors because it depends on organisational hierarchy. Therefore, Saudi Aramco and its policies and management processes are

influenced by the bureaucracy regime in the country. Eventually, this managerial system influences operations management in terms of the relationship amongst managers, employees and customers.

#### **8.5.4 Firm resources**

In this case (Saudi Aramco), the importance of firm resources is crucial. Given the fact that Saudi Arabia is the largest oil producer and holder of oil reserves in the world and Saudi Aramco is the company that takes the responsibility of exploration, digging, refining, exporting, and marketing of oil in Saudi Arabia. Hence, Saudi Aramco has the most valuable resources of the country which is the national income of Saudi Arabia, oil and its derivatives. Therefore, it is important to discuss these resources in this research.

In terms of firm resources, petrol products such as octane 91, 95 and diesel are as important to Saudi Aramco as they are to petrol stations. However, the prevention of evaporation issue is considered as an unsolvable issue for Saudi Aramco, and therefore, the 3PLs are not blamed for unloading the petrol shipment with a shortage of a maximum 350 litres into Saudi Aramco's bulk plants. Mr Haitham said, 'Saudi Aramco allows up to 350 litres in summer and winter for potential evaporation in each truck of 3PLs and they are not blameable to pay for this potential evaporation quantity'.

Moreover, Mr Akram addressed that considering Saudi Aramco the main provider of petrol products in Saudi Arabia, means that the energy supply is highly dependent on Saudi Aramco and therefore the electricity in the country is relying on petrol. For example he said, 'Saudi Electricity Company procures 30 percent of diesel products of the bulk plant each day, because Saudi Electricity Company utilises old generators in some rural areas and these generators are operated by diesel'.

Saudi Electricity Company (SEC), which is a joint stock company and the only electricity supplier in the country, consumes a high quantity of diesel and this sometimes causes a shortage of diesel products in bulk plants. Hence, SEC is trying to utilise gas turbines in all electricity stations to reduce the reliance on diesel products and use gas instead, which is considered cheaper and safer for the environment than diesel.

Moreover, the only mean of transportation in the country is cars and buses. Numbers of automobiles in Saudi Arabia is very high. There are approximately 13 million cars in Saudi Arabia, however the population of Saudi Arabia is approximately 27.6 million, which means a car for every two persons (Alarabia 2012). Given this, the population's consumption of petrol is also very high in Saudi Arabia.

Additionally, the number of petrol stations, that is more than ten thousands petrol stations, is evidence of high demand on petrol products. Thus Saudi Aramco, the only petrol provider in Saudi Arabia, should have plans for petrol rationalisation. Mr Akram said, 'Most young people in Saudi Arabia have cars and they spent their spare times driving round on streets for several hours, they do not care about petrol rationalisation because petrol prices in Saudi Arabia are very cheap'.

He explained that Saudi Aramco provides several memorandums to employees that the company is going to persuade the government to increase petrol prices domestically to increase the rationalisation of petrol products in Saudi Arabia. So petrol price is one of the reasons that Saudi Arabia dramatically consumes petrol products. Mr Aysar said, 'Refinery managers are doing their best to increase petrol prices domestically to enhance the services'.

Mr Aysar explained that any oil company is definitely looking for profit, however the process from digging and refining through distribution is very costly and Saudi Aramco is not able to make a notable improvement (e.g. new technology for better service quality at bulk plants) at the current domestic petrol prices. However, once the petrol prices increase Saudi Aramco can invest in technology in order to improve the services quality domestically. Mr Haitham added, 'Refining and transport cost per litre is much higher than the domestic prices, therefore Saudi Aramco sometimes buys refined petrol products such as petrol 91, 95 and diesel from nearby countries'.

Mr Haitham explained further that some machines and chemical elements that are used in refining processes are imported from overseas. Moreover, logistics cost, which includes third party marine transportation of crude oil, haulers and trucks and unloading processes in bulk plants, must be added to the price of each litre. Hence, it is not profitable for the company, but most people do not know this fact.

In this section the researcher discussed several important factors that influence organisational operations management i.e. (culture, religion, firm size and firm resources). The influence of each factor was discussed from the participants' perspectives and it has enriched the comprehensive understanding of the organisational influence particularly in Saudi Aramco and Saudi Arabia. For example, the researcher discussed cultural influence in terms of the family size and its influence on Saudis' desire to work from home. More so, some employees are indifferent in terms of training sessions because they attend just for promotional features. In terms of religious influence, working hours during fasting in Ramadan and its influence on the employees were discussed. In terms of firm size, the researcher highlighted the influence of hierarchy and bureaucracy in Saudi Arabian organisations. Last but not least, firm resources was discussed the petrol prices and its relationship with petrol rationalisation issues.

## **8.6 Environmental context**

Environment factors refer to the environment in which an organisation conducts its business such as, geographic location, competitors and dealing with the government. In this cluster (Saudi Aramco), the environmental factors discussed based on the participants respective. The first factor discusses geographic locations.

### **8.6.1 Geographic location**

Participants explained that geographic location and size of the country influence the organisation operations from different perspectives. For example, in terms of logistics operations, Mr Haitham claimed that Duba terminal on the Red Sea, located in the North West of the country, is approximately 200 Km away from Tabuk terminal (refer to figure 5 Saudi Aramco's facilities). In Duba there is one of Saudi Aramco's terminals, from which refined fuel is transported to Tabuk city by third party logistics providers, 3PLs. Mr Haitham said, 'Sometimes 3PLs' trucks delay in transporting the fuel because of Duba's location, approximately 200 Km from Tabuk'.

Delays can also happen in transporting refined fuel from Duba to Turaif bulk plant in the far north of the country, considering that the distance from Duba to Turaif is approximately 1,000 Km, and the only means of fuel transportation between these cities is truck transportation. Therefore, the geographic size of the country and the locations of bulk plants lead to delays in petrol transportation.

Moreover, Mr Akram emphasised and added another perspective on the example of Mr Haitham that petrol transportation delays is one of the issues that influence petrol supply chain management. In the case of Tabuk and Aljauif, Mr Akram added, 'We should also notice, that first of all the crude oil is refined in Yanbu and then shipped to Duba by marine transportation'.

Mr Akram explained that the refined fuel is transported by 3PLs vessels by Vela International Marine. Vela transports the refined fuel from Yanbu, where the refinery is located, to Duba but the distance between them is approximately 465 Km. In addition, this lead time will also increase due to the logistics processes, road transportation and marine transportation.

From another perspective, Mr Haitham addressed that petrol supply delays can also happen due to weather conditions. For example he said, 'Trucks that travel hundreds of kilometres through Saudi Arabia and vessels in the Red Sea and the Arabian Gulf can be affected by storms'.

Mr Haitham discussed the influence of weather, such as sand storms in terms of road transportation and wind storms in the Red Sea and the Arabian Gulf can affect the transporters. The Arabian Desert that is located in Saudi Arabia, is a desert wilderness. At its centre the Rub’al-Khalim is one of the largest continuous bodies of sands in the world, with the largest oil field in Saudi Arabia (Ghawar), the largest conventional oil field in the world. The Rub’al-Khali desert stretches from Yemen to the Arabian Gulf and from Oman to Jordan and Iraq. This illustrates that most part of the country is desert and hence, sand storms can influence road transportation and marine transportation. Figure 8.6 demonstrates oil and gas fields in Saudi Arabia.



Figure 8.6: Oil and gas fields in Saudi Arabia, Annual Energy Outlook (EIA 2014)

Furthermore, Mr Aysar addressed that weather influences in digging operations, he said, ‘The workers and engineers that work in desert for digging and exploration operations are also influenced by hot weather in the summer’.



He explained that desert weather is very hot in the summer when it reaches 55 degrees Celsius and this influences the work environment. Saudi Aramco provides high salaries and bonuses for employees and they are encouraged in several ways, such as free transportation, accommodation, health care, free schools for children, annual tickets, etc., as an incentive for employees to work in these harsh environmental circumstances.

Thus, it can be seen that the geographic location can influence organisations' operations such as logistics and supply chain based on different perspectives; the area of Saudi Arabia; weather issues, such as storms and extreme heat; facilities locations, such as refineries, terminals and bulk plants. The next sub-section discusses the competition intensity.

### **8.6.2 Competition intensity**

Saudi Aramco is the only provider of petrol domestically. While there are no other competitors domestically, Saudi Aramco has several competitors in the international oil market and therefore they are more focused on competing internationally. It is likely that the lack of competition in the domestic market is one of the reasons that Saudi Aramco is not that focused in improving the domestic market services towards customer's satisfaction.

When the researcher interviewed the participants they discussed the international competition and the role of Saudi Aramco in the global oil market. Nonetheless, they never discussed the competition in local markets or any influences within the competition domestically. This is because Saudi Aramco is a state owned company and has a very good existing relationship with the government, which is discussed in next sub-section 8.6.3.

For example, Mr Aysar discussed Saudi Aramco's reliability in terms of supplying crude oil to fulfil the global demand in sub-section 8.4.1.1 actual technology. Moreover, Mr Haitham claimed that cheap petrol prices is the reason that Saudi Aramco is not keen to enhance the domestic services, which is agreed by Mr Akram and Mr Aysar in sub-section 8.5.4 firm resources. Hence, it can be said that the lack of competition intensity in domestic market does not influence Saudi Aramco's operational improvements, but it does influence their operations in the international market indirectly. The next sub-section discusses the influence of government regulation in Saudi Aramco's market.

### 8.6.3 Government regulation

Given the fact that Saudi Aramco is a state owned company demonstrates the strengths of the relationship between the government and Saudi Aramco. For example, Mr Akram said, ‘Saudi Aramco is considered one of the government’s organisations therefore it supplies several government agencies with petrol and does not collect the payment based on the government’s instructions’.

This increases the influence in terms of domestic and international sales and highlights that decision making is always left to the government. For example, Mr Akram stated that Saudi Aramco provides research studies to the government in terms of several issues in the country such as how to monitor and prevent fraud at petrol stations. He explained that fraudulent behaviour in petrol stations is not Saudi Aramco’s responsibility because Saudi Aramco does not provide after sale services.

Moreover, Mr Haitham emphasised that Saudi Aramco’s responsibility for supplying petrol to customers ends after the customer’s truck exits the bulk plant. He believes trade fraud should be monitored by the Ministry of Commerce. He explained that Saudi Aramco provides instructions booklets to the customers that explain the fraudulent behaviour and corruption issues likely to be experienced at petrol stations and within the hauling process. However, the customers do not follow the instructions, and then end up blaming Saudi Aramco.

This highlights that there is lack of contact between government organisations such as Saudi Aramco and the Ministry of Commerce. More so, there is lack of influence by the Ministry of Petroleum and Mineral Resources (MOPM) in terms of domestic operations. MOPM’s responsibility is to manage and control petrol industry in Saudi Arabia. However, when asked Mr Haitham about the role of the MOPM in the domestic operations, he said: ‘MOPM has nothing to do with the domestic sales and operations, maybe its role in the international operations but domestically we only know Saudi Aramco’s headquarters’.

This emphasised that Saudi Aramco is independent in terms of domestic operations management and this is emphasised also in MOPM official website, which states that MOPM management processes are highly decentralised and hence each petrol company such as, Saudi Aramco, Aramco Gulf Operations Company, Saudi Chevron, Saudi Arabian Mining Company, etc., should manage their operations independently (MOPM 2013).

In terms of safety regulations in Saudi Aramco and why customers have issues with these regulations, Mr Thamer said, ‘Saudi Aramco is keen to minimise the government requirements in terms of safety regulations’. By the government, Mr Aysar means the Saudi Standards Metrology and Quality

Organisation (SASO). He explained that Saudi Aramco tolerates the application of SASO's requirements on customers, but customers are focused on cost saving benefits. Mr Aysar said, 'Haulers are looking for cost saving and values, however we are not going to lose our facilities to satisfy them'.

He explained further that customers would be surprised when Saudi Aramco actually applies the strict regulations of SASO in regards of standardisation of truck containers and safety specifications that started from first of January 2012. However, these requirements of truck containers are compulsory and check processing fees must be paid by the haulers, not by Saudi Aramco, because Saudi Aramco outsources the check processing to third party safety companies. This highlights that there are tight regulations concerning truck containers.

All haulers are required to apply the regulations and maintain their trucks accordingly, which states that trucks must be unified based on the typical truck container model; figure 8.7 illustrates the unified model of containers in Saudi Arabia starting from 1 January, 2012, which actually has been applied by Saudi Aramco. These petrol tankers must be isolated by thermal insulation to reduce the heat, the hoses and bottom boxes must be always maintained because the check process will inspect for any fault in these containers. Hence, customers who do not apply the required regulations cannot enter Saudi Aramco's bulk plants. Mr Thamer claimed that these regulations are required by the government through SASO, but Saudi Aramco is an executive organisation to apply these requirements on the customers.



Figure 8.7: Unified model of containers in Saudi Arabia (enforced from 1st of January 2012)

Mr Thamer highlighted that every month there are more than 1,000 trucks denied entering Saudi Aramco's facilities in Saudi Arabia due to their disqualification and breach of safety regulations, including containers that were made 25 years ago for petrol hauling purposes. Furthermore, the expected

hazards of such breach of safety regulations can cause fire or explosions, which can cause huge damage in terms of the facilities and people either in Saudi Aramco's properties or on roads.

Mr Akram, emphasised that customers breach the safety requirements and therefore he said, 'I do not mind to delay or denied the infringing truck from entering the bulk plant to prevent expected and unexpected dramas that can happen'. He explained that it is not only Saudi Aramco that requires the customers to follow the safety requirements. For example, the traffic police orders compulsory periodic checks on vehicles maintenance to be allowed to be driven on roads ensuring drivers and community safety.

Moreover, Mr Aysar emphasised the perspective of traffic police periodic checks and he highlighted an important perspective that traffic police require periodic checks on trucks too. However, they only check trucks but not containers. Therefore, Saudi Aramco should require the safety regulations from customers to check the containers for the same reason that the traffic police perform periodic checks for the safety of people and properties.

Furthermore, Mr Aysar addressed that in terms of petrol station safety, Saudi Aramco is not responsible for supervising petrol stations. Instead, Civil Defence (Fire Fighting) is responsible to monitor the safety in petrol stations. Mr Aysar said, 'When you go to most petrol stations you will find that rain water can leak inside underground petrol tanks, however there is no strict supervision on these tanks'.

This highlights the rationale why participants in this chapter and previous chapters hinted at the problems of government regulations in the petrol supply chain and operations management. For example, in chapters five and six, sections 5.7.3 and 6.6.3, the owners claimed that there are nine government organisations related to petrol stations and this caused unnecessary, redundant and repetitive processes. Moreover, in chapter seven, the Saudi Arabian Fuel Haulers are associated with four government organisations.

Participants claimed that customers feel that regulations in terms of safety and domestic sales are restrictive and confusing. However, these regulations were ordered through government and other government organisations, such as the Ministry of Commerce, Civil Defence and Saudi Standards Metrology and Quality Organisation. Therefore, these many regulations influence in petrol supply chain and operations management.

In summary, section 8.6 diagnosed the environmental context in Saudi Aramco. The findings revealed that weather-related issues, such as extreme heat and sea storms influence in Saudi Aramco's operations management. Moreover, the geographic location was an important factor that influences the petrol supply

chain in Saudi Aramco owing to the distance of refineries from Saudi Aramco's distribution stations. Coastal transportation of petrol is also considered slow. Competition intensity was found to have less influence because Saudi Aramco is the only petrol provider in Saudi Arabia. The strong relationship between government and Saudi Aramco was found to be an important factor that influences the regulations in the Saudi Arabian petrol industry.

In summary, the case study of Saudi Aramco provided extensive knowledge regarding the influence of the TOE factors in operations management and supply chain operations. Table 8.3 summarises the major findings of chapter eight.

Table 8.3: The Major Findings of Saudi Aramco

<b>Technology</b>	<b>Organisation</b>	<b>Environment</b>
Saudi Aramco is keen to apply technology in foremost operations, e.g. ERP software, SAP systems and Hydrocarbon Supply Chain management system	The norms of the tribal community in Saudi Arabia favour face to face negotiation because this way of negotiation most likely ends up with positive agreement	Geographic location influences operations management and supply chain processes considering the relationship between the area of the country and the increased demand for petrol transportation
Has implemented protected networks and servers which prevented the cyberattack that occurred in August 2012	Language is an issue that hinders technology utilisation from the perspective of truck drivers who speak no English or Arabic	Competition intensity does not influence Saudi Aramco domestically because it is the only provider of petrol in the country. However, this influences customers that only have one provider.
	Working hours during fasting in Ramadan and weekends were considered factors that influence employee performance	The centralisation of Saudi Aramco's management causes delays for customers and headed to a gap between top level management and lower level management
	Organisation hierarchy and bureaucracy influences Saudi Aramco	Saudi Aramco has a strong relationship with the government because it is a state owned company
	Cheap petrol prices led to growth of petrol consumption	

This chapter provides an understanding of the influence that types of technologies (i.e. actual technology, traditional technology and information technology) have on Saudi Aramco's operations management, such as ERP systems and Hydrocarbon Supply Chain management systems. Information systems helped Saudi Aramco's integration of the petrol supply chain from exploration process to distribution centres.

Furthermore, this chapter discussed the IT infrastructure and its importance in terms of IT utilisation, which eases and enhance supply chain operations such as monitoring the bulk plants and terminals in real time towards supplying these facilities on time and to avoid delays in international and domestic petrol supply chain. In this chapter we found that language is an issue that hinders technology utilisation in perspective of truck drivers. In addition, we found that Saudi Aramco is aware about the expected cyberattacks, therefore it has made and maintain secured and strong networks and servers which withstood the cyberattack that occurred in August 2012.

In terms of organisational context, we found that culture in a tribal community has a positive influence in terms of the relationship between the organisations and the customers. Family size and its influence in Saudis desire to work from home is also considered as initial factor that influence in work efficiency. In terms of religion, working hours during fasting in Ramadan and weekends' were found to have influence on employees' work productivity. Saudi Aramco provide their workers the choice of working in Ramadan from 7 am to 1 pm or from 9 am to 3 pm. This encouraged the workers in terms of work productivity especially during fasting time and helped them to manage sometime for worship once they came back to their houses. In terms of firm size, the researcher highlighted the influence of hierarchy and bureaucracy in Saudi Arabian organisations. Furthermore, firm resources discussed the issues of low petrol prices and its influence on Saudi Aramco's service quality.

Last but not least, the environmental context discussed the geographic location influence in terms of operations management and supply chain processes taking into consideration the size of the country and the transportation methods such as marine transportation and road transportation. Competition intensity has no influence on Saudi Aramco domestically, however it does influence the global competition with oil companies. Ultimately, government regulations have an important influence on Saudi Aramco which is state-owned company and this highlighted the accordance between Saudi Aramco and the government. The next chapter discusses fuel third party logistics providers.

# **Chapter 9 - Fuel Third Party Logistics Providers (3PLs)**

## **9.1 Introduction**

On the basis of the literature review in terms of 3PLs definition, generally the definition of 3PLs provided by Stefansson (2006, p. 77) will be used: ‘3PLs is a cooperative, three-way relationship between a buyer of goods, the supplier of those goods and a logistics service provider moving and/or storing the goods between buyer and supplier’.

Hence, chapter nine demonstrates the fourth and final unit in this study: Fuel Third Party Logistics provider (F-3PLs), which completes the loop of the petrol supply chain in Saudi Arabia, as well as understanding the Saudi Arabian petroleum industry that leads to supply chain integration.

This chapter discusses the issues related to the petrol supply chain and explores how 3PLs can help to improve petrol supply chain operations management in Saudi Arabia. The understanding of the issues related to the petrol supply chain and the available technical solutions through 3PLs will lead to petrol supply chain integration.

The researcher interviewed four participants in the Fuel Third Party Logistics Provider Company Ltd. (F-3PL) in Riyadh, Saudi Arabia. The participants are the CEO of the company, the marketing manager, the operations manager and a technician. The findings of these interviews represent the issues that face 3PLs in Saudi Arabia based on the TOE factors; technology, organisation and environment and how they influence the Saudi Arabian petrol supply chain and operations management. Furthermore, the interviews and findings exposed rich information in order to answer the research question: ‘how do the technological, organisational and environmental aspects of the Saudi Arabian petroleum industry impact on petroleum supply chain integration’.

This chapter starts with an overview of the F-3PL Co. which is followed by an overview of participants, and then the findings of the components of TOE are discussed from participants perceptive, followed by a summary of the chapter.



## 9.2 Background of F-3PL

The F-3PL was founded in 2010 and it is the only fuel 3PL provider in Saudi Arabia that provides both technical fuel management solutions and fuel logistics, which hints at the uniqueness of this business in the country. However, F-3PL is not able to oversee all petrol stations and fleets in the country which total approximately 70,000 petrol stations and approximately 109,000 fleet trucks. Therefore, the government support for fuel 3PLs success in the petroleum industry is vital and eventually this highlights the significance of this case study in this research.

F-3PL is an exclusive supplier of Ward Inc. which is a company in the USA that has provided fleet fuel management solutions since 1974. Based on working with thousands of customers, Ward identifies the concerns and requirements fleets have with their fuel management systems. Ward is recognised for providing technology, hardware and software solutions bringing solutions for fleet operation managers and petrol stations operations managers. F-3PL was founded by three Saudi partners who contracted with Ward Inc. to be the inclusive supplier to apply Ward's fleet solutions in the public and private fleets and petrol stations in Saudi Arabia.

F-3PL has approximately 200 employees including the fuel transportation fleet and the administrative staffs. In addition, F-3PL is also a recognised fuel hauler because it has a fleet of approximately 200 trucks and fuel containers. F-3PL buys fuel from Saudi Aramco distribution stations to supply petrol stations.

Although the company age is approximately three years, it has signed up several contracts with public and private fleets and petrol stations, for example, Almarai Dairy Liquids fleets, which deliver dairy products to approximately 48,000 customers daily within the (GCC) Gulf Cooperation Council, (Almarai 2013). Another example of important customers is TNT Express which is an international delivery company that delivers parcels, documents and freight items inside Saudi Arabia and overseas. Those and the other public and private fleets are contracted with F-3PL to gain several benefits such as, monitoring their fleet's fuel accountability, reducing fuel expenditures and improving fuel efficiency.

Moreover, F-3PL contracted with several individual petrol stations in Saudi Arabia to apply the Automated Fuel Management System (AFMS) to expand their sales by the allocation of contracted fleets to refuel their vehicles from those petrol stations who apply the system. Therefore, public and private fleets and petrol stations are considered shareholders in the Saudi Arabian petrol supply chain, which is discussed in this chapter.

F-3PL provides several technology-based fuel management solutions such as: fuel view software, fuel control terminal, GPS, tire pressure view and tracking sensors, and third party data integration. Thus, these management solutions help to enhance the operations management in terms of the petrol supply chain.

### **9.3 Participants**

The researcher interviewed four participants at F-3PL. The first participant is Mr Saeed, the CEO of the F-3PL, who explained the influence of culture on applying the automated fuel management amongst petrol stations and the community. Moreover, he identified several aspects that enhance petrol supply chain operations management based on his experience in petrol station management over approximately 15 years.

The second participant, Mr Nayef, is the marketing manager in F-3PL. He explained the technology-based solutions that the company provides and demonstrated the processes of automated fuel management and vehicle's fleet reporting systems based on real-time explanation in the operations control room. Mr Nayef's experience in petrol stations is approximately nine years, which contributes to the understanding of the issues occurring in petrol stations and fuel transportation processes.

The third participant, Mr Arham, the operations manager in F-3PL, was interviewed because he is authorised and permitted by the CEO of the company, to access Ward's servers to monitor the transportation and fleet operations in Riyadh region, the current location of the company. He explained and reviewed randomly selected reports concerning companies and fleets on Ward's servers, to provide examples of the reports generated by the automated fuel management system and vehicle fleet data reporting system.

The fourth participant, Mr Hani, is a technician in F-3PL. He accompanied the researcher to one of F-3PL's customers, which was Alyamamah petrol station in Riyadh (which the researcher referred to in chapter six, section 6.4.1.1) to explain the automated fuel management system. Mr Hani explained the practices of RFID readers and tags on vehicles and the process of the data reporting system based on live demo in Alyamamah petrol station. The following section provides a discussion of technology utilisation in F-3PL in terms of the technological context.

## **9.4 Technological context**

The contribution of this section is to explore the technology effectiveness in petrol supply chain operations management from the perspective of the participants from F-3PL, who discussed those factors that contribute to the role of technology in F-3PL operational processes. Those factors are relative advantage which includes the types of technology (actual technology, traditional technology and Information Technology) and IT infrastructure.

All four participants emphasised that technology influence is crucial in terms of 3PL operations management to enhance the petrol supply chain, but without technology it is next to impossible to monitor petrol stations' needs in real time, and quickly respond to customers. This is discussed in the next sub-sections.

### ***9.4.1 Relative advantage***

This sub-section discusses participants' perspectives based on the three types of technology (actual technology, traditional technology and information technology) to highlight the benefits of technology utilisation in F-3PL and the significance to the customers, in particular the petrol supply chain and fleets operations management. Relative advantage refers to the perceived benefits that are gained from technology utilisation in F-3PL and customers' fleets and petrol stations such as; customers support, minimising operations processes, reducing fuel and fleet maintenance costs, reducing lead time which help to control the petrol supply chain and enhance the efficiency.

### ***9.4.2 Actual technology***

In this sub-section the researcher discusses technical solutions that F-3PL provides in terms of petrol stations and fleets operations management. This can help to understand how the fuel supply chain can be automated. All participants emphasised that F-3PL is highly dependent on technology. For example, Mr Nayef said, 'Approximately all of the fleet management solutions that F-3PL provides are highly technology-based'.

Mr Nayef explained that F-3PL provides technical solutions to the fleets that have hundreds of vehicles for hauling and transportation, such as transport companies, manufacturers and retailers.

Moreover, government organisations were also considered customers of F-3PL, because government organisations have fleets, such as police department, traffic department, Civil Defence, municipal waste trucks, military, etc. These fleets need to be controlled in an effective and efficient way that assures accuracy and cost savings, for example, tracking their vehicles, overseeing vehicle fuel expenditures, forecasting fuel expenditures for each vehicle based on most current reports. Hence, the importance of technology was discussed

In addition, Mr Nayef discussed how traditional payment methods, such as pre-paid fuel cards and manual receipts, affect petrol stations in terms of fraudulent activities between vehicle drivers and petrol station workers. Therefore, one fuel management solution that F-3PL provides is RFID technology, which was discussed in chapter six, 6.4.1.1 that proved 25 percent cost savings in fuel expenditures. However, Mr Nayef said, ‘RFID technology ensures fuel expenditure savings that reach to 30 percent and this is included in the terms of the contracts between our company and customers’.

Considering that Saudi Arabia has approximately 70,000 petrol stations, F-3PL provides RFID technology not only for fleets, but for individual petrol stations irrespective of the size of petrol stations and this helps to expand the use of technology amongst petrol stations in the country. Mr Arham said, ‘Our technical solutions are designed for large and smaller petrol stations and the features are ease of installation and maintenance’.

This highlights that not only medium to large enterprises could benefit from technical solutions provided by 3PLs, but smaller petrol stations can also benefit from technical solutions. Although F-3PL provide technology solutions to manage fleets and control fuel expenses, F-3PL is considered a partner of petrol stations because F-3PL can allocate the customers (fleets) to refuel their vehicles from these petrol stations based on the geographic location of the fleet depots. Through this partnership a 3PL can encourage the use of technology by small firms because of the way they are specifically designed, and the promise of indirect benefit through increasing sales. This is further discussed in sub-section 9.5.3 firm size.

The F-3PL provides several solutions for fleets and petrol station operations management. These technologies were observed based on live demo in Alyamamah petrol station. For example, F-3PL provides Fuel Control Terminal (FCT-RT) that is demonstrated in figure 9.1 below, which is an advanced data acquisition and network access device designed for fuel management industry.

The FCT-RT sets the standard for fuel control terminals with its performance in extreme environments, expandability and durability. The FCT-RT is a stand unit that interfaces to gasoline, diesel, CNG, propane

and various other fuel dispensing devices. Figure 9.1 illustrates the FCT-RT control terminal. The FCT-RT is a terminal that dispatches the received data to the AFMS server that could be an SQL server or Oracle server. Access methods include fully automated CANceiver, HID reader, magnetic stripe cards, and a numeric keypad entry.

CANceiver is a fuel management system that utilizes the latest technology and combines fleet fuelling, vehicle diagnostic data retrieval and fleet data collection products into one automated system. The CANceiver unit scans the fleet vehicle's on-board diagnostic system (OBD) and uploads selected data to track through to the fuel card reader each time the vehicle is fuelled. Mileage figures scanned from the OBD fuel card system reflect the same mileage sent to the dashboard odometer and therefore eliminate mileage errors and any need for calibration. HID reader is a reader device that reads a smart card which can be read without inserting it into a reader device, as required by earlier magnetic stripe card, such as credit cards.



Figure 9.1: FCT-RT Fuel Control Terminal (F-3PL)

Flexibility and expandability was considered in the FCT-RT, which is configurable and can be installed on existing conduit or in new installations. It accommodates up to ten hoses and has the capability to add several components. Moreover, in terms of the communication features, FCT-RT can be configured to connect directly with TCP/IP, phone line, or fibre optic cabling or to communicate wirelessly by hub/modem using 802.11 WiFi, Spread spectrum Radio Frequency technologies or cellular communications. In addition, FCT-RT is capable of integrating with the GPS and Tire Pressure Management System.

Considering that underinflated tires are the main cause of tire failure and degeneration for fleets as emphasised by all participants in chapter eight, sub-section 8.3.4. Mr Arham emphasised that, ‘76 percent of all road side repairs involve tires and share over 83 percent of the total repairs’.

Mr Arham explained that underinflated tires lead to several issues for trucks. For instance, it increases fuel use, decreases handling and braking, increases downtime, added maintenance, etc. Therefore, F-3PL provides a pressure track that is a wireless, electronic, tire pressure monitoring system that both integrate seamlessly with the FCT-RT terminal. The pressure track is comprised of four primary units, valve stem sensors, electronic digital display module, CANceiver and FCT-RT terminal. The valve stem sensor is screwed onto the tire valve stem to transmit data using radio frequency technology, then the electronic display module which can be used on nearly app pneumatic tires send the data through the CANceiver to the FTC-TR control terminals. The CANceiver is a device that enables fleets to track vehicle odometers, driver performance, vehicle tracking, and tire pressure data in one vehicle interface unit which is the CANceiver. Figure 9.2 shows the track pressure system.

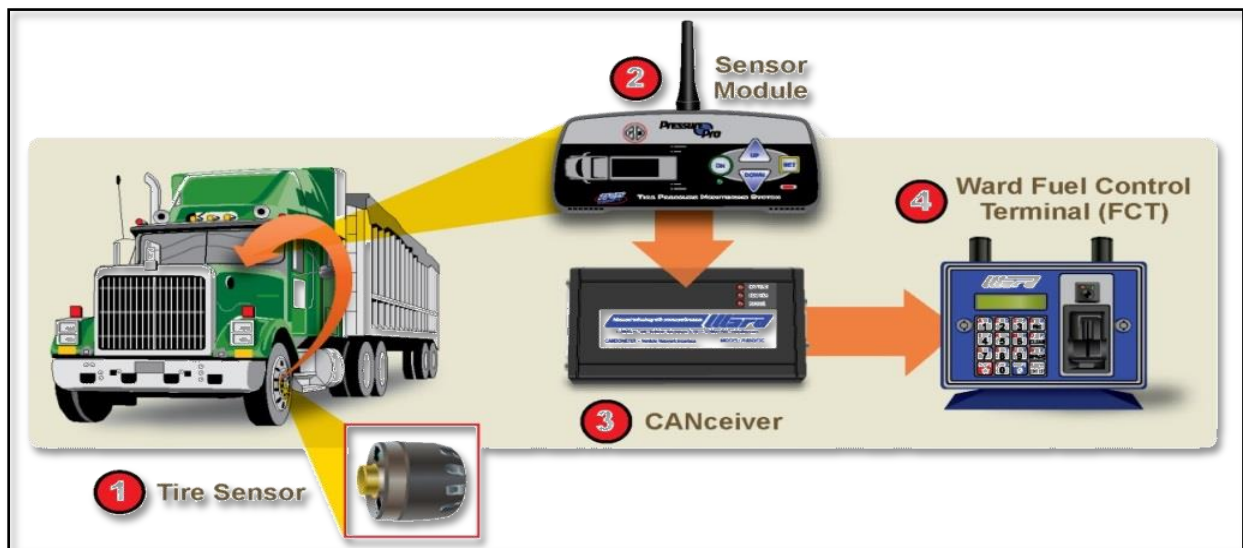


Figure 9.2: Pressure track technology (F-3PL)

In addition, Mr Nayef added that F-3PL GPS tracking helps to reduce fuel costs and vehicle's idle time by approaching vehicle tracking information seamlessly through either cellular or FCT terminals in petrol stations. GPS tracking is easily integrated with FCT terminals to transmit data to F-3PL servers which eases tracking of vehicles and data sharing by enterprise resources.

There are two ways to transmit location data, either through satellite GPS or via cellular network. Customers are then able to view the web-based data and download it into different formats such as, PDF or Word files. Figure 9.3 demonstrates the tracking real time GPS system.

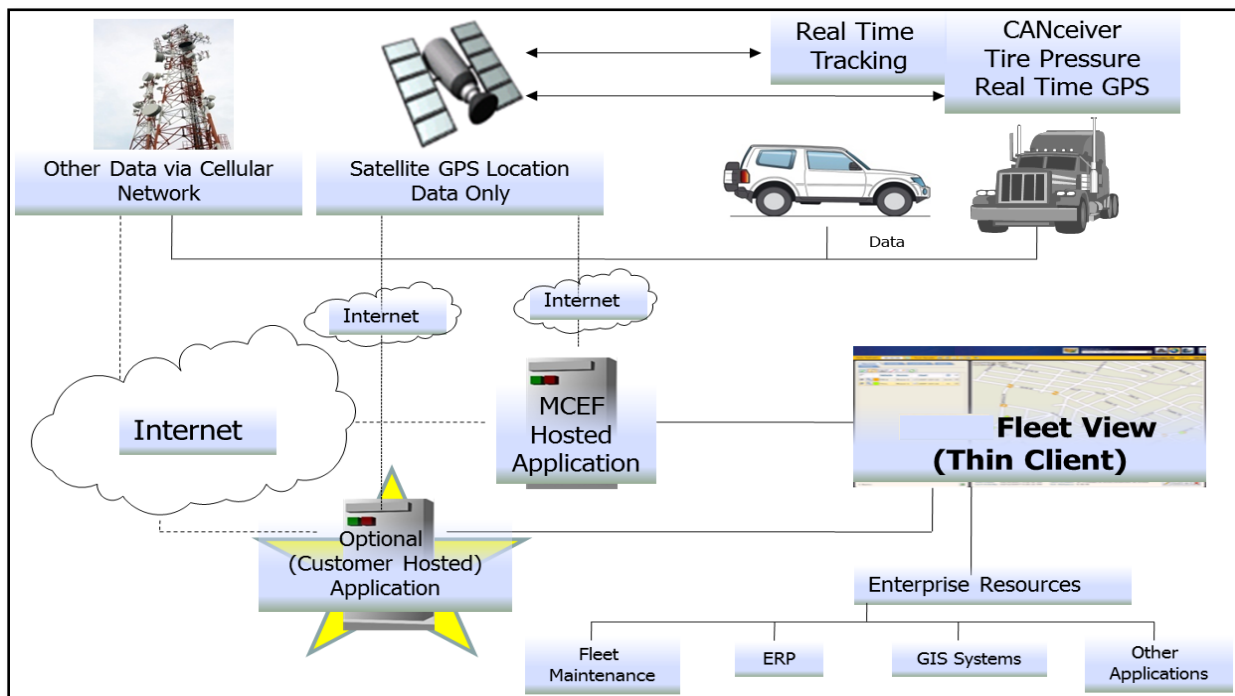


Figure 9.3: Tracking real time GPS system (F-3PL)

Mr Nayef explained further that F-3PL provides another important solution to monitor fuel storage tank levels in petrol stations. This helps to detect the issues in storage tanks and with the lines to petrol pumps, such as leaking issues and ground water levels. The Tank Level Sensing (TLS) which has a probe installed in the fuel storage tank is able to communicate with the FCT-RT terminals through a probe that generates: in-tank inventory reports, in-tank delivery reports, in-tank leak detect reports, line leak reports, ground water rates, and automatic paging on alarms. Figure 9.4 demonstrates the Tank Level Sensing that communicates with the FCT terminal, which supports networking and fax modem communication between the TLS and web-based system.

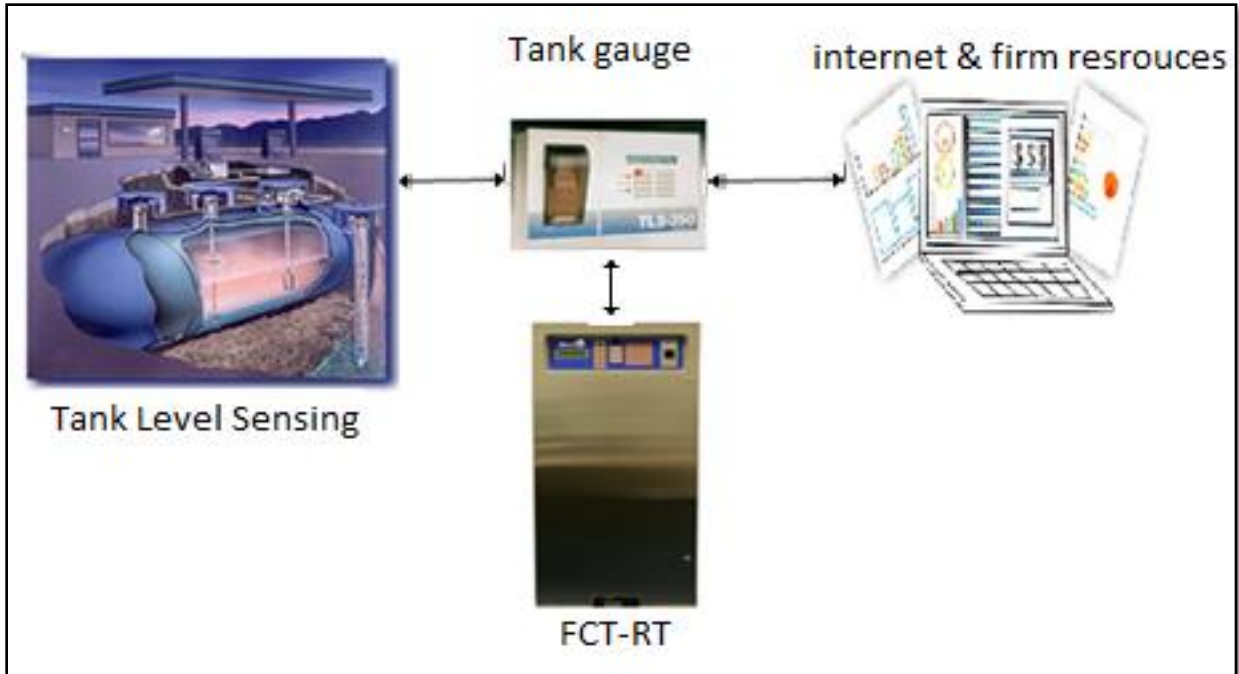


Figure 9.4: Tank Level Sensing (F-3PL)

Ultimately, the Automated Fuel Management System (AFMS) is the integration and synchronisation between all of the above technologies to manage petrol supply chain operations and fleets. Furthermore, this automation process enhanced Alymamah's petrol supply processes and cost savings which eventually led to add-value to the petrol station. Figure 9.5 demonstrates the processes of Automated Fuel Management System in terms of petrol stations and fleet operations management.



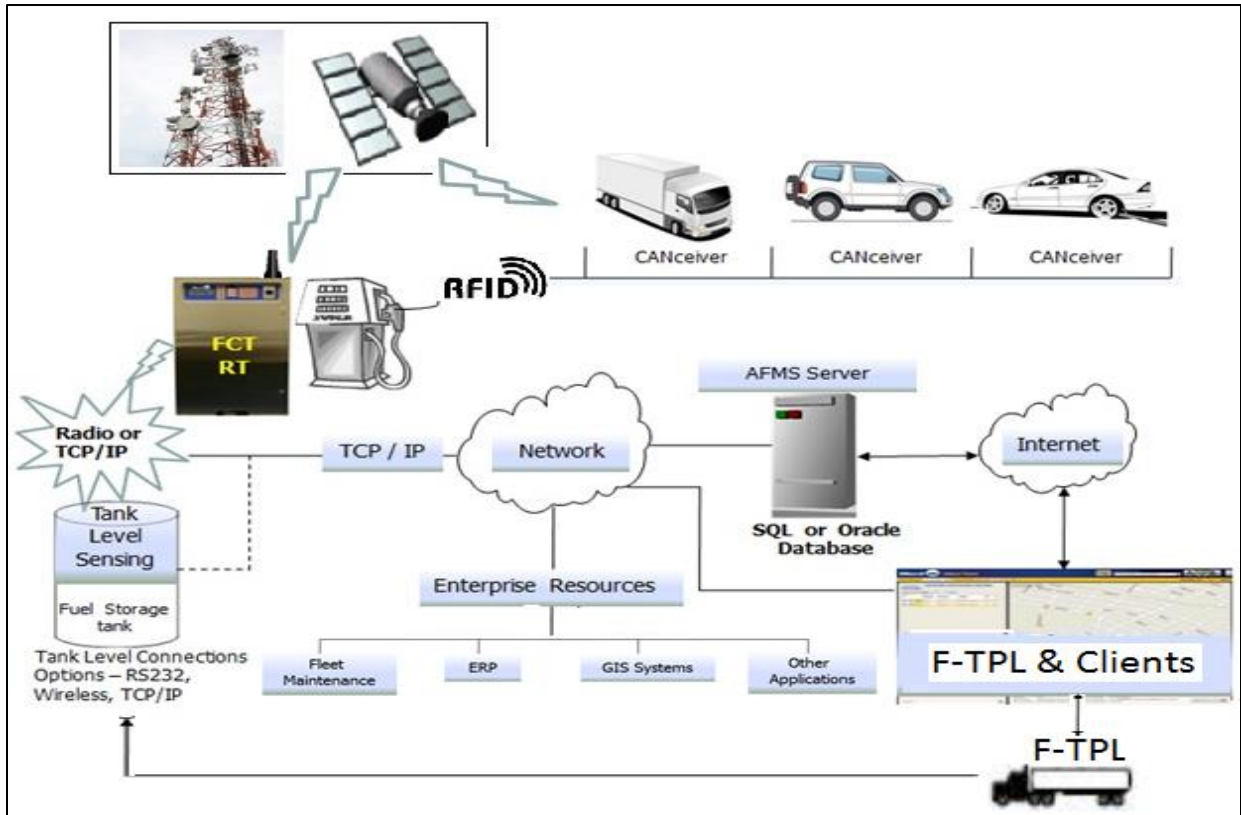


Figure 9.5: Automated Fuel Management System (AFMS) for petrol stations and fleet operations management

The process of automation of petrol stations starts when the vehicle driver enters the petrol station to refuel the vehicle. The RFID reader installed on the fuel nozzle reads the data from the RFID tag installed in the vehicle's petrol tank lid. The data is then transmitted to the FCT-RT terminal which dispatches the data to the AFMS server, a SQL or Oracle server. The data includes; vehicle information, driver ID, fuel quantity, fuel invoice, terminal location, date and time. Clients can view the data from their enterprise resources planning system, if there is one. Otherwise clients can view the information based on the web site that is connected to the F-3PL servers. Accordingly, the data is transmitted wirelessly through radio frequencies or TCP/IP, which is the communication protocol for the internet.

Fleet managers can monitor their vehicles that have CANceivers installed to transmit the data via short radio frequencies to the FCT-TR, which synchronises the transmitted data through the network. Hence, once the fleet's vehicle (F-3PL client) enters the petrol station (F-3PL client and partner), fleets managers would be able to track; vehicle odometers, driver performance, vehicle tracking, and tire pressure data.

In addition, the tank level sensing can transmit the reports of fuel storage in ground tanks via cable connections such as CAT5 cables otherwise it will be transmitted wirelessly to the servers. If the petrol

station needs in-tank delivery, a procurement order will be despatched automatically through the internet to the network that links F-3PL and the clients (petrol stations) to supply fuel. Ultimately, F-3PL will send the quantity of the required petrol product to the fuel station on time without unnecessary delays that occurs in the traditional supply processes.

### ***9.4.3 Traditional technology***

This section addresses how knowledge sharing amongst the F-3PL employees and customers increases the efficiency and effectiveness of the operations management.

The participants hinted at the importance of technology training courses. For example, Mr Saeed, the CEO of F-3PL is keen to educate his employees and sponsor them to attend technology courses in the USA. According to the contract policy between F-3PL and the franchisor, the franchisor agrees to educate the franchisee employees in the USA headquarters. He said, ‘Our company is keen to sponsor the technicians to the franchisor location in the USA to return with a comprehensive knowledge of technology and share it with their colleagues in the company’.

Moreover, Mr Saeed emphasised the benefits of sharing the technology knowledge amongst the employees which helps to enhance their performance. He said, ‘Employees find it a challenge to compete with their colleagues in terms of work performance to meet the sponsorship requirements’.

He explained that they can get a promotion when they come back from training. This gives them an opportunity to explore the western work environment, which helps to enrich their background experience. Moreover, F-3PL can also provide good service quality by the acquisition of the standards of service quality from the perspective of the developed countries, and accordingly F-3PL can influence the service quality of partners in the petrol supply chain.

In addition, the fact that majority of Saudi Arabian communities are youths. The youth like using technology and therefore, will not be afraid to take it up quickly. Mr Saeed said,

In the first place, we found that Saudi youths are excited to use technology; they are highly dependent on ICT. Based on the latest statistics and surveys that our company reviewed, researchers believe that technology utilisation is fun for youth and hence we believe that they are excited to utilise it in petrol stations.

Mr Saeed claimed an important perspective in terms of technology utilisation by youths. On the basis of literature, according to Herring (2008, p. 77) ‘The digital generation is enamoured of technology, for many youth, technology use may not be the most fun activity, but rather what is most available, a substitute for something they would rather do’. This emphasised that technology could entice youths. Moreover, considering that approximately 55 percent of the Saudi Arabian population are youths, this point of view may be an encouraging factor for technology utilisation in petrol stations that is essential step for petrol supply chain integration.

Technology acceptance amongst the Saudi Arabian communities is encouraging advances in the petroleum industry. Therefore, the relative advantage of sharing and transferring the knowledge is crucial in terms of the petrol supply chain integration.

#### ***9.4.4 Information technology***

The Participants emphasised that IT and ICT help organisations to save the labour costs and reduces operations processes. For example, Mr Saeed said, ‘Nowadays people are being replaced in their jobs by computers or computer directed machineries’.

Mr Saeed explained that IT and ICT help to save labour costs in terms of; salaries, physical buildings, electricity and water expenses. For example, emails help people to send their messages with a click. Therefore, people that used to send letters to their families, or organisation’s employees who need to contact their customers, are now able to use the internet and emails at any time. This helps to reduce the organisational processes that used to take several days to deliver the letters through the post carriers. F-3PL is alike, in terms of AFMS that uses internet and emails as the major IT process to transfer the flow of information within the petrol supply chain operations management. Hence, workers and management offices in petrol stations are not required because IT can help to minimise work hours and the need for physical offices.

Another example to expand the understanding of the relative advantage of IT is the ATMs that help to reduce the employees such as the bankers and tellers because of the 24/7 service availability. Customers normally look for the fastest services that enhance their satisfaction and service quality. The technical ATM devices only require electricity supply, IT infrastructure and periodic maintenance. Hence several manual processes that formerly required face-to-face service are now replaced by self-service processes. Therefore, Mr Saeed emphasised that IT provides an important portion of petrol supply chain operations

management because AFMS provides an automated system that minimises the need for physical attendants, as it can now provide 24/7 service based on IT.

Mr Nayef also added that the AFMS allows customers to view the data online showing consumed fuel quantity, fill quantity, and fuel costs. Moreover, the ability of the AFMS to connect with the ERP systems also provides the flexibility to share the information flow within the organisations such as government and private organisations and petrol stations. Moreover, customers are able to download the required documents at any time.

In addition Mr Nayef said, 'One of the influences of AFMS implementation in petrol stations is to eliminate the frauds and imprecisions in the petrol supply chain operations'.

As discussed in chapter five, section 5.2, which revealed that fraudulent activity at petrol stations in terms of payment techniques, such as traditional manual invoices and pre-paid fuel cards, have proved a failure in terms of accuracy. This highlights the importance of IT in terms of payment processes. The utilisation of IT in F-3PL is not only helpful to improve the imprecisions in terms of payment processes, but can enhance the imprecisions of fuel balances in petrol stations' tanks, which help to restrict the interruptions, improves the reliability of petrol stations and boosts customers satisfaction.

Eventually, IT can guide the petrol supply chain towards advanced replenishment and a safer operations management environment which can influence high quality services and customers' satisfaction.

#### ***9.4.5 IT infrastructure***

Information technology infrastructure is the key base of technology implementation within an organisation to improve the operations management (Bosstorff & Rosenbaum 2012). F-3PL is highly dependent on technology to provide the technical solutions in terms of operations management in the petrol supply chain in Saudi Arabia. Therefore, F-3PL is not only considered the provider of IT solutions, but also provides the IT infrastructure to customers. Mr Nayef said, 'We provide the technology with the required infrastructure to our customers as long as they are contracted with us'.

The role of F-3PL does not solely provide technical solutions, but it also provides the required technical infrastructure to complete the performance of AFMS. Mr Nayef explained that customers that have no IT infrastructure can benefit from the contract with the F-3PL, which includes installing the required IT infrastructure and the technical devices. However, there are terms and policies that are included in the contracts in terms of the prices and equipment's protection from damage.

This highlights that the 3PL are not just transporters of fuel but also providers of IT infrastructure to small petrol stations. Providing the required IT infrastructure includes providing the actual technology, workers' train on technology and periodic maintenance. Mr Nayef said, 'It is next to impossible to request from all individual petrol stations to enhance their infrastructure on their own cost especially when we are talking about approximately seventy thousand petrol stations in Saudi Arabia'.

Mr Nayef explained further that most Saudi Arabian petrol stations are more than 30 years old. Infrastructure that includes threadbare underground fuel tanks and pipes that need to be replaced or renovated can cost them more than expected. Therefore, it is good choice for these petrol stations to outsource these processes to fuel 3PLs in order to enhance their efficiency. The technical solutions and IT infrastructure can help them to gain maintenance and structures cost savings. For example, AFML can automatically examine underground tanks and pipes to test if there are leaks or environmental issues in the soil, by the tanks level sensing system as demonstrated in Figure 9.4.

Moreover, F-3PL can provide solutions that include technical and strategic solutions that can reduce the maintenance cost on these petrol stations. For example, renovations of petrol tanks and isolation processes of petrol tanks, replacing the tanks with better quality and low cost petrol tanks, and then implementing technical solutions to monitor these tanks based on the length of the contract.

In addition, F-3PL provides IT infrastructure for fleet customers of F-3PL. For example, fuel haulers' fleets can benefit from outsourcing the IT infrastructure to fuel 3PLs. The IT infrastructure includes flow meters, GPS and RFID technology that need connection to the servers via the internet and cables to control fuel quantities that truck drivers' transport. F-3PL installs the IT infrastructure such as AFMS and the required cables in petrol stations that fuel haulers supply. Hence, fuel haulage fleet managers can control their fleets through the internet based on the infrastructures installed by F-3PL. Thus fuel haulers can benefit from controlling the fuel quantity that is transported from Saudi Aramco distribution centres to the petrol stations.

Ultimately, the customers of F-3PL such as Petrol stations and fleets (private and government fleets) can save IT infrastructure costs that F-3PL provides based on the contracts to enhance the efficiency and effectiveness of operations management.

In summary, this section discussed the technical context and the related factors that influence the operational management in the petrol supply chain, based on the F-3PL technical solutions. The findings demonstrated that the role of 3PLs is significant in terms of providing technology solutions to enhance petrol supply chain operations management in Saudi Arabia. The F-3PL is an example of the fuel 3PLs

however it is the only fuel 3PL provider in Saudi Arabia, which has approximately 70,000 petrol stations. Therefore, this deserves consideration by the government which is discussed in section (9.6.3). The next section discusses the organisational context.

## **9.5 Organisational context**

The participants in F-3PL provided a rich source of information about the influence of culture, religion, firm size and firm resources in the operations management. In addition, the influence of each factor is discussed from the participants' perspectives. It has enriched the comprehensive understanding of the organisational influence particularly in terms of fuel 3PL providers in Saudi Arabia.

### **9.5.1 Culture**

Culture has an influence in the Saudi Arabian petrol supply chain and operations management. For example, Mr Saeed and Mr Nayef emphasised that culture must be carefully considered to achieve success in petrol stations' operations management. However, they argued that culture does not influence F-3PL's operations. For example, Mr Saeed said, 'F-3PL directly contacts the petrol stations, private and public fleets and government organisations, therefore the influence of the norms and customs of Saudi communities does not influence F-3PL but maybe influence on our customers'.

When the participants were interviewed, they discussed the culture in terms of the Saudi youths because they are the dominant population in the country. In addition, the previous literature stated that the majority of Saudi population are young people.

Mr Saeed speculated why some people believe that Saudi youths are reluctant to work in petrol stations. He said, 'Saudis do not want to work in the current petrol stations because they are not keen to achieve the minimum level of hygiene, safety and wages'.

He explained that Saudis are more likely to work in petrol stations once these stations improve the work environment, such as in the areas of hygiene and safety. Hygiene and safety have previously been discussed in chapter five (section 5.2) and addressed as an issue that hinders service quality. Moreover, the researcher discussed that most petrol stations in Saudi Arabia are rented by foreign workers in Saudi Arabia, and these stations lack hygiene and safety because there is no supervision by the regulator, which

is the government. Furthermore, the researcher discussed that the workers at these petrol stations are more concerned about the profit than service quality because they share the profit with their partners, and hence, they are not concerned about lower wages. This explains why Saudis do not want to work in petrol stations and emphasise what Mr Saeed argued, that the Saudis culture is not hindering Saudis' desire to work in petrol stations.

In addition, in terms of work opportunities in the proposed standardised petrol stations, such as self-service petrol stations based on the AFMS implementation, Mr Nayef said, 'Most Saudi youths and communities are educated. They know or they have heard about self-service petrol stations in many countries around the world'.

This emphasises that they are able to grasp that self-service petrol stations can help to create job opportunities for Saudis to work as petrol stations operators and this would help to reduce the reliance on foreign workers that are responsible for activities of corruption within some petrol stations in Saudi Arabia.

Ultimately, considering that Saudi Arabia has approximately 70,000 petrol stations, self-service petrol stations and technology utilisation such as the AFMS can potentially create a number of jobs for Saudis, such as petrol stations superintendents for each petrol station. Eventually, this may help to minimise the unnecessary number of foreign workers and reduce working hours in each petrol stations, as well as minimise the reliance on human-based processes.

### **9.5.2 Religion**

In Saudi Arabia there are no designated entertainment facilities for youths and this is not because of the religion of Islam. There is a failure by the government to provide entertainment facilities such as; public play grounds and parks, public sport clubs, equipped facilities to practice their hobbies, etc.

As a result, Mr Nayef emphasised that lack of entertainment led to increase fuel consumption because youths account for 55 percent of the Saudi Arabian population and favour driving their cars for entertainment. Mr Nayef said, 'Lack of types of entertainment in the country, not only in terms of cinemas, but in all means of entertainment, led to increased fuel consumption because youths will drive their vehicles without any goal, just for fun'.

This emphasises the perspective of participants in previous chapters, for example in chapter 8 (section 8.5.1.4), when participants discussed that Saudi youths prefer to drive their vehicles on highways as kind of entertainment.

In addition, Mr Saeed stated that it is unlikely Saudis participate in the fraudulent activity that occurs in petrol stations, such as sharing the collected money of pre-paid fuel amongst the workers. Mr Saeed said, 'Foreign workers know that the Islamic Law criminalises theft and fraudulent conversions. However, it harms Saudis more than foreigners'.

Mr Saeed explained that Saudi Arabia applies Sharia Law that criminalise fraud and theft, 'He cited a Hadith of prophet Mohammad' that explains that the theft punishment in Islamic Law is strict and this can discredit the reputation of who commits it in the community. However, foreign workers in petrol stations might ask other foreigners from the same nationality to share the collected money of pre-paid fuel amongst them. The punishment that they would face, if they are caught, is imprisonment for a specific period that is determined by the judge, and/or cancellation of their visa (Mahdi 2008). Hence, they will migrate to their origin countries in which nobody knows their history back in Saudi Arabia.

Mr Nayef discussed that petrol stations are 24 hours petrol service providers; however in Saudi Arabia all public and private businesses must be closed during the five prayers period. This was discussed in chapter five, (section 5.6.2). However, Mr Nayef claimed that the AFMS can help customers to refuel during prayers times, for emergency situations. There are emergency situations in which people need to refuel during prayers time, such as personal emergency situations requiring hospitalisation. Therefore, the pumps are equipped with credit card slots to help in these cases, where customers can refuel and pay automatically, so that the workers do not need to serve customers during these times. However, there is a divide by religious people in terms of allowing people to refuel during prayers time. But Mr Nayef claimed, 'If all business facilities including self-service machines must be closed during prayer times, why are ATM machines, which are one of a petrol station's facilities, allowed to remain open during prayer time?'.

Mr Nayef hinted that people who want to withdraw money from ATMs can pray and withdraw after prayer but they are allowed to withdraw during prayer time though. Therefore, people who have emergency situations sometimes need to refuel their vehicles and this can happen only when self-service petrol pumps are available and permitted during prayers times, a solution that does not contradict Sharia Law. The next sub-section discusses the firm size of F-3PL.



### 9.5.3 Firm size

Firm size is an important factor in terms of operations management. F-3PL which has approximately 200 employees is categorised as a large enterprise according to the scale of employee's numbers (Herrera & Sánchez-González 2013; Nieto & Santamaría 2010).

Mr Saeed, the CEO of the company, explained that he hired five females in F-3PL, in the operations department because the company relies on technology and ICT would help to minimise the need of work hours in terms of administrative jobs. Mr Saeed said, 'We have five ladies to supervise the demand in petrol stations and complete the operational processes of petrol supply during the day shift, and one guy works in the night shift'.

Mr Saeed discussed that it is uncommon to find women working in the petrol industry in Saudi Arabia due to the nature of petrol industry within a harsh organisational environment. However, in F-3PL, women can work in supervisory and administrative jobs that do not require them to move to petrol stations or to hauling fleets. Their job is monitoring the screens in the operation room, which is connected to the internet and phones, to update the truck drivers about the required quantity and type of fuel product that petrol stations need. Hence, this is relevant to firms size as part of petrol supply chain integration, because hiring women helps to increase the firm size, which in turn will improve on service delivery.

In terms of the number of employees in the day and night shifts, Mr Saeed argued that the day shift which starts from 8am to 8pm is the peak time, and therefore he hired five ladies to work during these times. However, the night shift which starts from 8pm to 8am is off peak, therefore one guy can finalise the required supply processes during these times.

Mr Saeed and Mr Nayef emphasised that the shift working hours can help to enhance the operational management of petrol supply chain and reduce the shortage of petrol products in petrol stations. Ultimately this helps to enhance service quality in the petrol industry. Moreover, this would help to increase the sales in petrol stations and enhance petrol stations' operations management. Mr Nayef said, 'Most petrol stations that are rented from Saudi owners are managed by foreign workers because the owners do not know how to manage petrol stations'.

Mr Nayef argued that foreign workers at petrol stations need to update the station owner when petrol supply is required and this can occur in different hours of the day or late at night. Therefore, petrol station owners authorise those workers and provide them the required user and password for login to Saudi Aramco when fuel is required through Aramco's procurement website. Accordingly, the foreign workers

can delay petrol supply orders to minimise the income and the sales to affect the stations' income. When the sales dropped, the owner will not be able to know the cause of sales downturns because he has no idea of the required demand of his petrol station and when he should supply it. Hence, the owner leased his petrol station to the foreign workers for monthly or yearly rent instead of the loss. In other words, on the basis of chapters five and six that 80 percent of the Saudi Arabian petrol stations are owned by uneducated people in petrol station business management therefore, they prefer to rent petrol stations to the workers instead of taking a loss.

In addition, Mr Saeed addressed that F-3PL contract with petrol stations based on the fuel sales which depend on the private and public fleet vehicles (F-3PL's customers) that refuel from these petrol stations. Therefore, F-3PL contract with petrol stations for short-terms (yearly-based contracts). Once the petrol stations sales increase, F-3PL increases the value and renews the contracts accordingly. The increase of petrol stations sales means F-3PL customers' fleets are expanding and this would reflect on the firm size of F-3PL, which would require additional costs, such as hiring additional employees to reduce the maintenance delays and speed up the supply operations processes. This is reasonable for F-3PL to increase the value and the profit margins to enhance the service quality. Mr Saeed said, 'The normal increase of the value is approximately half to one halala per litre but if the petrol station's owner refuses to renew with us, there are approximately ten thousands petrol stations in the country we can contract with'.

However, Mr Saeed claimed that F-3PL contracts with private and public fleets based on long-terms contracts because they are the strategic partners and the expansion of these fleets means more ROI for F-3PL. Therefore, F-3PL is keen to remain with these customers based on long-term contracts (minimum of three years) in order to expand their fleet size, which consequently increases their ROI.

#### **9.5.4 Firm resources**

Firm resources addressed an important factor that influences the operations management in the F-3PL. Participants emphasised that the firm's resources help it to enhance service quality and increase profit, specifically petrol sales. For example, Mr Nayef discussed that the AFMS helps them to increase their profit. Mr Nayef said, 'The AFMS assist us to know our customer's profits and sales and accordingly we can evaluate our ROI'.

He explained that F-3PL customers were classified into different clusters based on their sales, such as petrol stations, and based on their fuel consumption, such as private and public fleets. For example,

private fleets that have approximately 500 vehicles, but do not refuel on a daily basis, are less important. However, other private fleets that have 100 vehicles but refuel daily are considered important customers. This is because those who refuel daily increase the sales of petrol stations contracted with F-3PL in terms of petrol supply. Thus, F-3PL will be able to benefit from customers resources, which are considered external resources, rather than the internal resources.

This also highlighted the importance of relationships with the petrol stations contracted with F-3PL. Therefore, F-3PL is keen to review the sales of petrol stations and the value of petrol procured by the fleets to update the classification of F-3PL's customers to identify important customers.

Furthermore, Mr Arham the operations manager in F-3PL stated that firm resources includes the operations management processes. For example TNT Express, which is a delivery company that delivers parcels and freight items inside Saudi Arabia and overseas, is contracted with F-3PL to gain several benefits such as, monitoring their fleet's fuel accountability, reducing fuel expenditures and improving fuel efficiency. Mr Arham said, 'F-3PL also benefits from TNT to deliver the F-3PL parcels, documents and freights for special prices or sometime for free'.

Hence, a customer such as TNT is considered a strategic partner and important customer for F-3PL. Furthermore, TNT helps the F-3PL avoid additional costs such as hiring additional employees for communications management, and correspondence fees.

In this section the researcher discussed important factors influencing fuel 3PL organisational operations management i.e. (culture, religion, firm size and firm resources). For example, the researcher discussed culture influence in terms of youths' desire to work in self-service petrol stations. More so, religion is discussed in terms of the influence of Sharia Law on F-3PL solutions provided to petrol stations, such as utilising self-service petrol pumps during prayers time. In terms of firm size and firm resources, the researcher discussed that information flow helps F-3PL categorise the contracted firms that have a direct relationship with the F-3PL firm resources, in order to increase the ROI and make the decision whether the firm's expansion is required or not.

## **9.6 Environmental context**

Environment factors refer to the environment in which an organisation conducts its business, such as geographic location, competitors and dealing with the government. In this unit (F-3PL) the environmental factors are discussed based on the participants' perspective.

### **9.6.1 Geographic location**

In terms of the geographic location, participants discussed the importance of the selection of petrol station locations from different perspectives. For example, Mr Nayef states that F-3PL selects petrol stations based on those stations contracted with F-3PL, such as public and private fleets. Mr Nayef said, 'We offer our solutions to petrol stations that are considered close to our customers' public and private fleet location and we consider the service quality in these petrol stations'.

Mr Nayef explained, for example, if the customer's fleet location is in Northern suburbs of Riyadh, F-3PL should search for petrol stations located in the Northern suburbs of Riyadh and offer high quality services in order to offer them F-3PL operations management solutions. This is because these petrol stations will serve other F-3PL's customers (public and private fleets). Hence, F-3PL will be able to integrate the petrol supply chain amongst all customers (i.e. petrol stations, public and private fleets). This also helps to reduce fuel consumption for private and public fleets because they will supply their vehicles from petrol stations located near to their fleets, as well as improving their supply chain and operations management through the integrated AFMS. Moreover, truck drivers can start their travel with a full tank of petrol from their origin, which helps to reduce the interruption en route to their destination.

Moreover, high service quality is important for F-3PL because F-3PL wants to contract with petrol stations who are able to preserve the technical infrastructure that will be installed by F-3PL. In addition, high service quality helps to maintain the relationship with the customers (fleets) to remain contracted with F-3PL long-term because customer's fleets are going to extend the contract when they are happy with the quality of service provided by petrol stations, which eventually leads to F-3PL considering these fleets as strategic partners.

Mr Saeed discussed the geographic location from another perspective. He discussed the influence of the geographical location in terms of petrol consumption in Saudi Arabia and how this can influence the overall petrol industry. Mr Saeed said, 'The area of Saudi Arabia is approximately two million square

kilometres and the population is approximately 28 million and the number of population is increasing, consequently the demand on petrol supply will increase in all regions of the country’.

Mr Saeed explained that there are several factors linked to the geographic location, which eventually led to the increase of petrol consumption in the country. He stated that the area of Saudi Arabia, which is considered huge in contrast with the other countries in the region, makes the petrol supply chain more difficult than the other countries due to the distance of customers and the locations of Aramco’s distribution centres. Then Mr Saeed discussed that population is increasing and will increase in the near future due to the fact that approximately 55 percent of population are youths who are within range of the marriage age, and this would also lead to increase in new born numbers. Hence, the petrol demand will increase and this will also influence the fuel transporters by expanding their operations to meet this demand.

Moreover, Mr Saeed highlighted that the government statistics proved that after ten years the population would increase by 40 percent and this increase requires doubling all means of social services, such as hospitals, schools, houses, petrol stations, etc. Ultimately, this will lead to the increased utilisation of vehicles, automobiles, trucks for transportation, etc. This will increase the demand for petrol, hence more petrol transporters will be required to meet the demand in all regions in Saudi Arabia.

Moreover, the population of teachers in Saudi Arabia is approximately half a million male and female teachers. However, not all of them are teaching in the cities, with 40 percent teaching in remote villages. This requires them to travel every weekend (if not every day because they usually live with their families) from their homes to these villages, and back next day. Distances to reach these remote areas can be up to 600 km. Hence, the demand on petrol consumption would increase considering the only means of transport in the country is vehicles and buses.

In addition, the major consumer of diesel in the country is the private sector vehicles, particularly, in the capital city (Riyadh) because the population is approximately eight million and the area of Riyadh is approximately 1,554 square kilometres. Moreover, Riyadh is the financial capital of Saudi Arabia, in which King Abdullah Economics City resides, where most of the large enterprises headquarters and operations management departments are located.

Furthermore, Riyadh is located on the transportation route that connects all regions of Saudi Arabia: Northern, Southern, Eastern and Western regions. Therefore, most haulers and transporters should pass through Riyadh city. This highlighted the importance of Riyadh’s strategic geographic location linking all regions of the country. This also influences the location of the petrol supply chain and operations

management of haulers and petrol stations. For example Riyadh is a strategic location for fuel haulers and petrol stations due to the close proximity of Aramco's distribution centres. Many customers consider Riyadh as a strategic location that links all regions of Saudi Arabia. This also helps determines who F-3PL contracts with as they seek to contract with those customers close to Riyadh.

Moreover, the government plans to operate railways in Saudi Arabia that can help to improve the logistics operations; however establishing a new sector should not affect a previous one. Mr Saeed said, 'The implementation of railways in Saudi Arabia can affect the road transportation sector; therefore the government should find solutions to protect the current transportation sector, which is road transportation'.

Mr Saeed explained that when the government operate railways this will affect the business of road transportation. Therefore, he is aware of this operation that could minimise his business income, but if the government regulate this sector in order to improve the transportation in Saudi Arabia, haulers and transporters should be also organised to operate their fleets, otherwise their business will be threatened with loss.

Last but not least, Mr Saeed hinted that the geographic location also influences implementation of technical solutions in rural areas. For example, F-3PL aims to start AFMS phase one implementation in Riyadh city, where employees and educated people are living because the perception of people in terms of technology is different from a city to a village. Therefore, the implementation should start in metropolitan areas with those people who are conversant with technology, and the perception of those people would influence the other metropolitan and rural areas. Hence, technology acceptance in metropolitan areas is critical to the gradual adoption of technology in other rural and metropolitan areas in the country.

### **9.6.2 Competition intensity**

F-3PL provides logistics and technology services for their contracted clients (petrol stations, private and public fleets) to improve their supply chain operations management including logistics and SCM integration. This highlights that F-3PL is the only fuel third party logistics provider that provides logistics and technical services in Saudi Arabia. This means that F-3PL have no competitors. However, the technical solutions carried out by F-3PL and utilised in petrol stations and fleets can help to increase profits and save costs for petrol stations and fleets from different perspectives.

For example, public and private fleets are not able to manage their vehicle fuel expenses accurately unless technology is implemented in petrol stations and vehicles. Therefore, F-3PL supplies the fleets and petrol stations with technology to control vehicle fuel expenses at fleets and increase petrol stations' sales. Mr Nayef said, 'We are considered as brokers and logistics providers together, because we provide technology, transport fuel, share the profits with petrol stations and help fleet managers to control their fleets'.

Moreover, F-3PL's customers are considered strategic partners of F-3PL because they share the information flow in terms of service quality enhancement. In other words, petrol stations and fleets can control the organisational efficiency and effectiveness which is considered in the literature review, chapter two (5.2.1), an important portion in terms of supply chain success.

The competition amongst F-3PL's customers and other petrol stations and fleets, can lead them to seek the causes that helped F-3PL's customers (petrol stations, public and private sector) to increase their profits, gain cost savings and entice customers. The competitors will perceive that public and private fleets are enticed by petrol stations who utilise technology in their operations and procurement management. This can increase the intensity of competition towards achieving the efficiency and effectiveness of petrol supply chain amongst competitors.

In other words, by using technology and seeing competitors use that technology causes rapid adoption of technology and forces companies to keep up with one another. By this they can improve sales, and cost savings, and entice customers. Thus, they can gain a competitive advantage. This also will help to encourage the competitors of F-3PL's customers to move some of their logistics activities to F-3PL in order to reap from technology and compete. This also influences the improvement of service quality amongst petrol stations, public and private fleets, as well as the competitive environment.

Mr Arham claimed that when F-3PL contracts with petrol stations, F-3PL requests from the petrol stations promotional offers such as, petrol discounts and monthly pay periods to encourage the fleets to refuel from these petrol stations. This can help to increase the sales in petrol stations based on the number of fleet vehicles. Moreover, this can help to enhance the competitive environment in petrol stations, which is currently described as a dishonest competition environment in chapter five (5.7.2).

In addition, Mr Arham discussed that the company hires employees who have a minimum nine years of work experience in petrol stations. This can help to grasp all issues in petrol stations such as transport issues and supply chain operations management issues. Therefore, the company is well qualified in terms

of petrol station operations management and this can enhance petrol stations' competitive environment by using expert knowledge gained through trial and error, experience which is hard to replicate.

Furthermore, Mr Arham explained that monitoring petrol stations demand can enhance the petrol supply chain to minimise interruptions due to lack of petrol products. Mr Arham said, 'We have six employees in operations management who work 24/7 to monitor petrol operations by technology to prevent delays in the petrol supply chain'.

Moreover, some corrupt workers in petrol stations can cause delays in petrol stations. They can delay the procurement process from Saudi Aramco to reduce the petrol station's income. Thus the owner can fall into the trap of wanting to lease out their business to foreign workers as discussed in sub-section (9.5.3). In other words, an automated procurement process, which despatches orders automatically to the operations management employees on time, with the required amount of fuel, can give the owner a competitive advantage because it can help them to manage their petrol stations more effectively without the reliance on foreign workers, preventing unnecessary delays within the petrol stations operations.

### **9.6.3 Government regulation**

Participants explained that the government support is vital towards fuel 3PLs success in the Saudi Arabian petroleum industry. They highlighted that fuel 3PLs need government support in order to overcome three significant issues, 1) the country's main income is oil, however petrol consumption is extremely high within Saudi Arabia, 2) the petroleum industry in Saudi Arabia is not tightly regulated due to a lack of government supervision, 3) There is a lack of guidance and clarity in following the government regulations.

The first problem in regards to the high consumption of petrol, Mr Saeed discussed that given the fact that petrol consumption in Saudi Arabia is high in contrast to other comparable countries, the Saudi government should resolve this issue before it becomes too late. He said,

Saudi government funds 80% of local petrol prices by approximately 40 billion Saudi Riyals each year, the consumers consume five million barrels of oil each day and the annual rise of petrol consumption in the country is approximately six percent.

This sets off alarm bells because this means Saudi Arabia is the first consumer of petrol products in the world and if the consumption rates continue at six percent, it is expected that Saudi Arabia will consume eight million barrels each day by 2030 (Alahmad 2013).



Hence, Saudi government can save up to 30 percent of government funds in terms of supporting the fuel prices through technical solutions that F-3PL provides. Mr Saeed further explained that F-3PL assures up to 30 percent saving petrol consumption cost by implementing technical solutions, such as RFID and AFMS. This was confirmed by petrol stations managers, such as Mr Majed who was interviewed in chapter six (Section 6.4.1.1), when he utilised RFID technology and reaped up to 25 percent saving of his vehicles' petrol consumption.

Therefore, government need to support customers so they contract with 3PLs who have better service quality. For example, Saudi Aramco should consider providing special discounts for petrol stations and haulers to encourage them to contract with fuel 3PLs, which can assure better service quality and enhanced petrol stations supply chain operations, and this will help to minimise petrol consumption in the country. Mr Arham said, 'Saudi Aramco which is the primary provider of petrol in the country does not provide any supportive offers for petrol stations' owners or renters to improve their stations such as encouragement discounts or rewards'.

The second problem deliberated was the lack of petroleum industry regulations and enforcement in Saudi Arabia with no government organisation to supervise the industry. Saudi Aramco is not only the government organisation that should support 3PLs; but the Ministry of Finance, Ministry of Transport, The Saudi Commission for Tourism and Antiquities, Ministry of Municipal and Rural Affairs. All of them are government organisations related to petrol supply chain.

Although the Ministry of Petroleum and Mineral Resources (MOPM) is the authorised Ministry to supervise and regulate oil industry in the country, Mr Saeed, Mr Nayef and Mr Arham claimed that there is no reason why it does not take the lead responsibility to control petrol supply chain members in Saudi Arabia. For example Mr Saeed said,

Our understanding that MOPM is the authorised government Ministry to manage the Saudi Arabian local and overseas petroleum industry, however I do not understand why the role of MOPM is completely hidden in terms of the local petroleum industry management.

He discussed further that Saudi Aramco which is the petrol provider should be under the umbrella of MOPM. However, for example, Saudi Aramco takes the responsibility to perform workshops to educate the petrol station owners and the petrol haulers in terms of managing the fleets and petrol stations. This should be organised by the authorised government Ministry which is MOPM. Instead Saudi Aramco is

being distracted from the major responsibility of providing oil and petrol products and assuring high service quality for the customers, to offer training workshops.

Mr Saeed and Mr Nayef claimed that when they established the F-3PL they were confused in terms of government regulations. They were required to contact three government organisations, Mr Saeed said, 'To obtain the licence we were directed to the Saudi Chamber, to obtain the location licence we were directed to Ministry of Municipal and Rural Affairs and to buy the petrol we were directed to Saudi Aramco'.

Mr Saeed discussed that this confusion between government organisations affected their operations management because it caused unreasonable delays.

More so, Mr Arham also discussed that there is no specific government organisation taking the lead responsibility to manage the petrol supply chain and shareholders instead of unnecessarily repeating or contradicting processes. For example, Mr Arham said,

Saudi Aramco instructions in terms of petrol pumps' electricity voltage in petrol stations must be 380 volts. However, once we meet the Aramco's instructions and installed the petrol pumps the Municipals fined us because the Municipals instructions advised that the electricity voltage must not exceed 220 volts.

Mr Arham elaborated that the Civil Defence (fire fighters) inspects safety requirement in petrol stations once they have been constructed, however after 48 hours the petrol stations owners or renters can change whatsoever they want due to the paucity of Civil Defence patrols of petrol stations.

Therefore, 3PLs can help the government to integrate all organisations related to the petrol supply chain, as well as monitor and supervise the petrol supply chain in the country based on the information flow of the integrated petrol supply chain. It was suggested that government regulations must be aligned with each other. This can occur once the government centralises regulations, by having e-government services and the petroleum industry supervised and managed by one authorised government organisation.

The third problem was highlighted in regards to the clarity and execution of government regulations. There is a lack of guidance in following regulations. For example Mr Saeed said,

Licence approval should not be granted by the Ministry of Transport unless the haulers have completed the contracts instead of allowing the hauler to buy the trucks and eventually the

hauler surprised that he is unable to operate his trucks unless all contracts provided.

Mr Saeed explained that holding five trucks those cost approximately two and a half million SR means that each day of holding these trucks costs the hauler money because he has not completed Saudi Aramco's requirements in terms of petrol quota. Several customers will cancel their contracts and look for another hauler because the hauler is unable to supply them until he completes all required contracts. Moreover, the hauler will have to pay the depot rents and employee salaries even if he/she have not started the business.

Hence, there is a lack of consistency in regulations and shared understanding across organisations in the petroleum sector that hinders petrol supply chain operations management. Therefore, government regulations and requirements should be linked amongst the government organisations. In addition, the investor should be notified about the government regulations based on unified policy documentation that address all government regulations before he/she starts the business and face contradicted requirements which hinders his/her business and maybe causes business failure.

Eventually, the government support for fuel 3PLs could enhance the petrol supply chain operations management in the petroleum industry. For example when AFMS is implemented in petrol stations and fleets, government organisations can connect their ERP systems with the AFMS and this can help to monitor the quotas, predict the future demand, determine petrol consumption in the country and share the information flow of petrol supply chain among shareholders in real time.

To summarise this section, the geographic location of 3PLs' clients, such as petrol stations, is important to be close to hauling fleets, so the haulers can reduce the cost of petrol by refilling from these petrol stations that benefit from increased sales. In addition, by using technology in hauling fleets and petrol stations, seeing competitors use that technology causes rapid adoption of technology and forces companies to keep up with one another. By this they can improve sales, and cost savings, and entice customers. Thus, they can gain a complete advantage. Ultimately, this section discussed the importance of government regulations to enhance petrol station operations management and reduce the fuel consumption in Saudi Arabia (five million oil barrels each day) which is recognised as the highest fuel consumer in the world.

Therefore, the sub-section discussed three main issues that should be considered by the government in order to understand the issues related to the Saudi Arabian petrol supply chain: 1) the country's main income is oil, however petrol consumption is extremely high within Saudi Arabia and this sets off alarm bells, 2) the petroleum industry in Saudi Arabia is unregulated due to lack of precise government

organisation to supervise the industry, which has led to unnecessary delays, and 3) there is a lack of consistency in regulations and shared understanding across organisations in the petroleum sector that hinders petrol supply chain operations management. Therefore, the 3PLs could help in order to overcome these issues through the understanding of technical solutions for petrol supply chain integration.

In summary, this chapter discussed the issues related to the petrol supply chain and explored how 3PLs can help to improve petrol supply chain operations management in Saudi Arabia. The understanding of the issues related to petrol supply chain and the available technical solutions through 3PLs can help with better petrol supply chain integration. The findings of this chapter are summarised in Table 9.1.

Table 9.1: The Major Findings of Fuel 3PL Providers

<b>Technology</b>	<b>Organisation</b>	<b>Environment</b>
actual technology was the primary base of F-3PL (e.g. AFMS, GPS, RFID technology)	self-service petrol stations can create thousands of jobs for youths	Saudi Arabia is the first consumer of petrol products in the world by five million barrels per day
F-3PL Company is keen to provide overseas training courses for the acquisition of knowledge from the developed countries	the utilisation of self-service petrol stations during prayers time was considered a technical solution that should not contradict Sharia Law	there is a lack of precise government organisation to supervise the petroleum sector
3PLs could provide the required IT infrastructure for petrol supply chain integration	the greater sales of petrol stations led to greater profit and long-term contracts with 3PLs because they are considered strategic partners	there is a lack of consistency in regulations and shared understanding across organisations in the petroleum sector

Table 9.1 revealed that in terms of technical context, the findings of actual technology highlight that F-3PL is very reliant on technical solutions that include, but are not limited to, AFMS, GPS and RFID technology. The use of such technologies can lead to petrol supply chain integration.

In terms of traditional technology, the acquisition of knowledge from developed countries such as the USA and providing courses and sessions to educate the employees can enhance knowledge sharing amongst the employees in F-3PL. This also helps to improve the understanding of the influence of technology on petrol supply chain and operations management amongst the employees. This also can help to increase the knowledge amongst the Saudi community and enhance the service quality in the petrol supply chain.

In addition, F-3PL provides IT infrastructure that can encourage petrol stations and fleets to contract in terms of IT infrastructure installation. Hence, petrol stations can increase their customers through fleet vehicles who propose to refuel from the equipped petrol stations. Moreover, fleets can benefit from contracting with F-3PL in terms of controlling their fleets through the installed IT infrastructure in the petrol stations.

In terms of organisational context, the researcher discussed important factors influencing fuel 3PLs' organisational operations management i.e. (culture, religion, firm size and firm resources). In terms of the culture, the findings addressed that self-service petrol stations can create thousands of jobs for youths who do not mind to work if the work environment in those stations fulfils the minimum standards of hygiene, safety and wages.

More so, religion is discussed in terms of the influence of Sharia Law on F-3PL solutions provided to customers, such as self-service petrol pumps utilisation during prayers time. Findings addressed that there are emergency conditions that should be considered in regard to utilisation of self-service petrol stations during prayer times.

In terms of the firm size, the researcher discussed how F-3PL can monitor the expenditure of customer fleets based on the petrol sales in petrol stations and accordingly this will reflect on the firm size of F-3PL. This will require additional costs, such as hiring additional employees to reduce the maintenance delays and speed up the supply operations processes and eventually provision of high quality services.

In terms of firm resources, the researcher discussed how internet-based information flow can help F-3PL to categorise the contracted customers. This determines the direct relationship of the petrol stations who contract with F-3PL based on fuel sales to the public and private fleets. Therefore, F-3PL is keen to review the sales of petrol stations and the value of petrol consumption in the fleets to update the categorisation of the customers. Accordingly F-3PL can increase the ROI and decide if the expansion is required or not, which includes the firm resources such as trucks and employees.

From an environmental perspective, the findings of the geographic location addressed that the area of Saudi Arabia increases the fuel consumption in accordance with population increase, which will continue to increase in the near future. To reduce the fuel consumption F-3PL provides technical fuel solutions that can help petrol stations and fleets to control the fuel efficiency and effectiveness. This is considered in previous literature an important portion in terms of supply chain success. In addition, choosing the geographic location of 3PLs' clients, should be based on how close they are to hauling fleets, so the

haulers can reduce the cost of petrol by refilling from these petrol stations that benefit from increased sales

In addition, in terms of competition intensity, the competitors will perceive that public and private fleets are attracted by petrol stations who utilise technology for their operations and procurement management. This is considered competitive advantage that can increase the intensity of competition towards achieving the efficiency and effectiveness of petrol supply chain integration.

Ultimately, there are three key issues related to government regulations that influence the petrol supply chain in Saudi Arabia. First, the country's main income is oil, however petrol consumption is extremely high within Saudi Arabia and this sets off alarm bells. Second, the petroleum industry in Saudi Arabia is poorly regulated due to lack of precise government organisation to supervise the industry, which has led to unnecessary delays. Third, there is a lack of consistency in regulations and shared understanding across organisations in the petroleum sector, which hinder petrol supply chain operations management. Understanding of these issues and the technical solutions provided by 3PLs for petrol supply chain integration could help to overcome these issues. Next chapter discusses triangulation of the research and discussion of results.

# **Chapter 10 – Discussion of Results and Triangulation**

## **10.1 Introduction**

This chapter aims to supply additional levels of research validity in this research by analysing the similarities and differences between the data collected in phase 1, (i.e. the findings of chapters 5,6,7,8, and 9) and phase 2 (the key informants).

## **10.2 Triangulation process**

This research used data triangulation whereby the data was collected from different sources, in order to triangulate the findings. In the first place, four units of the Saudi Arabian petrol supply chain were introduced by the Council of Saudi Chambers (i.e. petrol stations, Saudi Aramco, petrol haulers and third party logistics providers). According to the data collection process (phase 1), between November 2011 and February 2012, twenty-four semi-structured interviews were conducted and eventually analysed, allowing the interviewees to introduce other issues that they considered relevant for discussion.

Initially, the researcher interviewed owners of petrol stations in two investigative areas (rural and metropolitan petrol stations). The researcher found that the petrol station owners not only provided rich information for data collection, but they allowed the researcher to observe the petrol station operations and services in person, such as petrol tank measurement, purchasing from Saudi Aramco online, petrol loading and refuelling processes, which provided a secondary source to triangulate interview data. Furthermore, the owners allowed the researcher to approach other petrol stations and interview truck drivers and petrol station accountants and managers. From the perspective of triangulation, interviews were conducted with the other petrol supply chain units.

The other approach used to increase the validity of this research is through member checks (Merriam 1995; Neuman 2000). The researcher sent a copy of each transcript that had been transcribed by the researcher to the participants to review their own interviews. This allows the participants to change their transcripts in terms of terminology used or errors by the researcher misinterpreting the recording of the interviews. In addition, the researcher sent each member a summary copy of research findings translated from English to Arabic plain statement. This allowed the opportunity for participants to provide more

information and to review information that the researcher may have taken in the wrong context, or to provide any additional information relevant to the case study.

In addition, the researcher conducted phase 2 of research triangulation, interviewing Mr Rawaf, the president of the National Committee of Petrol Stations in the Saudi Chambers and Mr Samer, the president of the National Committee of Land Transport in the Saudi Chambers. They also were given a copy of the research findings and they appreciated the opportunity to share their views on the petrol supply chain. Overall, the changes from the participants and the experts were minimal. Any minor changes did not affect the analysis of the research units. The researcher interviewed Mr Rawaf and Mr Samer in petrol stations and land transport industries to maximise the credibility and accuracy of the data and the findings of this research.

Finally, the researcher used different sources of data given by the participants interviewed to match what was said in the interviews, such as: health and safety instructions, government regulations and requirements, and other publicly available information (e.g., press releases, and trade press articles). This increases the triangulation of the research and helps to ensure that the information given by the participants interviewed was accurate, minimising the potential inaccurate information given by participants.

### **10.3 Participants**

The participants interviewed for the purpose of data validation were: Mr Sami (petrol station owner), Mr Sami is the same participant from chapter five (rural petrol stations); Mr Nawaf (fuel hauler), Mr Nawaf is the same participant from chapter seven (fuel haulers); Mr Rawaf (the president of the National Committee of Gas Stations at the Saudi Chambers) and; Mr Samer (the president of the National Committee of Land Transport at the Saudi Chambers). These participants, considered the key informants, were given the transcriptions and a summary of research findings to verify the conclusions of this research.

The president of the National Committee of Gas Stations at the Saudi Chambers, Mr Rawaf, explained that his committee is set to tackle a number of key issues relating to the gas stations sector to be discussed through the media. This comes as part of the committee's efforts to develop activities of the sector and



raise awareness to the obstacles facing investors in it in order to push the sector to a level that matches the global economic position of Saudi Arabia.

The president of the National Committee of Land Transport at the Saudi Chambers, Mr Samer highlighted that the committee of land transport is set to address and support the common interests of the Kingdom's transportation, the problems and obstacles this sector faces and try to overcome them by finding appropriate solutions and presenting them to the concerned authorities.

The following section revealed the reliability and validity of this research from the perspective of the key informants interviewed. The TOE framework contexts (technology, organisation and environment) are used to frame this analysis of reliability and validity.

#### **10.4 Technological context**

This research finding demonstrates that relative advantages that include the types of technology (actual technology, traditional technology and information technology) and technology infrastructure are substantial internal factors that impact the petrol supply chain and operations management. Table 10.1 summarises the similarities and differences between phase 1 and phase 2 of data collection in order to validate and triangulate the findings.

Table 10.1: Similarities and differences of the technological factors revealed in phase 1 and confirmed in phase 2

<b>Technological factors</b>	<b>Phase 1</b>	<b>Phase 2</b>	<b>Similarities</b>	<b>Differences</b>
<b>Actual technology</b>	The high cost of modern petrol pumps and maintenance were identified as the reasons that hinder rural petrol stations from modern petrol pumps utilisation	The application of technology is discouraged owing to the high cost of technology	Rural areas are less responsive to applying technology due its high cost, which hinders petrol supply chain integration	
<b>Traditional technology</b>	Most customers of fuel haulers (i.e. petrol stations owners) are not keen to use technology due to lack of knowledge of technology	The lack of knowledge hinders the acceptance of technology amongst petrol stations and haulers	Knowledge can be improved by educating the haulers and petrol stations owners, which helps petrol supply chain integration	
<b>Information technology</b>	In rural petrol stations, a minimum use of IT in terms of office administration and certainly no usage of IT in terms of providing petrol service or infrastructure for the supply and receipt of petrol	The lack of ICT influences online procurement in rural areas because 90% of the haulers do not have websites	IT are less applied in rural areas due to lack of ICT, this hinders petrol supply chain integration	
<b>IT infrastructure</b>	There is poor IT infrastructure in rural and metropolitan petrol stations in Saudi Arabia. There is a reliance on manual systems and human-based petrol stations services	The lack of technical infrastructure and ICT in rural areas is an issue that hinders the technology utilisation in petrol stations and fuel haulers fleets	Poor IT infrastructure hinder the petrol supply chain integration	Technology infrastructure is about the type of petrol pumps and underground tanks, as well as the ability of the owners to link their petrol stations with other parties

Table 10.1 demonstrated the findings in respect to the issues that related to the technological context in petrol stations and fuel haulers from the perspective of phase 1 interviews. Those findings confirmed by Mr Sami and Mr Nawaf, as well as the key informants, Mr Rawaf and Mr Samer, who were interviewed in phase 2. In regards to the IT infrastructure, Mr Rawaf, confirmed that the lack of ICT influences online procurement in rural areas. Mr Rawaf said,

Some rural petrol station owners procure from Saudi Aramco by approaching petrol haulers who have an account with Saudi Aramco or they should have contact with people who have internet connections to procure from Saudi Aramco on their behalf.

Mr Rawaf further discussed that technology infrastructure is not only about the technical connections whether slow or fast connections, however it is about the type of petrol pumps and underground tanks and the ability of the owners to link their petrol stations with other parties, then the cost of mechanism which is also crucial but last step.

Mr Rawaf also emphasised that petrol station tanks are tested by the traditional measurement dip-sticks and this is the only process for petrol tank measurement, which confirms that petrol stations rely on human-based systems. To supplement the information given by the participants, the researcher found that Saudi Aramco advised petrol station owners to measure their tanks by the traditional measurement sticks. Figure 10.1 demonstrates the source of Saudi Aramco's sales department booklet, the processes to control petrol products in petrol station.

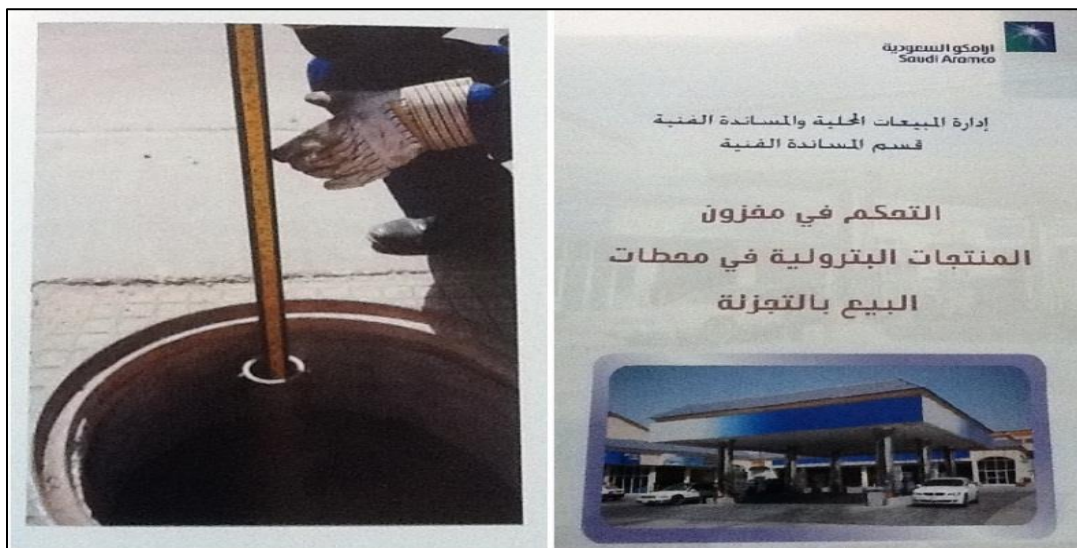


Figure 10.1: Saudi Aramco sales department, the processes to control petrol products in petrol station.

In addition, Mr Samer highlighted that 90% of the haulers do not have websites due to their lack of knowledge, which influenced their lack of use of Information and Communications Technology (ICT).

Furthermore, Mr Sami emphasised that lack of knowledge amongst some petrol station owners hinders them from applying technology in their stations. These petrol stations owners are within the generations born before 1980s, therefore, their knowledge about technology is poor. Mr Rawaf confirmed that lack of knowledge caused chaos in the functioning of petrol stations because individual investors do not have a sound business plan. Hence, lack of knowledge is confirmed as a factor that hinders the utilisation of technology in petrol stations.

Technology cost was also considered an issue highlighted from the perspective of participants in Chapters 5, 6 & 7. This was also confirmed by the key informants that the high cost of technology hinders petrol stations from utilising technology. Mr Rawaf said, 'applying technology is discouraged owing to the high cost of technology'.

## **10.5 Organisational context**

The participants emphasised the influence of culture, religion, firm size and firm resources in the operations management. In addition, the influence of each factor was discussed from the participants' perspectives and it has enriched the information of the organisational influence. Table 10.2 summarises the issues related to organisational context that was confirmed by the key informants (phase 2) based on the findings of phase 1 data collection.

Table 10.2: Similarities and differences of the organisational factors revealed in phase 1 and confirmed in phase 2

<b>Organisational factors</b>	<b>Phase 1</b>	<b>Phase 2</b>	<b>Similarities</b>	<b>Differences</b>
<b>Culture</b>	No Saudis want to work in petrol stations.	Firms believe that the expatriates are better than Saudis in terms of the productivity and lesser in wages. The petrol stations work environment is not attractive for Saudis.	Low wages and work environment hinders Saudis of working in petrol stations Language is an issue influence petrol supply chain	
<b>Religion</b>	During prayers time all services and business either public or private must close	Personal behaviours should not exemplify the religion		Habits which affect religion is the reason that hinders petrol stations and supply chain operations management
<b>Firm size</b>	The granted visas for petrol stations workers and truck drivers are not sufficient	The Ministry of Labour grants only one visa for each truck, which affects the firm size in terms of the numbers of employees	Illegal expatriates are working in petrol stations that are managed by companies due to the low number of visas that the Labour Ministry has issued for gas companies.	
<b>Firm resources</b>	Petrol leaks were highlighted as a problem that increases the waste of petrol products	Petrol stations remain for decades without maintenance or renovation which causes petrol leaks issues in petrol stations	Waste of petrol products is considered waste of firm's resources and countries' resources	

### 10.5.1 Culture

Table 10.2 demonstrated the confirmed findings related to the technological context in petrol stations and fuel haulers. In terms of the culture, Mr Rawaf, confirmed that petrol stations and fuel hauling jobs are not attractive jobs for Saudis. Mr Rawaf said, ‘the community is involved in the hesitancy of Saudis to work in petrol stations and hauling sector because they consider working in petrol stations or driving trucks as low class jobs’.

However, Mr Rawaf, addressed another rational reason for the hesitancy of Saudis to work in petrol stations and truck driving, that is the low wages of these jobs. He said,

There are many firms who believe that the expatriates are better than Saudis in terms of the productivity and lower wages, but the truth is that firms do not want to increase the wages. Therefore, the Saudi youths are not encouraged to work in petrol stations or as truck drivers.

Mr Rawaf, stated that there are different reasons that let firms believe that the expatriates are better than Saudis in terms of productivity and wages. He explained that Saudis will not accept to live in petrol stations, because most of them are working to support their families, therefore they prefer to live with their families instead of living in petrol stations. The men in Saudi culture and in Islam are responsible for their wives, mothers and sisters if the father is not alive. In addition, women’s jobs in Saudi Arabia are scarce, therefore the reliance of Saudi families is always on men.

In addition, some expatriates save money to spend it on their families in their countries where living expenses are lower than Saudi Arabia and their culture is different. However, Saudis are working to spend their money in Saudi Arabia, therefore the firms should consider these reasons when employing Saudis in petrol stations or as truck drivers. Mr Rawaf said, ‘Increasing Saudi wages is crucial to encourage Saudi youths to work in petrol stations and hauling sector, once the wages increased the productivity and efficiency will increase’.

Language was also confirmed as an issue that influences the petrol supply chain in Saudi Arabia. Mr Samer confirmed that ninety percent of petrol stations are managed by expatriates who do not know Arabic or English. Most of the expatriates who work in petrol stations and truck hauling fleets came from different Asian countries, such as, Pakistan, India, Nepal, and Bangladesh. Therefore, they face some difficulties to understand Saudi Aramco’s paperwork (i.e. loading orders, invoices, and receipts).

## 10.5.2 Religion

Religion influences the petrol supply chain in different ways, from the perspective of the key informants. For example in perspective of the haulers, Mr Samer and Mr Rawaf discussed that the religion does not influence the haulers directly, but the habit's effect on the religion is the reason that hinders petrol stations and supply chain operations management. For example, Mr Samer said,

The expected time to pray is approximately fifteen to thirty minutes, however some people extend it to one hour or more to accomplish other personal things. This behaviour is personal but not ascribed to the religion, however this behaviour contradicts the religion.

Mr Samer explained that some personal behaviour should not exemplify the religion. However, personal behaviour should be corrected by the people themselves. This behaviour is noticed in different government and private institutions, therefore a person who wants to pray should replicate his religion in appropriate manner. Prophet Mohammed taught Muslims that God loves those who do good to others.

Mr Rawaf, also confirmed that the delay by the workers and employees comes from personal mistakes. However, he said that the delay after prayers is likely to happen in the public sector but not in petrol stations or stores. Mr Rawaf said, 'Petrol stations are private businesses therefore the owners or the workers are keen to re-open their petrol stations as soon as they complete their prayer because they are looking for profit'.

In addition, Mr Rawaf explained that one of the important deeds in Islam is the loyalty in everything including the work. Therefore, in Islam it is not accepted behaviour that employees extend their prayer time more than the expected time to pray, in order to sort out personal affairs. However, some people discussed the closure of petrol stations during prayer time affected customers who faced emergency situations. Mr Rawaf said,

Prayer time is approximately thirty minutes for each prayer, but prayers have different times and most people know that petrol stations should be closed in these times based on the government orders but not the religious orders.

He explained that once people know that petrol stations are closed for prayer time they should know that stores have definite opening and closing times and they should prioritise their shopping time and their refuelling time to suit opening hours. Mr Rawaf further explained that government policies state that no

one can deduct these times from the workers' and employees' wages because of the importance of prayer and the fact that it is a second pillar of Islam. The government does order that all public and private institutions be closed to assist workers break for prayer. He also stated that each country has its regulations and religious acts that Muslims should understand and respect, even for Muslims who do not live in Saudi Arabia. Hence, the religion itself does not influence the supply chain but, some personal behaviour does have an effect on religion.

### **10.5.3 Firm size**

Regarding data validation of research findings in respect to firm size, Mr Sami stated that the number of workers in the petrol station affects the operations management. The Ministry of Labour evaluates the size of petrol stations in order to decide how many visas could be granted for a petrol station (refer to chapter five, section 5.6.3). This is considered a problem in the petrol station and hauling sector. Mr Samer explained that, according to the regulations of the Ministry of Labour, only one visa is granted for each truck. The truck drivers and petrol stations workers need to rest at least for sixteen hours between drives and between work shifts. However, the number of the truck drivers and the workers is not sufficient for the three working shifts that supply petrol to petrol stations. This hinders the petrol supply chain and operations management that needs to work for twenty-four hours to get petrol products to supply petrol stations and serving customers.

Mr Rawaf also confirmed that the lack of visas has also led petrol station companies to hire illegal expatriates, he said, 'Illegal expatriates, too, are working in gas stations that are managed by companies due to the low number of visas that the Labour Ministry has issued for gas companies'.

### **10.5.4 Firm resources**

Firm resources that include petrol products, petrol tankers, and petrol station facilities were confirmed as a factor influencing the operations management in the petrol supply chain. Participants expressed that firm resources help the firm enhance service quality and increase profits. The key informants have also confirmed that petrol leaks in petrol stations adversely affect the environment, the petrol supply chain and operations management. The petrol leaks are considered a waste of the kingdom's resources. Mr Sami narrated a real story that occurred in Alkhurmah, he said, 'A man wanted to drill for sewerage disposal from his land, however he discovered petrol that leaked from a petrol station behind his property'.



Mr Rawaf also emphasised this issue of petrol leakage in petrol stations. He highlighted that the reason is that any citizens can build a petrol station and lease it to anyone. Therefore, neither the owner nor the tenant is keen to improve the petrol stations; they all are looking for profit. Therefore, petrol stations remain for decades without maintenance or renovation.

## **10.6 Environmental context**

Environment factors refer to the environment in which an organisation conducts its business such as, geographic location, competitors and dealing with the government. The environmental factors are discussed based on the key informants' perspective in order to increase the rigour of the research findings. Table 10.3 summarises the issues that relate to the environmental context as confirmed by the key informants (phase 2) based on the findings of phase 1 of the data collection.

Table 10.3: Similarities and differences of the environmental factors revealed in phase 1 and confirmed in phase 2

<b>Environmental factors</b>	<b>Phase 1</b>	<b>Phase 2</b>	<b>Similarities</b>	<b>Differences</b>
<b>Geographic location</b>	The vast area of Saudi Arabia makes it difficult for truck drivers to transport petrol from area to another. The distance of Saudi Aramco distribution stations from fuel haulers and petrol stations cause delays and increase truck maintenance cost	There are 200,000 trucks for overall land transportation in the Saudi Arabia. This highlights that there is a shortage of fuel haulers in the country, 600,000 trucks are ideally required to cover 24x7 petrol delivery to petrol stations	The demand on petrol products and petrol transportations is greater than supply Extreme heat weather increases fuel evaporation levels and leads petrol stations to refill tanks only at night or early at morning	
<b>Competition intensity</b>	Dishonest petrol stations competitive environment	competition in hauling sector is considered authentic to the extent that the competitors allocate customers to each other	Petrol stations are monopolised by the expatriates in Saudi Arabia	
<b>Government regulations</b>	Inconsistencies of government regulations caused significant problems for petrol stations and fuel haulers	Insufficient workers visas contradicted the regulations of the Ministry of Labour that workers should not work more than eight hours Shortage of workers in petrol stations led to poor service quality, resulted in customers going to other petrol stations instead	Hierarchical management system cause unnecessary delays in petrol supply chain	

### 10.6.1 Geographic location

Table 10.3 demonstrated the confirmed findings in respect of the organisational context in petrol stations and fuel haulers. In terms of the geographical location, Mr Samer, added important updates in terms of the paved roads in Saudi Arabia. He highlighted that in 2012 the Ministry of Transport completed 50,000 kilometres of paved roads in Saudi Arabia including 15,000 kilometres of main roads that link between the countries' major cities and the international boundaries. This also includes 9,000 kilometres of roads that link between the major cities inside the country. In addition, there are approximately twenty six kilometres link between cities and farming areas. This updated information about the paved roads proves the vast area of Saudi Arabia and proves that there are thousands of kilometres that need to be supplied by fuel, transported by fuel haulers.

Railways could help to minimise the impact of the geographic location of petrol providers, retailers, and customers. However, there is no railway that links the local cities in the country or links the local cities with the nearby countries. Furthermore, Mr Samer stated that there are approximately 200,000 trucks in Saudi Arabia utilised for land transport which includes goods, petrol products, local transportation ... etc, which is too few. Given the fact that petrol stations need to be supplied with petrol 24x7, petrol stations in Saudi Arabia need three drivers and three trucks to cover 24x7 petrol delivery. This then suggest 600,000 trucks are really required to cover 24x7 petrol delivery to petrol stations. This highlights the lack of railways and shortage of trucks to meet the increased demand on hauling sector hinders petrol supply chain. This cause delays bearing in mind the distance of bulk plants, fuel haulers, and petrol stations locations those are located in different geographic locations.

In addition, the key informants confirmed that Saudi Aramco's distribution station locations are considered an issue in terms of petrol transportation. They emphasised that the location of Saudi Aramco's distribution stations should be organised based on the geographic location of petrol stations and the haulers' locations. Mr Rawaf said, 'Saudi Aramco should increase the distribution centres in the country to enhance the petrol supply chain, minimise delays, minimise transport costs, and minimise truck maintenance costs'.

In addition, in terms of the environmental factors Mr Rawaf and Mr Sami highlight that the weather influences petrol station operations management. Mr. Rawaf said, 'I have doubt that customers will get out from their vehicles in the hot climate that reaches more than fifty degrees in summer, so we can imagine how much the workers suffer in such an environment'.

Furthermore, Mr Rawaf addressed the impact of the weather in Saudi Arabia on petrol station pumps and operations management. He said,

The hot climate influences refill processes of petrol products in petrol stations because there are certain times identified by the Civil Defence when refilling petrol products is considered hazardous in the extreme hot climate.

Mr Sami explained that the Civil Defence regulated safety processes in terms of unloading petrol products in petrol stations. For example, in summer trucks can unload petrol products in petrol stations only in the evening hours or in the early morning hours because the climate is potentially cooler and this can help to reduce fire risks.

Mr Samer noted that in November 2012, a gas tanker truck veered into a bridge on a main road of the capital city of Saudi Arabia that was busy with vehicles causing a gas leak that spread out and then burst into flames, destroyed nearby cars and businesses. This accident caused the death of 22 people and 131 were injured. Therefore, Mr Samer trusts that the safety regulations in terms of petrol hauling products are significant in order to protect the community from unpredicted accidents.

### **10.6.2 Competition intensity**

The participants interviewed confirmed that the petrol stations are monopolised by the expatriates in Saudi Arabia. Mr Rawaf said, 'It is hundred percent true that the expatriates affects not only the competition in petrol stations, but it influences the national income of this industry'.

Mr Rawaf explained that the dishonest competition in petrol stations is a problem that affects the national income of the country, because the expatriates transfer billions of Saudi Riyals to their home countries per annum. In addition, the citizens can easily rent and then lease a petrol station to expatriates based on sub-contracts between them, which is considered a breach of Anti-Commercial Concealment Law that states, 'it is not allowed -in all circumstances- that non-Saudis invest in any business that they are not allowed to invest in', including the petroleum industry, based on the regulation of Foreign Investment Regime (MCI 2004, p. 2).

Mr Samer confirmed that the competition in the hauling sector is considered authentic to the extent that the competitors allocate customers to each other. Mr Samer said,

The competition in hauling industry is authentic. It reached to the extent of the cooperation amongst the competitors who help each other by allocating contracts for those who want to expand their fleets and have the sufficient trucks to meet the commitment to the customers.

This verifies that the competitive environment in the hauling sector is promising.

### **10.6.3 Government regulation**

The participants interviewed raise different perspectives in terms of the government regulation and the relation between customers and employees. Mr Samer addressed that the bureaucracy regime is one of the issues in Saudi Aramco's departments. Saudi Aramco's management is highly centralised and this increases the gap between the middle management and the executives which cause lack of communication. Mr Samer said,

Customers can only deal with the middle management who lack contact with the head management that is located in Dhahran. This increases the problem of communication with Saudi Aramco, therefore the sales department head office should be in the capital city where the most sales of petrol products occur.

Another perspective is the inconsistency of government regulations. Mr Sami highlighted that the rules of the Ministry of Labour revealed that the workers must not work more than eight hours in a business day. However, the Ministry of Labour that revealed this regulation, granted him only two visas for a petrol station that has ten petrol pumps and should be open to serve customers for twenty-four hours. He said,

I cannot force the worker to work twelve hours because the government did not provide me the six visas that I require, however I can violate the rules and hire illegal workers to work in the country without work permission to meet my commitment to the customers. Otherwise I have to close my petrol station for eight hours each day.

Therefore, he stated that the Ministry of Labour regulations, based on theoretical assessment of the number of workers in petrol stations, adversely affects the business and operations management. There was also a problem with interpreting the regulations and that is why petrol stations are stretching the law. Hence, petrol station owners could blatantly breaking the law and hire the illegal workers. Furthermore, Mr Rawaf highlighted that insufficient workers in petrol stations means poor service quality, resulting in customers going to other petrol stations instead, where they will be served at the same cost and better service quality.

This also was confirmed in respect to fuel haulers who were granted only one visa for each truck. Mr Samer highlighted that this regulation by the Ministry of Labour hinders the haulers from meeting their customer commitment, because a truck is driven by only one driver, who can drive it for only

eight hours. However the hauling business serves petrol stations twenty-four hours a day (refer to chapter seven 7.5.3 and chapter ten, 10.5.3).

In summary, chapter ten discussed the reliability of this research by analysing the similarities and differences between the data collected in phase 1, (i.e. the findings of chapters 5,6,7,8 and 9) and phase 2 (the key informants). The key informants confirmed that most factors were consistent except for two factors: IT infrastructure and religion. They highlighted that technology infrastructure is about the type of petrol pumps and underground tanks, as well as the ability of the owners to link their petrol stations with other parties. This means IT infrastructure includes the actual technology and the ability of the owners to participate in the petrol supply chain integration.

In regards to religion, the key informants highlighted that personal behaviour should not exemplify the religion. The personal behaviour affects religion and this hinders petrol stations and supply chain operations management. It was not religion that hindered the petrol supply chain. For example, some people extend prayer time to one hour or more to accomplish other personal things. This is considered personal behaviour that contradicts the religion. Those different opinions of key informants do not affect the findings of this research, but they add strength to our understanding of the issues that influence petrol supply chain integration.

Hence, the researcher believes that the notions of validity and reliability are addressed from the perspective of the paradigm out of which this study has been conducted. In terms of internal validity, the findings of this research are consistent with the data collected and this maximises the internal validity by assuring rigorous control of all variables other than the intervention. In addition, the story revealed or constructed in one unit of this research is applicable to another, which confirms the external validity of this research because each unit has similar factors affecting operations management in the participants' respective business unit. But each factor affects each unit differently. This also increases the triangulation of the research findings and helps ensure that the information given by the participants interviewed was accurate, minimising the misinformation theoretically given by participants therefore the consistency of this research is verified. The next chapter discusses cross-case analysis and discussion.

# **Chapter 11 - Cross-Case Analysis and Discussion**

## **11.1 Introduction**

This chapter represents the cross-case analyses and discussion in view of the findings of the studies conducted in this research, i.e. (Chapter 5, Saudi Arabian rural petrol stations); (Chapter 6, Saudi Arabian metropolitan petrol stations); (Chapter 7, Fuel Haulers); (Chapter 8, Saudi Aramco), and (Chapter 9, Fuel 3PL providers). Considering the research question: how does the understanding of the Saudi Arabian petroleum industry lead to supply chain integration. This chapter discusses the similarities and differences between these units of analysis based on the TOE contexts in order to provide a cohesive understanding of the issues that influence the Saudi Arabian petrol supply chain and how solving these issues led to the petrol supply chain integration. This is followed by a literature analysis to compare the research findings from this research with that of other studies.

## **11.2 Similarities and Differences between the rural and metropolitan petrol stations that influence the petrol supply chain integration in view of the TOE factors.**

This section provides a cross-case analysis and discussion of the technological, organisational and environmental factors that influence the petrol supply chain integration from the owners' perspectives in rural and metropolitan petrol stations in Saudi Arabia. The cross-case analysis is based on the case findings discussed in the Saudi Arabian petrol stations, in Chapter 5 and 6. By comparing the technological, organisational and environmental issues in rural and metropolitan petrol stations that were identified in Chapter 5 and 6, the similarities and differences that influence petrol supply chain integration are discovered.

### **11.2.1 Technological factors**

Actual technology identified in rural and metropolitan petrol stations from the owners perspectives are reported in Table 11.1.

Table 11.1: Similarities and differences of the actual technology as technological infrastructure influencing Saudi Arabian petrol supply chain integration in the rural and metropolitan petrol stations

Factors	Differences		Similarities
	Rural Petrol Stations	Metropolitan Petrol Stations	
Actual Technology	Old mechanical petrol dispensers	Modern electronic petrol-dispensers	PCs
	Mobile internet	RFID	Printers
	Mobile phones	LAN	Human-based petrol station services
	Facsimiles	DSL	Human-based accounting process
		MS-Office	Human-based petrol tank measurement process
		Emails	

The shaded area in Table 11.1 represents similar opinions of actual technology utilised in terms of operational processes that lack technology infrastructure. The non-shaded areas represent the different opinions regarding the technology infrastructure influencing supply chain integration in rural and metropolitan petrol stations. There were three operational processes identified in rural and metropolitan petrol stations, namely, human-based petrol stations services, human-based tally process and human-based measurement process. There were six actual technologies at rural petrol stations and seven actual technologies at metropolitan petrol stations that differed from each other.

The actual technologies utilised in rural petrol stations are: old mechanical petrol pumps to refill vehicles; personal computers (PC), mobile internet, and printers to procure the required quota of petrol from Saudi Aramco's procurement website; mobile phones and facsimiles for communication processes. The different actual technologies utilised at some metropolitan petrol stations were modern electronic petrol pumps, radio frequency identification technology (RFID), local area network (LAN), digital subscriber line (DSL), Microsoft-office (MS-Office), and electronic mail (email).

By comparing the technological infrastructure in three metropolitan petrol stations with three rural petrol stations, the technological infrastructure of metropolitan petrol stations was encouraged in terms of building the petrol supply chain infrastructure. However, it is important to highlight that the AA chain of petrol stations was the only petrol company that utilised RFID technology among other petrol stations encompassed in chapter six. This was because AA company contracted with government and private sectors that require privacy in terms of petrol sales. Furthermore, AA petrol stations were not satisfied with the utilisation of pre-paid petrol cards that were abused by customers and workers. Therefore, AA petrol stations replaced the pre-paid petrol cards with RFID technology.



In addition, the utilisation of email for communication and MS-Office such as, Excel in order to review the orders based on the history records, LAN and DSL for internet connectivity were also encouraged in AA and DB petrol stations. The presence of technologies is motivated to add-value to metropolitan petrol stations, which ultimately assist regular use of actual technology that leads to petrol supply chain integration in Saudi Arabia.

Rural petrol stations differed from metropolitan petrol stations in technological infrastructure. The old mechanical petrol pumps were identified in the three rural petrol stations from the owner's perspectives, as represented in Chapter four, (Section 4.5.1.1). The high cost of modern petrol pumps and the high cost of petrol pump maintenance were identified as the reasons that hinder rural petrol stations from modern petrol pump utilisation. The workers' and owners' knowledge of technology was also identified as reasons that hinder rural petrol station technology utilisation, a point confirmed by the key informants in Chapter ten, (Section 10.4). In addition, the utilisation of PC was only to procure from Saudi Aramco's procurement website. Mobile internet was used in the three rural petrol stations because of the lack of ICT infrastructure, such as DSL and LAN.

This section highlighted that metropolitan petrol stations are more responsive to apply technology because the technological infrastructure was encouraging. However, both areas are similar in terms of reliance on manual systems, such as, human-based petrol station services, human-based accounting processes, and human-based petrol tanks measurement processes. Rural areas petrol stations are less responsive to apply technology than metropolitan petrol stations due to the high cost of technology, high cost of maintenance, lack of knowledge amongst the workers and petrol stations owners, and lack of ICT infrastructure. This is confirmed in Chapter ten (Section 10.4). The next section discusses the organisational factors.

### **11.2.2 Organisational factors**

This sub-section details the cross-case analysis of organisational factors in rural and metropolitan petrol stations. Table 11.2 below demonstrates the factors that influence petrol supply chain integration in Saudi Arabian rural and metropolitan petrol stations.

Table 11.2 Similarities and differences of the organisational factors influencing Saudi Arabian petrol supply chain integration in the rural and metropolitans petrol stations.

Factors		Differences		Similarities
		Rural Petrol Stations	Metropolitan Petrol Stations	
<b>Organisational</b>	<b>Culture</b>	Teenagers who refuel their vehicles and leave without paying happens only infrequently in rural petrol stations because it impacts the reputation of the perpetrator's family.	Teenagers frequently refuel their vehicles and leave without paying in metropolitan's petrol stations because of the social-demographic factors.	No Saudis want to work in petrol stations.
	<b>Firm Size</b>	Two to four workers work in rural petrol stations.	Four to eight workers work in metropolitan petrol stations	Petrol stations in Saudi Arabia are micro businesses.
	<b>Religion</b>			In Saudi Arabia, one finds the lowest level of service in petrol stations because of the domination of expat workers who run it in a primitive way. They care only about the profits regardless of the quality of service. Ultimately, this influences in the service quality in terms of the hygiene of mosques and toilettes in petrol stations.  Petrol stations must be closed during prayer times, which influence the supply of petrol to petrol stations.
	<b>Firm Resource</b>			At least 70% of the stations were built 30 years ago by underground steel extensions and leak testing is difficult as a consequence.  Petrol stations in Saudi Arabia float on lakes of leaked petrol due to the lack of leakage testing technologies and government surveillance of such processes. Therefore, if any leak were to be found, it would be too late to repair the soil because the workers only do this test twice a year

The shaded area in Table 11.2 demonstrates that culture, religion, firm size, and firm resources are similar in rural and metropolitan petrol stations. For example, no Saudi nationals want to work in petrol stations as discussed in sub-section 5.6.1 and 6.5.1. Culture was highlighted according to the owners' perspectives, where they explained that Saudi nationals are not keen to work in petrol stations. This is because the community classifies petrol station jobs as low status jobs and this influences the reputation of the worker among his tribe or family, which highlights that Saudi Arabia is classified as a tribal community. Saudi Arabia encompassed many different Arab tribes and families, influenced by the cultural norms of these tribes and families in terms of job classification among the community. In addition, the low monthly pay of the workers in petrol station (700-1000 Saudi Real) is not encouraged because the worker needs to pay for rent, food and transportation. Further, the Saudi worker will not live in petrol stations as some expatriates do, a practice that is fundamentally prohibited by the Civil Defence. Therefore, low pay and living expenses are considered obstacles that hinder Saudis working in petrol stations. Religion, firm size and firm resources are also similar based on the cross-case analyses of Chapter five sub-sections 5.6.2, 5.6.3, and 5.6.4 as well as Chapter six, sub-sections 6.5.2, 6.5.3, and 6.5.4.

The non-shaded areas represent the different opinions regarding the organisational factors influencing supply chain integration in rural and metropolitan petrol stations. There are only two factors that are different in terms of organisational factors (i.e. culture and firm size). There is influence of social-demographical factors in Saudi Arabian petrol stations, such as cultural norms of Saudi tribes and families in rural and metropolitan areas. For example, rural petrol station owners explained that only infrequently some teenagers refuel their vehicles and leave without paying. Bearing in mind the close relationships of the families and tribes in rural areas, if an offender refuels and leaves without paying it affects the reputation of the offender's family due to the ease of approaching the offender's family or tribe. However, in metropolitan petrol stations located in the cities it was stated that some teenagers are involved in these issues and it frequently happens in their petrol stations. This is because the size of the cities are big and the relationships between populations are not as close to each other unlike rural areas. Therefore, it is difficult to approach the offender and hence it is a frequent issue as discussed in Chapter five (5.6.1) and Chapter six (6.5.1).

The number of workers in metropolitan petrol stations is between four and eight workers due to the large size of petrol stations and high customer demand in metropolitan petrol stations. However, in rural petrol stations the number of workers is two to four due to the smaller sized petrol stations. Nevertheless, this negatively influences rural petrol stations because the Ministry of Municipalities and the Ministry of Labour classified rural petrol stations as small petrol stations and generalised this number of employees on all rural petrol stations. They paid no attention to the customer demand, which may be greater than metropolitan petrol stations especially during summer and holiday periods which are popular for car travel, as confirmed in Chapter ten, section 10.5.3).

This section discussed the organisational similarities and differences between rural and metropolitan petrol stations. In respect to the culture, the community classifies petrol station jobs as low status jobs. In addition, low pay and living expenses are considered obstacles that hinder Saudis working in petrol stations. In respect to the firm size, Saudi Arabian petrol stations are micro petrol stations. Petrol stations must be closed during prayer time highlighting that religion is a factor that influences the petrol supply chain. In respect to the firm resources, old underground steel extensions that lead to petrol leakage issues are considered a waste of firm resources. The next sub-section discusses the environmental factors.

### **11.2.3 Environmental factors**

This sub-section discusses the cross-case analysis of the environmental factors in rural and metropolitan petrol stations. Table 11.3 below demonstrates the similarities and differences of environmental factors that influence petrol supply chain integration in Saudi Arabian rural and metropolitan petrol stations (i.e. geographical location, competition intensity, and government regulations).

Table 11.3 Similarities and differences of the environmental factors influencing Saudi Arabian petrol supply chain integration in the rural and metropolitans petrol stations.

Factors		Differences		Similarities
		Rural Petrol Stations	Metropolitan Petrol Stations	
Environmental	<b>Geographic Location</b>	<p>Most rural petrol stations are considered far in distance from Saudi Aramco’s distribution stations. This influences in truck drivers those travel 14 hours each day</p> <p>This distance increases the probability of road hazards, which, in turn, threatened the drivers and trucks</p> <p>The remote distance to the technology supplier’s stores, which are normally located in metropolitan cities, require additional maintenance costs</p> <p>The desert extreme hot weather and sand storms hinders the utilisation of technology, such as modern electronic petrol dispensers (new emerged factor: weather)</p>	<p>Teenagers frequently refuel their vehicles and leave without paying in metropolitan petrol stations because of the social-demographic factors.</p>	<p>Customers are apprehensive about stepping out of their cars to refuel in Saudi Arabian hot weather that averages around 40-50 degrees Celsius</p> <p>The area of Saudi Arabia (2,217,949 km<sup>2</sup>) creates challenges concerning petrol supplies</p>
	<b>Competition Intensity</b>			<p>Rural and metropolitan petrol stations are affected by competition intensity which is described as dishonest competition, due to competitor’s fraudulent behaviours in trying to increase profits</p> <p>This intense competition caused serious problems such as mixing petrol products to reduce prices and attract more customers, defrauding petrol dispensers’ meters, wasting petroleum resources and petrol smuggling to nearby countries, leading to a shortage in petrol products in the domestic market</p> <p>The illegal leasing of petrol stations to the expat and charge the expatriates for this cover up</p>
	<b>Government Regulation</b>		<p>In Riyadh region, along the national highways, there are approximately 1000 petrol stations, and 400 of these were not built in compliance with pre-construction regulations of the Ministry of Municipalities and Rural Affairs.</p>	<p>The lack of supervision and control by the government on petrol stations endorsed the expatriates and local individual petrol stations owners’ to violate the rules consistently</p>

The shaded area represents the similar opinions regarding the environmental factors that influence the petrol supply chain integration in Saudi Arabia. Similar categories of environmental factors were identified, namely, geographical location, competition intensity and government regulations as being similar in rural and metropolitan petrol stations. This encompasses the issues of extreme heat in Saudi Arabia, the country size, the competition intensity that described as dishonest competition, waste of firm resources such as petrol smuggling, lack of government supervision that endorsed the expatriates and locals to violate the rules consistently. These issues were discussed in Chapter five (section 5.7) and Chapter six (section 6.6).

The non-shaded area represents the influence of geographical location in rural areas that are a long distance from Saudi Aramco distribution stations, which impacts petrol supply to rural petrol stations. This issue increases the road hazards for truck drivers, trucks, and other people driving on the national highways. For example, unexpected camel herds crossing highways, road accidents and dangerous flammable products that they transport. The remote distance of technology suppliers, typically located in larger cities, is also an issue that hinders rural petrol stations from utilising technology because technology suppliers charge additional fees for maintenance, etc. due to the remote distance.

By comparing the geographical location's influence on the petrol supply chain from rural and metropolitan petrol station owners' perspectives, the metropolitan petrol stations appear not to be influenced by the geographical location issues that occur in rural petrol stations. Metropolitan petrol stations are considered near in distance from Saudi Aramco's distribution stations and the petrol station technology suppliers are considered near to petrol stations. However, metropolitan petrol stations face delays during public holidays and summer due to seasonal consumption of petroleum products such as, petrol and diesel. Metropolitan petrol stations claimed that Saudi Aramco's refineries and distribution stations should increase the production of petroleum products to fulfil customer requirements based on the seasonal consumption of petroleum products to overcome delays.

In addition, rural petrol stations are typically located in desert environments where the extreme heat and airborne dust can affect petrol pumps and technical devices in petrol stations, which not only disturbs petrol stations, but is costly to fix. Therefore, rural petrol station owners, such as Mr Saleh, Mr Sami and Mr Faisal, are not keen to utilise technology in their petrol stations as discussed in Chapter five (section 5.7.1) and Chapter six (section 6.6.1).

In terms of government regulations, rural and metropolitan petrol stations are influenced by a lack of government surveillance. One would expect that rural petrol stations are affected more than metropolitan petrol stations due to the distance from government authority and shortage of municipal inspectors, which is true. However, metropolitan petrol stations are also influenced by the lack of government surveillance, for example, in the Riyadh region, along the national highways, there are

approximately 1,000 petrol stations, 400 of which were not built in compliance with pre-construction regulations of the Ministry of Municipalities and Rural Affairs. This highlights that the government regulation is a significant factor that influences the petrol supply chain because the lack of government surveillance and enforcement negatively influences Saudi Arabian petrol stations, because this leads the expatriates and local petrol stations' owners to breach laws and provides no incentive to invest in technology to enhance their supply chain.

Furthermore, there are nine government authorities to control petrol stations in Saudi Arabia but there is no relationship between them in terms of electronic integration or collaboration. This led to unnecessary managerial processes such as, repeating documentation that is required by the government authorities. This can influence petrol supply chain integration because of the unnecessary managerial processes leading to the unnecessary delays.

In summary, this section discussed the analysis of the technological, organisational and environmental factors that influence in the petrol supply chain integration. In terms of actual technology, rural petrol stations are less responsive to apply technology than metropolitan petrol stations. However, both areas are similar in terms of reliance on manual systems, such as, human-based petrol station services, human-based accounting processes, and human-based petrol tank measurement processes. In respect to the organisational factors, culture influences the Saudi Arabian petrol supply chain. For example, the community classifies petrol station jobs as low status jobs. Furthermore, low pay and living expenses are considered obstacles that hinder Saudis working in petrol stations. In respect to the firm size, Saudi Arabian petrol stations are micro petrol stations base on the number of workers in petrol stations. Petrol stations must be closed during prayer time, which highlights that religion is a factor that influences the petrol supply chain. In regards to firm resources, old underground steel extensions that lead to petrol leakage issues are considered waste of firm resource.

Geographic location of petrol stations and Aramco's distribution centres is considered a problem that causes delays to the petrol supply chain. The extreme heat and sand storms affect the technical devices in petrol stations, which hinders the supply chain integration, especially in rural areas because it is considered open area. Therefore, weather is a new emerged factor in this research. Dishonest competitive environments of rural and metropolitan stations leads to serious issues affecting this business in Saudi Arabia, such as, defrauding petrol pump meters and mixing petrol products to reduce petrol prices.

This section provides a cross-case analysis and discussion from the owners' perspectives in the rural and metropolitan petrol stations in Saudi Arabia. Rural and metropolitan petrol stations have been discussed in a separate section because it has two investigative locations (rural and metropolitans) therefore providing a different unit of analysis for the cross-case analysis. However, petrol station units are discussed in comparison with other units in the following sections. The similarities in

government regulations highlighted the lack of supervision and control by the government on petrol stations and endorsed the expatriates and local individual petrol stations owners to violate the rules consistently. The next section discusses the similarities and differences in the results/findings as presented in Chapters 7, 8 and 9.

### **11.3 Similarities and Differences of the TOE factors between the studies conducted in Chapters 7, 8 and 9**

By comparing the technological, organisational and environmental issues in rural and metropolitan petrol stations as identified from Chapter 5 and 6, the similarities and differences that influence the petrol supply chain integration were discovered and discussed in section 11.2. This section, 11.3, provides a cross-case analysis and discussion of the technological, organisational and environmental issues that influence the petrol supply chain integration from the owners' and managers' perspectives. The cross-case analysis was conducted in view of the studies discussed in Chapter seven (Fuel Haulers), Chapter eight (Saudi Aramco) and Chapter nine (Fuel 3PL). The following sub-section represents the technological factors.

#### **11.3.1 Technological factors**

In contrast to the petrol stations, the fuel haulers, Saudi Aramco and fuel 3PL providers were keen to utilise technology in their firms due to the importance of relative advantage of technology in terms of cost benefit, productivity, time-saving, profit generation and customer service. The owners and managers confirmed that technology helps to enhance their business performance in management, fuel procurement and transportation processes. The findings of this sub-section addressed the similarities and differences of technological infrastructure between the three units (Fuel haulers, Saudi Aramco and fuel 3PL providers).

The importance of perceived relative advantage of technology was re-confirmed in this study as most participants showed an appreciation for the advantages offered by the technology that influences their firms. Accordingly, the similarities and differences of the technological infrastructure identified in fuel haulers firms, Saudi Aramco and fuel 3PL providers are reported in Table 11.4.



Table 11.4: Similarities and differences of the technological infrastructure identified in fuel haulers firms, Saudi Aramco and fuel 3PL providers

		Technology		
Factors	Differences			Similarities
	Fuel haulers	Saudi Aramco	Fuel TPL providers	
Actual Technology	Mobile Phones	ERP Systems e.g. SAP	Flow Meters	PC
	Handheld Transceiver	224 Digital Screens to Monitor Oil Processes	RFID	ADSL
	Phones to Contact Customers	Hydrocarbon Supply Chain system (HSC)	Fuel Control Terminal (FCT)	Intranet
	SQL server	Terminal Management System (TMS)	CANceiver	Internet
		E-services Website	Tires Pressure Sensing	Email is Only Used for Internal Communication
		E-procurement	Tank Level Sensing (TLS)	GPS
			Automated Fuel Management System (AFMS)	Facsimiles for Customer Communications
			SQL Server	Printers
			ERP System Accessible Via Internet	

There were different technologies identified that influence petrol supply chain integration according to the needs of each unit for technology. For example, fuel haulers utilised mobile phones and handheld transceivers to contact truck drivers once fuel transportation was requested. They have different reasons for using the mobile phones and handheld transceivers. For example, the handheld transceivers benefit is in contacting the drivers at no cost, but the wireless coverage is only obtainable in narrow ranges, therefore they use mobile phones. In addition, fuel haulers utilise landline phones to contact customers because most of their customers are not keen to use emails due to lack of knowledge. Therefore, they prefer to use the phones or facsimiles as listed in the similarities area in Table 11.4. Fuel haulers also utilise the SQL servers to save their data in terms of managerial perspectives, such as stock management, warehousing, and truck maintenance and order schedules. This is discussed in Chapter seven (fuel haulers), sub-section 7.4.5.

However, Saudi Aramco utilises e-procurement and e-services for fuel orders and receipts, combined with the SAP system to ease the procurement process for customers. In addition, the Hydrocarbon Supply Chain system (HSC) combines with the SAP system to determine the demand in each bulk plant in each region in the country, in real time. In addition, Saudi Aramco utilises Terminal Management System (TMS), a control system also combined with the SAP system to record the actual time that trucks arrive and depart and generate the final receipts that records the uploaded fuel quantity. Eventually, control units at Saudi Aramco monitor the fuel supply chain from oil exploration to distribution stations, as expounded in Chapter eight. (sub-section 8.4.1.1). Accordingly, Saudi Aramco IT infrastructure is encouraged in terms of fuel supply chain integration, however it ends at the distribution stations.

Based on the fact that Saudi Aramco's petrol supply chain starts with oil exploration and ends in distribution centres. It is obvious that there is lack of SC integration between the customers (e.g. fuel stations), fuel haulers and the provider (Saudi Aramco). Hence, there is a necessity for the combination of these units to enhance Saudi Arabia's petrol SC. Third Party Logistics Providers that provide technical fuel management solutions for fuel stations and fuel haulers is the constructive solution to enhance the petrol SC in Saudi Arabia. Therefore, the researcher identified the IT infrastructure in the Fuel Third Party Logistics Provider Company Ltd. (F-3PL) that provides technical and logistical solutions (refer to Table 11.4). The IT infrastructure of F-3PL in terms of managerial technical infrastructure encompassed the ERP system accessible via internet for the authorised users such as employees, partners and customers. In addition, F-3PL managerial technical infrastructure encompasses SQL servers that contain customer's information and operations monitoring information (discussed in Chapter nine, sub-section 9.5.3).

In terms of the technical solutions for fuel supply chain, F-3PL provides flow meters combined with the ERP system to remotely control petrol tanks in petrol stations. The flow meters generate in-tank

supply reports, in-tank leak detection reports, underground tubes leak reports, in tank water rates and automatic paging on alarms. This minimises the fuel leakage issues and enhances the fuel SC management. Moreover, F-3PL provides technical solutions for fuel haulers' fleet management such as, tire pressure, CANceivers that monitor the trucks operations that help to enhance the truck's performance and reduce maintenance cost. RFID technology and fuel control terminals are also technical solutions that help to combine petrol stations, fuel haulers, Saudi Aramco and F-3PL to gain an integrated fuel supply chain (refer to chapter nine, sub-section 9.4.1).

This sub-section discussed the analysis of the technological infrastructure of the study units, (Chapters 7, 8, 9). In respect to Saudi Aramco, IT infrastructure is encouraged in terms of fuel supply chain integration. However, it ends at the distribution stations. In addition, there is lack of SC integration between the customers (fuel stations), fuel haulers and Saudi Aramco. The actual technology provided by F-3PL for customers and suppliers was progressive. That technology helped to overcome many issues that occurred in the petrol supply chain. It will also set the required infrastructure for petrol supply chain integration. The next sub-section discusses the organisational factors.

### **11.3.2 Organisational factors**

This section provides a cross-case analysis and discussion of the organisational factors that influence the petrol supply chain integration from the owners' and managers' perspectives. The similarities and differences of the organisational factors that incorporated culture, religion, firm size and firm resources are identified according to the perspectives of fuel haulers, Saudi Aramco and fuel 3PL providers. The cultural factors are reported in Table 11.5.

Table 11.5: Similarities and differences of culture factors identified in fuel haulers firms, Saudi Aramco and fuel 3PL providers.

	Culture			
Factors	Differences			Similarities
	Fuel haulers	Saudi Aramco	Fuel TPL providers	
Culture	Truck drivers are not familiar with the terms of technology	Work-related stress causing inactivity	Low wages and work environment hinders Saudis of working in petrol stations	Demographics of age influence in petrol supply chain integration, the majority of Saudis are 15-49 years and those youth are 64% of Saudi population those are up-to-date with the latest technology
	Language hinders understanding the paperwork of Saudi Aramco that is in English/Arabic	Lack of understanding the benefits of technology for employees hinders the technology utilisation		
		Management hierarchies causes delays in the administration perspective, which cause unnecessarily delays		
		Language hinders understanding the paperwork of Saudi Aramco that is in English/Arabic		

In terms of the similarities listed in table 11.5 and according to the three units (fuel haulers, Saudi Aramco, Fuel 3PL) compared with section 11.2 petrol stations analysis, the cross-case analysis re-confirmed that the demographics of age are one of the factors that influence petrol supply chain integration in Saudi Arabia. The age demographics of Saudi Arabia shows that the majority of Saudis are 15-49 years and that youth (under the age of 30) comprise 64% of the Saudi population (CIA 2013). In addition, given the fact that the only means of transportation in Saudi Arabia is either by cars or buses, the majority of customers who refuel their vehicles from petrol stations are youth. This is also discussed in Chapter five (5.7.1), Chapter six (6.6.1), Chapter eight (8.5.1.4), and Chapter nine (9.5.1). Thus, technology utilisation to enhance petrol supply chain integration, for example self-service petrol stations or RFID technology is going to be utilised by youths who are up-to-date with the latest technology.

Furthermore, Saudi Aramco re-confirmed that the norms of Saudi Arabia's tribal community influences customer service. For example, customers in urban areas where most people from popular tribes prefer to discuss their matters personally because the tribal community norms consider meeting people face to face is the best way to solve problems. However, in Saudi Aramco customer's service offices in metropolitan regions where urbanisation lessens the impact of tribal community norms, face to face meetings are not prioritised by customers. Hence, the social norms in Saudi Arabia, such as face to face negotiation that lead to physical contact hinder customers and employees from utilising the e-services in Saudi Aramco. Therefore, the social norms influence petrol supply chain integration.

In terms of the differences of the culture factors that influence petrol supply chain integration, the cross-case analysis of the four units (i.e. petrol stations, fuel haulers, Saudi Aramco, fuel 3PL) indicated that a lack of IT knowledge influences petrol supply chain integration, refer to table 11.5. For example, fuel haulers re-confirmed that truck drivers are not educated in terms of technology. Moreover, Saudi Aramco employees consider technology utilisation in the organisation only benefits the organisation, for example they agree that technology speeds up work productivity and enhances employees' performance. However, this is perceived to not benefit the employees, but the company. They also claimed that work-related stress is one of the reasons that they are not keen to utilise Employee Corporate Access, which is discussed in Chapter eight, sub-section 8.4.1.3, so they want to rest instead of working after-hours. Saudi Aramco employees also claimed that the employee empowerment is also an influence in technology utilisation in the organisation. Employee empowerment affects the management in most Saudi Arabian organisations (Mobashar, Bala & Bhagwatwar 2011). Moreover, petrol station owners refer to technology as only the tangible technology such as machines and computers, which require training and full understanding to benefit from it. Therefore, they are not aware of how to use this type of technology.

Language is another culture factor that hinders the utilisation of technology in petrol supply chain integration. Petrol station owners re-confirmed that English is important to benefit from technology because most technology is made by westerners therefore English is the key to appropriately benefit from technology. The owners and the workers do not know English to effectively use computers or the ERP systems. The owners are Arabs and the workers are Asians, who did not learn English, hence they see no sense of technology utilisation. In addition, the owners explained that workers sometime fill-up underground tanks with different types of products by accident because they are unable to read Aramco's receipts as they were printed in English or Arabic.

Furthermore, Saudi Aramco also re-confirmed that truck drivers that want to load their trucks with fuel are unable to type their identification numbers and order numbers on the control panel because they do not know the numbers. Therefore, Saudi Aramco puts the instructions on the wall to demonstrate how to type the identification numbers on the control panel.

The low wages and work environment identified the reasons that hinder Saudis from working in petrol stations and hauling fleets. The wages to work in petrol stations are approximately 700 Saudi Riyals to 1000 Saudi Riyals, while truck driver's wages are approximately 1,500 Saudi Riyals. Those wages are not sufficient for Saudis considering that they have to pay for rent and support their families. The cost of living in Saudi Arabia is high, but it is not for the expatriates, because expatriates are able to live in petrol stations to save money and support their families overseas and one day they are going to leave the country and return back to their homes. However for Saudis who are willing to live permanently in Saudi Arabia, living in petrol stations is not the solution, they want to be married and have families. In addition, work environments that lack the minimum requirements of hygiene and safety, such as Saudi Arabian petrol stations, do not encourage Saudis to work there. Furthermore, prolonged work hours driving trucks is another reason that hinders Saudis from working in fuel hauling fleets. Hence, issues around wages and the work environment can be reasons that hinder Saudis working in petrol stations. The following table 11.6 demonstrates the similarities and differences of the religion factors.

Table 11.6: Similarities and differences of religion factors identified in fuel haulers firms, Saudi Aramco and fuel 3PL providers.

	<b>Religion</b>			
<b>Factors</b>	<b>Differences</b>			<b>Similarities</b>
	<b>Fuel haulers</b>	<b>Saudi Aramco</b>	<b>Fuel 3PL providers</b>	
<b>Religion</b>	Waiting for hours in Saudi Aramco's distribution centres to be served	Saudi Aramco gives the employees the choice of working in Ramadan from 7 am to 1 pm or from 9 am to 3 pm	Why are ATMs within petrol stations allowed to operate during prayer time?	During prayers time all services and business, either public or private, must close
		Weekend days influence in Saudi Aramco's international operations		approximately 7,030,451 Muslims visit Saudi Arabia every year to fulfil their religious obligations in terms of Haj and Umrah

In terms of the similarities and differences of the religious factors that influence petrol supply chain integration, the cross-case analysis identified that all services and trade either public or private must close during prayer time. These influence petrol stations as customers claim that they may have emergency cases that require them to refuel their vehicles during prayer time. In addition, this influences fuel haulers as truck drivers claim that waiting times often reach one hour in Saudi Aramco's distribution centres. This causes delays for fuel haulers to supply fuel to their customers. Saudi Aramco state that closing all offices during prayer time is government regulation and this is the rule of the country.

The peak season for petrol demand is during Haj and Umrah when approximately 7,030,451 Muslims visit Saudi Arabia every year to fulfil their religious obligations (MOH 2011). This influences petrol stations, Saudi Aramco, fuel haulers and fuel 3PL because the demands on fuel increase during these times.

In terms of the differences of religious factors, truck drivers stated that waiting hours during prayer time should not exceed 30 minutes for prayer in most mosques of the country. However, they wait for approximately one hour which impacts the transportation time specifically for those travelling to supply rural petrol stations.

It is up to the employees to work in Ramadan from 7 am to 1 pm or from 9 am to 3 pm. This is discussed as an ultimate solution for organisations to work around Ramadan, however not all organisations give the choice to employees to select the time that suits them.

The practice of Thursday and Friday weekends influence Saudi Aramco's international operations given the fact that Saudi Arabia is the only member of the six-member Gulf Cooperation Council to have a Thursday and Friday weekend, after Oman. This impacts on the ability of Saudi Arabia's economy to boost international business relations because the weekend in furthestmost countries is Saturday and Sunday. Therefore, a royal decree was issued on 22 June 2013 changing the official Saudi weekend to Friday and Saturday, a move potentially bringing the Kingdom's working week closer to that of other countries and a boost to international business relations. It is important to pinpoint that the weekend (Thursday and Friday) is perceived as a factor that influences Saudi Aramco's international operations and this was discussed in Chapter eight Saudi Aramco, sub-section 8.5.1.2.

Fuel-3PL that provides technical solutions for petrol supply chain wondered why ATMs in petrol stations are allowed to operate during prayer times. This enquiry directed the researcher to the role of technology that enhances petrol supply chain integration and eliminates the reliance on people. As discussed in Chapter five (section 5.6.2) and Chapter six (section 6.5.2) the government banned all trade businesses and organisations from working during prayer time, because all people are obligated



to pray. Technology does not hinder people who need to pray, but technology will help to enhance petrol supply chain integration instead, and will minimise the reliance on people to serve customers during prayer time. The following table 11.7 summarises the similarities and differences of firm size.

Table 11.7: Similarities and differences of firm size factors identified in fuel haulers firms, Saudi Aramco and fuel 3PL providers.

	<b>Firm size</b>			
<b>Factors</b>	<b>Differences</b>			<b>Similarities</b>
	<b>Fuel haulers</b>	<b>Saudi Aramco</b>	<b>Fuel TPL providers</b>	
<b>Firm Size</b>	Large enterprise approximately 200 employees in fuel fleets	Large enterprise with approximately 55,066 / approximately 20,000 employees working in IT department	Large enterprise approximately 200 employees	The demand on petrol exceeds the size of firms
			Women working in petrol industry	

As noted in table 11.7, fuel haulers, Saudi Aramco and Fuel 3PL are considered large organisations and this has an impact on petrol supply chain integration in terms of IT utilisation whereby the larger the firm, the greater the investment in IT and associated resources (Brynjolfsson et al. 1994). Although most metropolitan petrol stations in Saudi Arabia have an average of eight workers, indicating that most petrol stations in Saudi Arabia are considered small petrol stations, there is a reliance on workers to serve customers in Saudi Arabian petrol stations using manual processes. This highlights the importance of the workers in Saudi Arabian petrol stations, which has been discussed (human-based petrol stations) in Chapter five (section 5.5.1.3) and Chapter six (section 6.4.1.3). Hence, firm size based on the number of employees is determined as a significant factor influencing petrol station operations management, and ultimately, this influences supply chain integration in terms of technology that can replace labour hours, to gain cost savings and enhance operations management in the petrol supply chain.

In addition, typically women work in non-oil based industrial sectors around the country. However, it is noted that women are working in oil-based industrial sector such as fuel 3PL, which is unusual in Saudi Arabia owing to the work environment that does not suit women. This is discussed in Chapter seven, Fuel 3PL, sub-section 7.5.3 firm size. Nonetheless, according to the unemployment benefits ‘حافظ’ Hafiz’ program, which pays unemployed Saudis 2,000 riyals (\$533) a month for up to one year, the number of unemployed citizens exceeded 1,700,000 in 2011 (Agagi 2012). Hence, this highlights the importance of fuel 3PL firms that create new job sectors largely for unemployed permanent citizens, including women and men, to resolve unemployment problems.

The cross-case analysis revealed that the demand on petrol exceeds the size of firms. For example, the research findings revealed that Saudi Arabian petrol stations are categorized micro-enterprises. Micro-enterprises employ one to ten workers, including independent workers (Morrisson, Lecomte & Oudin 1994). Further, most metropolitan petrol stations in Saudi Arabia have an average of eight workers; however this number of employees in petrol stations differs. For instance rural petrol stations have an average of two to four workers, and this does not meet customer’s requirements. This is discussed in Chapter five (5.6.3) and Chapter six (6.5.3). In addition, fuel haulers fleets and fuel 3PL re-confirmed that the demand for fuel transportation exceeds firms’ readiness, so that fuel haulers and fuel 3PL outsource fuel transportation and logistics operations to other fuel haulers and transporters. Therefore, this is evidence that the oil industry requires additional haulers and 3PL to meet customers’ requirement. Customers include petrol stations, factories and final customers.

To summarise, the firm size factor impacts petrol supply chain integration in terms of IT utilisation, whereby the larger the firm, the greater the investment in IT and associated resources. Moreover, the number of employees in petrol stations hinders the petrol supply chain, bearing in mind the shortage

of workers in petrol stations. The following Table 11.8 summarises the similarities and differences of firm resources.

Table 11.8: similarities and differences of firm resources factors identified in fuel haulers firms, Saudi Aramco and fuel 3PL providers.

	<b>Firm Resources</b>			
<b>Factors</b>	<b>Differences</b>			<b>Similarities</b>
	<b>Fuel haulers</b>	<b>Saudi Aramco</b>	<b>Fuel TPL providers</b>	
<b>Firm Resources</b>	Truck drivers and trucks are the spine of firms.	Employees, truck drivers, trucks and distribution centres are the foremost important resources for Saudi Aramco therefore safety is very important in order of loss prevention.	Customers are the firm's resources because they are considered as strategic partners.	Safety of human resources and assets protection.

Safety of human resources and the protection of firm resources were significant internal factors that influence the Saudi Arabian petrol supply chain for all four units examined in this research (i.e. petrol stations, fuel haulers, Saudi Aramco and fuel 3PL).

The cross-case analysis revealed that Saudi Aramco is keen to prevent loss of human life and assets as they are the most important resources for Saudi Aramco. Human life is priceless and fuel racks in Saudi Aramco's distribution centres are pricey; they cost millions of dollars. Therefore, Saudi Aramco is keen to protect employees, customers, and assets. Petrol products are flammable so people should handle fuel with caution to prevent loss of life and assets. Therefore, Saudi Aramco is very strict in terms of safety requirements in petrol distribution centres.

Fuel haulers re-confirmed that truck drivers are the spine of their fleets. With the absence of truck drivers the fuel hauling firms are unable to operate the fleets, thus their fleets will fail. In addition, the trucks are the most high-value assets in fuel hauling fleets so safety and care in handling trucks is important to prevent loss of these firm's assets and minimize disruptions to the fleet operations. This is critical for maintaining petrol transportation to satisfactorily deliver customer service.

Fuel 3PLs are keen to retain the relationship with customers over the long-term. Fuel 3PL's customers are classified in different categories owing to their sales (for example petrol stations and private and public organisations) because there is direct relationship between them. So if petrol station fuel sales increase, the fuel 3PL profit will increase. The private and public organisations are also important for fuel 3PL, because once the private and public organisations' fuel procurement increases, the fuel 3PL profit will increase too. Therefore, the customers are the firm's resources for fuel 3PL, which are considered partners of their customer base. However, IT infrastructure is also important in terms of firm resources for fuel 3PL because it is pricy, thus periodic maintenance that is included in their contracts is crucial.

Furthermore, participants revealed the problem of leaked petrol due to the lack of leakage testing technologies and a lack of government surveillance on such processes. Participants claimed that if any leak were to be found, it would be too late to repair the soil because they only do this test twice a year. Hence, firm resources served as an important factor as all petrol stations tested their dispensers for leaks by closing the entire petrol station and resetting petrol pumps. This is done because it is difficult to explore petrol leaks in most Saudi Arabian petrol stations due to the age of the stations with at least 70% of them built more than 30 years ago using underground steel extensions (Alsaied 2011).

In summary, oil products are important resources for Saudi Arabia as a country and are important for petrol stations and final customers too. Therefore, it is wise to prevent loss of these valued products. In addition, safety requirements are important to prevent loss of human life and assets. Therefore, firm

resources, such as oil products, are a significant factor that influences successful petrol supply chain integration and the prevention of oil leaks becomes critical.

### **11.3.3 Environmental factors**

This section provides a cross-case analysis and discussion of the environmental issues that influence the petrol supply chain integration in view of the studies discussed in Chapter five (rural petrol station), Chapter six (metropolitan petrol stations), Chapter seven (Fuel Haulers), Chapter eight (Saudi Aramco) and Chapter nine (Fuel 3PL). The similarities and differences of environmental factors incorporated geographic location, competition intensity and government regulation. The similarities and differences of geographic location are reported in Table 11.9

Table 11.9: similarities and differences of geographic location factors identified in fuel haulers firms, Saudi Aramco and fuel 3PL providers.

	<b>Geographic Location</b>			
<b>Factors</b>	<b>Differences</b>			<b>Similarities</b>
	<b>Fuel haulers</b>	<b>Saudi Aramco</b>	<b>Fuel TPL providers</b>	
<b>Geographic location</b>	Road traffic is an issue for truck drivers.	Saudi Aramco’s distribution centres are only located in metropolitan cities.	Selection of petrol stations is based on their distance from the contracted (public and private fleets) and based on the service quality of petrol stations.	Lack of railways increases the concentration on road and sea transport.
	Far distance transportation increases the trucks’ maintenance cost.	The weather was considered as one of the major elements that influence in road and marine transportation.		geographic area of the country and the locations of bulk plants influence in operations management and logistics operations



The cross-case analysis revealed that lack of railways increases the concentration on road and sea transport, which leads to the shortage of transporters who are not able to meet the increased demands on transportation. Moreover, the geographic area of the country and bulk plants location influences in operations management and logistics operations in view of the studies discussed in Chapters 5, 6, 7, 8, and 9.

Saudi Aramco re-confirmed that petrol bulk plants and distribution stations are only located in the metropolitan areas. This is also re-confirmed by fuel haulers and rural petrol stations who are distant from Saudi Aramco's distribution stations approximately 450 kilometres. In addition, long distance transportation increases the truck maintenance cost. This is discussed in Chapter ten, sub-section (10.6.1).

The weather was considered as one of the elements that influenced road and marine transport in Saudi Arabia. Saudi Aramco is contracted with 3PL for road and marine transport; however, dust storms and sea storms affect fuel transport, hence Saudi Aramco expects delays. This is also re-confirmed by petrol stations and fuel haulers. Petrol stations re-confirmed that extreme heat and dust storms are also considered elements that hinder petrol supply chain integration. The fuel dispenser's meters are affected by dust storms in rural areas and the extreme heat hinders customers in terms of self-service. This is discussed in Chapter ten, sub-section 10.6.1.

Road traffic is another element influencing petrol supply chains. Fuel haulers prefer to transport petrol to the factories that are located out of cities rather than to petrol stations that are located in cities where road traffic is an issue for truck drivers. Road traffic in cities causes delays for truck drivers because they are only permitted to drive through city roads for a specific time during the day. This is regulated by the Saudi Traffic Department for fuel haulers to minimise roads traffic and accidents that may lead to blast or fire.

Therefore, the geographical location of petrol stations is important for fuel 3PL, because fuel 3PL favour petrol stations that are located near contracted customers (private and public fleets). This will help to minimise fuel costs for private and public fleets. For example, once a customer fleet is located in the north of the city, the petrol station that is favoured for fuel 3PL should locate in the north of the city. This is discussed in Chapter seven (sub-section 7.3.4). The following table summarises the similarities and differences of competition intensity.

Table 11.10: Similarities and differences of competition intensity elements identified in fuel haulers firms, Saudi Aramco and fuel 3PL providers.

	<b>Competition Intensity</b>			
<b>Factors</b>	<b>Differences</b>			<b>Similarities in terms of competition intensity</b>
	<b>Fuel haulers</b>	<b>Saudi Aramco</b>	<b>Fuel TPL providers</b>	
<b>Competition intensity</b>	The competition is described as honest competition	There is no competition because Saudi Aramco is the only petrol provider in Saudi Arabia	Fuel TPLs provides innovative technical solutions to enhance petrol supply chain integration	Competitive advantage of technology utilisation fascinate customers and government (Saudi Aramco)
	Individual transporters those have less than five trucks are not considered haulers, hence they are not considered competitors	Fuel prices are relatively low-priced which influence in service quality improvement	Fuel TPLs hires employees those have minimum of nine years' experience in petrol stations	
	A shortage occurs in hauling sector because the demand is greater than supply		The company (F-TPLs) is the only fuel TPLs in Saudi Arabia	

Technology utilisation in petrol stations and private/public fleets is an important competitive advantage that fascinates customers and government, such as Saudi Aramco. This is discussed in Chapter nine, (sub-section 9.6.2); and Chapter seven, (sub-section 7.6.2).

In contrast to petrol stations, the fuel haulers are pleased in terms of competition and they describe it as straightforward competition. They have no problems with competition because the number of haulers with truck fleets is small. There are only fifteen large enterprises in Riyadh (where the study was conducted). The other competitors are small haulers that have fewer than five trucks and therefore, are not considered strong competitors to fuel haulers. However, there is lack of competition in the Saudi Arabian hauling sector because the demand is greater than supply. This is similar in terms of the fuel 3PL where the F-3PL company is the only fuel 3PL in Saudi Arabia that provides technical solutions for petrol supply chain integration and logistics operations. Saudi Aramco also does not have competitors because it is the exclusive petrol provider in Saudi Arabia. So the shortage of haulers, lack of fuel 3PL providers and the fact that Saudi Aramco is the unique petrol provider in Saudi Arabia are considered important elements that hinder the petrol supply chain in Saudi Arabia.

In addition, Saudi Aramco's participants pointed to low price petrol, which hinders Saudi Aramco improving service quality. They explained that low-priced fuel led to lower profit, therefore Saudi Aramco is not keen to devote money to improve the domestic service quality such as investment in technology to enhance petrol supply chain integration. This is discussed in Chapter eight. (sub-section 8.5.1.4).

Fuel 3PL play an important role regarding petrol supply chain integration because they have the necessary technical infrastructure for petrol supply chain integration. They also have innovative technical solutions to improve petrol stations in terms of sales and procurement management, minimisation of leaks and monitoring petrol stations sales to prevent the defraud that occurs in petrol stations. Fuel 3PL hire employees who have minimum of nine years' experience in petrol stations. Fuel 3PL also has the technical infrastructure that helps to enhance fuel haulers fleet management. Therefore, a shortage of fuel 3PL is considered a hindrance to petrol supply chain integration in Saudi Arabia. Government attention is crucial to support this important sector that has evidence of petrol supply chain integration success according to F-3PL recent customers, such as 'Almarai' the largest integrated dairy foods company in the Middle East. This means that 3PLs will help to overcome many issues that hinder petrol supply chain integration. The following table summarises the similarities and differences of government regulation.

Table 11.11: Similarities and differences of government regulation elements identified in fuel haulers firms, Saudi Aramco and fuel 3PL providers.

	<b>Government Regulation</b>			
<b>Factors</b>	<b>Differences</b>			<b>Similarities</b>
	<b>Fuel haulers</b>	<b>Saudi Aramco</b>	<b>Fuel TPL providers</b>	
<b>Government regulation</b>	Shortage of petrol products on Saudi Aramco's part and payment 14 days in advance are issues facing fuel haulers	Bureaucracy and centralisation: keeping all of the important decision making powers within head office (the centre of Saudi Aramco in Dhahran) which cause delays for customers and cause gap between top level management and lower level management.	1) the country's main income is oil, however petrol consumption is extremely high within Saudi Arabia,  2) the regulators need to prioritise and share their regulations  3) the petroleum industry in Saudi Arabia is loose due to lack of appointed government organisation to supervise the industry	Saudi Aramco is busy with the international oil exporting which influence in local petrol sales and marketing operations.
	local press and media help to update the top level management in Saudi Aramco about what occurs in petrol distribution stations	Approximately six government agencies are attached with Saudi Aramco in terms of decision making powers, i.e. Ministry of Transport, Ministry of Municipal Affairs, Ministry of Interior, Ministry of Trade and Ministry of Petroleum and Mineral Resources	Saudi Arabia (five million oil barrels each day) which is recognised the highest fuel consumer in the world	lack of government surveillance and punishment influences negatively on Saudi Arabian petrol stations and leads the expatriates and individual petrol stations owners' to breach laws and provide no incentive to invest in technology to enhance their stations supply chain

Saudi Aramco is a State-owned company, so it is the only fuel provider in Saudi Arabia. Since Saudi Aramco is too busy focused on exporting crude oil to meet the international demand, they do not maintain service quality when it comes to local petrol distribution. Lack of service quality influences the petrol supply chain causing delays that affect the customers and end-consumers.

In addition, the cross-case analysis revealed that lack of government surveillance and enforcement influences the Saudi Arabian petrol supply chain by allowing the expatriates and individual petrol stations owners' to breach laws and provide no incentive to invest in technology to enhance service quality in their petrol stations. This is considered one of the major problems occurring in Saudi Arabian petrol stations, which ultimately hinders the petrol station supply chain integration through a lack of technology and poor quality service.

The shortage of petrol products at the end of Saudi Aramco and the required petrol payment of 14 days in advance impacts fuel haulers and petrol stations. This may be considered as insurance for Saudi Aramco that customers will collect the purchased petrol. It is also considered as a forecasting strategy for local market demand for petrol but this strategy does not make sense. This will impact petrol haulers and petrol stations through delays in petrol supply. Hence they are unable to meet their customer's demand for petrol. However, the fuel haulers and petrol station owners are keen to maintain the relationship with the only supplier in the country (Saudi Aramco), therefore they do not want any trouble with Saudi Aramco.

The hierarchy, bureaucracy and centralisation that is keeping all of the important decision making powers within head office (the centre of Saudi Aramco in Dhahran) cause delays for customers and cause a gap between top level management and lower level management by putting in many levels of bureaucracy. In addition, it is important to highlight that approximately six government agencies are attached with Saudi Aramco in terms of decision making powers, i.e. Ministry of Transport, Ministry of Municipal Affairs, Ministry of Interior, Ministry of Trade and Ministry of Petroleum and Mineral Resources.

The cross-case analysis re-confirmed that petrol stations, petrol haulers, fuel 3PL and Saudi Aramco are also attached to different government agencies in terms of decision making powers. The significance of this is as discussed in Chapter five (5.7.3). Petrol station owners claimed that there are nine government organisations related to petrol stations and this causes unnecessary and repeated processes. Moreover, as discussed in Chapter seven, fuel haulers are related with four government organisations. In Chapter eight (section 8.6.1.3.), participants claimed that there are several regulations assigned by different government ministries to Saudi Aramco, for example the Ministry of Commerce, Civil Defence and Saudi Standards Metrology and Quality Organisation. This is considered a hindrance to petrol supply chain integration. Hence, government regulations integration and e-government implementation is crucial. This can occur once the government assign the

regulations and supervision of the petrol industry to the relevant ministry which should be the Ministry of Petroleum and Mineral Resources. This will help to minimise unnecessary processes, as well as improve petrol supply chain in Saudi Arabia.

Fuel 3PL confirmed that there is a lack of consistency in regulations and shared understanding across organisations in the petroleum sector, which hinders petrol supply chain operations management. Therefore, government regulations and requirements should be linked amongst the government organisations. The next section summarises the major findings of the study through a comparison of the conclusions in the existing research with the outcomes of the interviews conducted in this research.

#### **11.4 Comparisons between literature and interviews findings**

The following Table 11.12 summarises the major findings of the study through a comparison of the conclusions in the existing research with the outcomes of the interviews conducted in this research.

Table 11.12: Comparisons between literature and interviews findings in terms of the TOE factors, Technological factors

Factor	Recent research	Title	Findings	Revised findings based on Alhawas (2014)
<b>Actual Technology</b>	Flidner, G 2003	CPFR: an emerging supply chain tool	<p>Retailer benefits:</p> <ul style="list-style-type: none"> <li>•Increased sales</li> <li>•Higher service levels</li> <li>•Faster order response time</li> <li>•Lower product inventories</li> </ul> <p>Manufacturer benefits:</p> <ul style="list-style-type: none"> <li>•Increased sales</li> <li>•Higher order fill rates</li> <li>•Lower product inventories</li> <li>•Faster cycle times</li> <li>•Reduced capacity requirements</li> </ul> <p>Shared supply chain benefits:</p> <ul style="list-style-type: none"> <li>•Direct material flows</li> <li>•Improved forecast accuracy</li> <li>•lower system expenses</li> </ul>	Private and public sector are keen to protect their information about their fuel consumption; therefore they are not willing to share their fuel consumption reports with competitors. So CPFR would not be favoured due to the privacy issues.
	Wamba, SF & Chatfield, AT 2010	RFID-Enabled Warehouse Process Optimization in the 3PL Industry	<p>More recently, the impacts of RFID technology on SC-enabled business process transformation.</p> <p>RFID-enabled warehouse optimisation that is plausible, but has not been implemented largely because of the lack of stakeholder investment.</p> <p>83% improvement when the RFID tagging process is done by the supplier to be ready for 3PL provider.</p>	<p>RFID technology proved 30% cost saving of petrol consumption of fleet vehicles.</p> <p>RFID technology is a very useful integrated tool that adds value to the petrol supply chain and led to petrol supply chain integration.</p>
<b>IT infrastructure</b>	Sohail (2006)	Benchmarking usage of Third Party Logistics:	Digital divide and poor infrastructure to conduct payments (secure transactions) for e-	Digital divide and poor IT infrastructure in rural areas of Saudi Arabia are considered

		a comparison of practices between firms in Malaysia and Saudi Arabia	government services was hindering citizens' adoption of e-services in Saudi Arabia.	hindrances of petrol supply chain integration.
<b>IT knowledge</b>	Aleid, F. A., S. Rogerson, et al. (2010)	Practical Solutions to Encourage Consumers' Adoption of E-commerce in Developing Countries – A Saudi Arabian Empirical study	<p>Recommendations from friends and society help to facilitate e-commerce implementation</p> <p>Lack of knowledge about e-commerce and online stores among customers and business firms led to lack of attention to e-commerce.</p>	<p>Lack of IT knowledge is considered hindrance for customers e.g. petrol stations' owners and workers. IT knowledge is considered also hindrance for petrol haulers and truck drivers.</p> <p>Sharing the knowledge amongst owners and employees help to enhance petrol supply chain operations management especially in terms of technology. This also helps to minimise cost, such maintenance, education, etc.</p>

- Actual Technology, the literature revealed that more recently, the impacts of RFID technology on SC-enabled business process transformation (Fliedner 2003). The research finding highlighted that RFID technology is very useful integrated tool that add value to petrol supply chain and led to petrol supply chain integration. RFID technology proved 30 percent cost saving of petrol consumption of fleet vehicles.
- Poor infrastructure of rural petrol stations is considered hindrances of petrol supply chain integration. This confirmed based on the literature, Digital divide and poor infrastructure to conduct payments (secure transactions) for e-government services was hindering citizens' adoption of e-services in Saudi Arabia. However, it is encouraged in metropolitan stations, Saudi Aramco, fuel haulers and fuel third party logistics providers.
- Lack of IT knowledge is considered hindrance for customers e.g. petrol stations' owners and workers. IT knowledge is considered also hindrance for petrol haulers and truck drivers. Similarly, the literature revealed that lack of knowledge about e-commerce and online stores among customers and business firms led to lack of attention to e-commerce.



Table 11.13 Comparisons between literature and interviews findings in terms of the TOE factors: Organisational factors

<b>Factor</b>	<b>Recent research</b>	<b>Title</b>	<b>Findings</b>	<b>Revised findings based on Alhawas (2014)</b>
<b>Culture</b>	Sherer, S, Kohli, R & Yao, Y 2009	Impact of Cultural Differences on CPFR Implementation	Culture does have an impact on the process of implementing cross cultural systems and processes shared by multiple organisations in a supply chain.	To work in a petrol station is considered a low class job in Saudi Arabia.  The empowerment, centralisation, and hierarchy management system in Saudi Arabia are considered as factors influence supply chain integration.
<b>Firm size</b>	Morrisson et.al (1994)	Micro-enterprises and the institutional framework in developing countries	SMEs are paying more logistics expenditures for 3PLs more than large enterprises due to employees' numbers.	Large fuel hauling fleets, such as government and private fleets are keen to pay logistics expenditure for 3PLs more than individual transporters and micro businesses, such as petrol stations those were considered micro businesses because they proper 4 to 8 workers in each petrol station.
<b>Language</b>	Aleid, F. A., S. Rogerson, et al. (2010)	Practical Solutions to Encourage Consumers' Adoption of E-commerce in Developing Countries – A Saudi Arabian Empirical study	Language and Religion factors should no longer an obstacle in e-commerce adoption in Islamic world. Due to the improvement in Islamic law principles. Nor language, owing to availability of both English and Arabic versions in most Saudi Arabian websites.	Language is considered an issue in terms of technology utilisation, especially for the expatriates such as truck drivers and petrol station's workers.
<b>Religion</b>	Aleid, F. A., S. Rogerson, et al. (2010)	Practical Solutions to Encourage Consumers' Adoption of E-commerce in Developing Countries – A Saudi Arabian Empirical study	Applying offline payment may help consumers to adopt e-commerce owing to the argument about compatibility of some credit cards with Islamic Law (Sharia). Government should regulate e-commerce policies to protect the customers.	Religion does have an impact on petrol supply chain e.g. petrol stations close during prayers time led to delays in petrol supply Government regulations should be allocated to one government authority to avoid irritations and unnecessary processes.

- Culture, the research finding revealed that culture influenced the petrol supply chain. For example, to work in a petrol station is considered a low class job, which hinders Saudis from working in petrol stations in Saudi Arabia. The empowerment, centralisation, and hierarchy management system in Saudi Arabia are considered as factors influence supply chain integration due to unnecessary delays in administration process.
- Firm size, the literature revealed that SMEs are paying more in logistics expenditures for 3PLs, more than large enterprises due to employee numbers (Morrisson, Lecomte & Oudin 1994). Similarly, the research finding revealed that large fuel hauling fleets, such as government and private fleets are keen to pay more in logistics expenditure for 3PLs than individual transporters and micro businesses, such as petrol stations who are considered micro businesses because they employ four to eight workers in each petrol station.
- Language and religion, the literature revealed that language and religious factors should no longer be an obstacle in e-commerce adoption in the Islamic world, due to the improvement in Islamic law principles. Nor should language hinder, owing to availability of both English and Arabic versions in most Saudi Arabian websites. However, this research found that language was considered an issue in terms of technology utilisation, especially for the expatriates such as truck drivers and petrol station workers.
- Religion does have an impact on petrol supply chain e.g. petrol station closure during prayers time led to delays in petrol supply.

Table 11.14 Comparisons between literature and interviews findings in terms of the TOE factors, Environmental factors

Factor	Recent research	Title	Findings	Revised findings based on Alhawas (2014)
<b>Government regulations</b>	Aleid, F. A., S. Rogerson, et al. (2010)	Practical Solutions to Encourage Consumers' Adoption of E-commerce in Developing Countries – A Saudi Arabian Empirical study	The Saudi Arabia has started e-government project, which will be ready by the end of 2010.	The current e-government services in petrol industry is progressive in Saudi Aramco, however, MOPM, Ministry of Trade, Ministry of Transport haven't applied e-government yet.  lack of government surveillance and punishment influences negatively on Saudi Arabian petrol stations and leads the expatriates and individual petrol stations owners' to breach laws and provide no incentive to invest in technology to enhance their stations supply chain
<b>Competition</b>	Tuncalp (1993)	The marketing research scene in Saudi Arabia	There is lack of information available in terms of Saudi Arabian market characteristics, competition, consumer behaviour, or the other elements of the marketing, promotion, product and distribution.  Most local manufacturers tend to be monopolies.  No pressure on producers to research the local consumers' needs and wants.	The competition was described as dishonest competition in terms of petrol stations.  In terms of customer's behaviour, the norms of the tribal community in Saudi Arabia favour face to face negotiation because this way of negotiation most likely ends up with positive agreement.
	(Australian Competition & Consumer Commission December 2008)	Monitoring of the Australian petroleum industry: Report of the ACCC into the prices, costs and profits of unleaded petrol in Australia	There are impediments to the most significant potential competitive threat to domestic refiners.	Saudi Aramco, which is a state owned company, is the only petrol provider in the country.
	Calex, R. et al. (2010)	Regional Integration: Status, Developments, and Challenges	Saudi Arabia's logistics is below expectations.  Poor trade and transport logistics is one of the main causes of high trade transactions.	Saudi Arabian fuel hauling sector needs government attention in order to organise this loose sector.
	(ACIL Tasman August 2009)	Petroleum Import Infrastructure in Australia	The nature of competition, investment requirements, and the level of interest from independents vary from region to another.	Some owners are not interested in profits as much as they are looking for social interaction.

- Government regulations, lack of government surveillance and enforcement negatively influences Saudi Arabian petrol stations and leads the expatriates and individual petrol station owners to breach laws and provide no incentive to invest in technology to enhance their station's supply chain. Based on the literature, government regulation was extensively discussed in the literature, and pinpointed as an important factor that influences Saudi Arabian governance in the public and private sector (Al-Somali, Gholami & Clegg 2010; Wang, Wang & Yang 2010).
- Competitive environment, on the basis of the literature, most local manufacturers in Saudi Arabia tend to be monopolies. Similarly in petrol industry, the research finding deliberated that the competition was described as dishonest competition in terms of petrol stations. In addition, Saudi Aramco, which is a state owned company, is the only petrol provider in the country.

In summary, this chapter discussed the analysis of the research findings, as well as the similarities and differences between the metropolitan and rural petrol stations. The key findings of this research indicated that metropolitan petrol stations are more responsive to the application of technology because the technological infrastructure was encouraged. However, both areas are similar in terms of reliance on manual systems, such as, human-based petrol station services, human-based accounting processes, and human-based petrol tank measurement processes. In respect to the culture, the community classifies petrol stations jobs as low status jobs. In addition, low pay and living expenses are considered obstacles that hinder Saudis working in petrol stations. In respect to the firm size, Saudi Arabian petrol stations are micro petrol stations based on the number of workers. Petrol stations must be closed during prayer time, which highlights that religion is a factor that influences the petrol supply chain. In respect of the firm size, old underground steel extensions that lead to petrol leakage issues are considered a waste of firm's resources.

The cross-case analysis was conducted in view of the studies discussed in Chapter seven (Fuel Haulers), Chapter eight (Saudi Aramco) and Chapter nine (Fuel 3PL), revealed that IT infrastructure at Saudi Aramco, is encouraged in terms of fuel supply chain integration. However, it ends at the distribution stations. In addition, there is lack of SC integration between the customers (fuel stations), fuel haulers and Saudi Aramco. The actual technology provided by F-3PL for customers and suppliers was progressive. That technology helped to overcome many issues that occurred in the petrol supply chain. It will also set the required infrastructure for petrol supply chain integration.

In respect to the organisational factors, low wages and work environment hinders Saudis from working in petrol stations. In respect to religion, the government banned all trade businesses and organisations from working during prayer time, because all people are obligated to pray, however this causes some delays for fuel haulers and customers. Technology does not hinder people who need to pray, but technology will help to enhance petrol supply chain integration instead, and will minimise the reliance on people to serve customers during prayer time. The demand for petrol exceeds the capability of firms due to their small size. Firm resources, such as oil products, are a significant factor that influences successful petrol supply chain integration and the prevention of oil leaks becomes critical.

In terms of environmental factors, geostrophic location of petrol stations is important for petrol supply chain members to minimise delays. In addition, lack of railways increases the concentration on road and sea transport, which leads to the shortage of transporters who are subsequently unable to meet the increased demands on transportation. In respect to competitive environment, fuel haulers are pleased with competition and they describe it as straightforward competition. However, Saudi Aramco is the unique

petrol provider in Saudi Arabia, this is considered a barrier for the improvement of customer service quality. In respect to the factors related to the government regulations, the inconsistency of government regulations and lack of fair assessment in terms of granted visas may result in fraudulent behaviour by the owners to hire illegal workers and this may affect the service quality and, in turn, affect the community. Moreover, lack of government surveillance and enforcement influences the Saudi Arabian petrol stations and leads the expatriates and individual petrol station owners to breach laws. It also provides no incentive to invest in technology to enhance their station's supply chain. Finally, section 11.4 summarised the major findings of the study through a comparison of the conclusions in the existing research with the outcomes of the interviews conducted in this research.

## **Chapter 12 - Conclusion**

### **12.1 Introduction**

The central concern of this thesis has been to answer the research question ‘How do the technological, organisational and environmental aspects of the Saudi Arabian petroleum industry impact on petroleum supply chain integration?’ In addition, the actual data analysis was based on the framework of how does our understanding of the organisational-technological-environmental factors lead to Saudi Arabian petrol supply chain integration?

Furthermore, the focus of this thesis is on diagnosing the Saudi Arabian petrol supply chain and it explores the issues involved in three key areas namely: technology, organisation, and environment that influence petrol supply chain integration. Therefore, a diagnostic tool is important to identify the issues involved in these areas, which will help provide richness to an understanding of what contributes to improve the Saudi Arabian petrol supply chain that leads to petrol supply chain integration.

Adopting the organisational-technological-environmental framework, has assisted in identifying the issues that hinder and/or help petrol supply chain integration through the diagnostic tool. The research findings confirmed that the Saudi Arabian petrol supply chain is influenced by the technological (i.e. relative advantage and IT infrastructure), organisational (i.e. culture, religion, firm size and firm resources), and environmental (i.e. geographic location, competition intensity and government regulation) factors.

The research also revealed that each of these factors has specific sub-categories. The research identified 17 sub-categories that influence operational performance enhancement in the Saudi Arabian petrol supply chain. Figure 12.1 illustrates the modified TOE framework, which has been adjusted to the petrol supply chain integration in the Saudi Arabian petrol supply chain context.

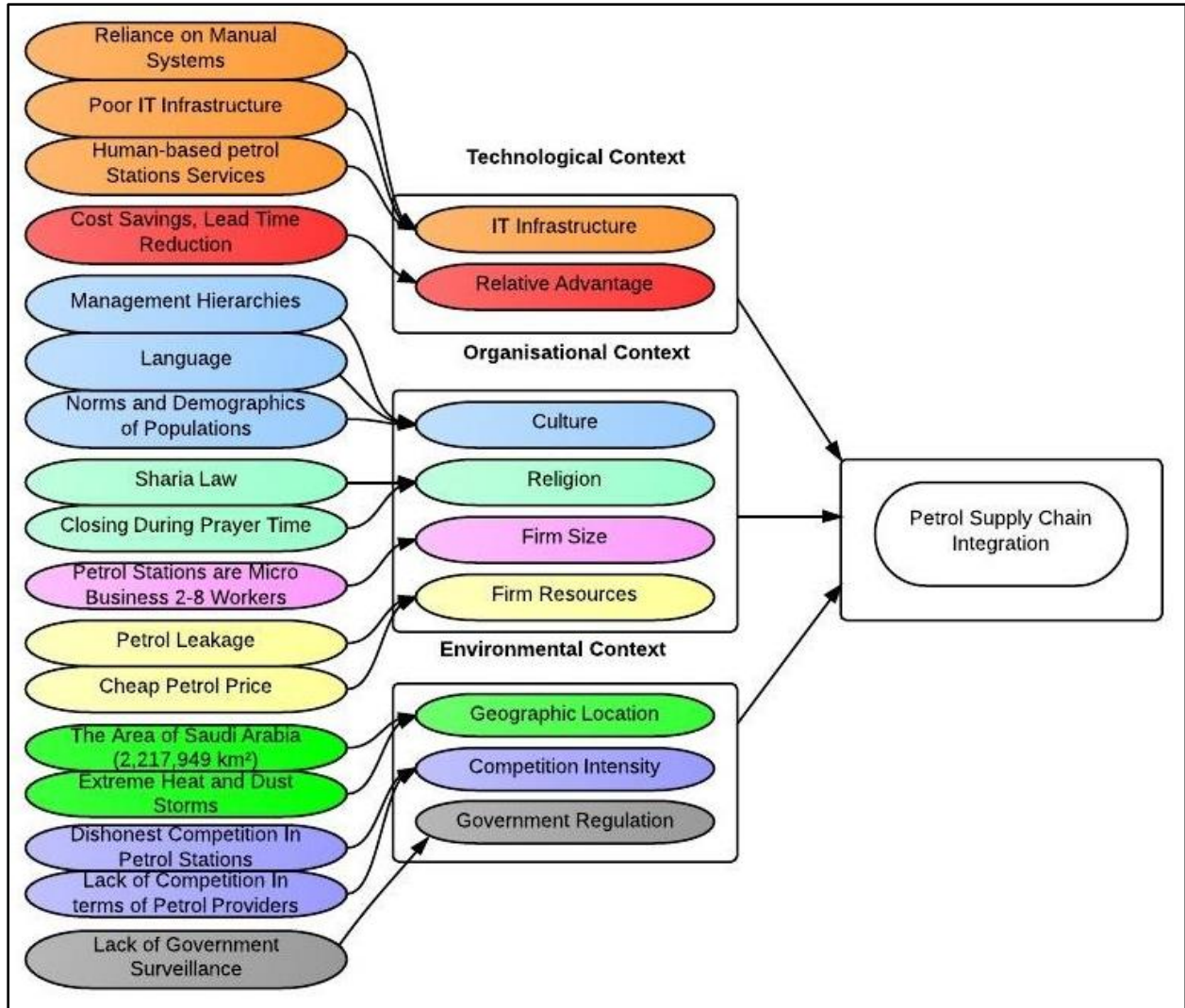


Figure 12.1: Modified TOE framework that has been adjusted to the petrol supply chain integration in the Saudi Arabian petrol supply chain context.

The IT infrastructure has three sub-categories i.e. reliance on manual systems, poor IT infrastructure and human-based petrol station services. Relative advantage has one sub-category that is cost savings and lead time reduction. In addition, the cultural factor has three sub-categories i.e. management hierarchies, language, norms and demographics of populations, while the religion factor has two, Sharia Law and closing during prayer time. Firm size also has one sub-category: petrol stations. These are considered micro-businesses that employ two to eight workers. Firm resources have two sub-categories, which are petrol leakage and cheap petrol price. Geographic location has two sub-categories, which are the size of the country and extreme heat and dust storms. Competition intensity also has two sub-categories that are



dishonest competition and lack of competition in terms of petrol providers. Lastly, government regulation has one sub-category, which is lack of government surveillance. Accordingly, the researcher modified the TOE framework. These factors are listed below in Table 12.1, which contains a summary of new emerged sub-factors (sub-categories) that influence the Saudi Arabian petrol supply chain, which is linked to the literature review.

Table 12.1: Summary of new emerged sub-factors that influence the Saudi Arabian petrol supply chain integration and the literature review references that confirms the sub-factors

Main context	Factors	Sub-factors	Literature review concerning the importance of sub-factors
Technology	IT Infrastructure	Reliance on manual systems	Technology utilisation instead of reliance on manual systems is considered the fundamental stepping stone for building a supply chain infrastructure (Wood 1997)
		Poor IT Infrastructure	
		Human-based petrol Stations Services	
	Relative Advantage	Cost Savings, Lead Time Reduction	Traditional supply chain adds unnecessary cost; delays reaction to supply chain (Stewart 1995).
Organisation	Culture	Management Hierarchies	The management practices in Saudi organisations are strongly influenced by tribal traditions where the manager is the father figure for the organisation. This has shaped an organisational culture where employees expect to be guided and told what to do by their managers. With such a working culture in place, activities like ERP systems implementations that require organisation-wide changes pose a formidable challenge in terms of convincing the owners and top management to change and get these systems implemented successfully (Mobashar, Bala & Bhagwatwar 2011).
		Language	
		Norms and Demographics of Populations	
	Religion	Sharia Law	Use of self-service petrol dispensers during prayers time was considered a technical solution that should not contradict Sharia Law. There is lack of literature in terms of religion as a factor of influence in the supply chain context.
		Closing During Prayer Time	

	Firm Size	Petrol Stations are Micro Business 2-8 Workers	Micro-enterprises employ one to ten workers, including independent workers (Morrisson, Lecomte & Oudin 1994) Given that petrol stations in Saudi Arabia are Micro Business will help to understand the firm size of each petrol station and accordingly better planning for SC integration.
	Firm Resources	Petrol Leakage	It is important to mention that the forecasting and transactional scheduling is done by the petrol stations on a manual basis by taking seasonal and cyclical movements into account and using traditional manually testing for leaks to minimise cost and increase profit (Grozniak & Trkman 2006)
		Cheap Petrol Price	Saudi Arabia is the second cheapest country after Venezuela, with prices at US\$0.15 per litre at the petrol stations (Kobayashi 2007). Therefore the petrol consumption is very high in Saudi Arabia.
Environment	Geographic Location	The Area of Saudi Arabia (2,217,949 km <sup>2</sup> )	Owing to Saudi Arabia's area railway network construction that will join Saudi Arabia with Jordan, Iraq and Medina as well as joining economic cities to each other is considered a competitive advantage in terms of logistics services (SAGIA 2009)
		Extreme Heat and Dust Storms	There is lack of literature that addresses the influence of extreme heat and dust storm in petroleum industry.
	Competition Intensity	Dishonest Competition In Petrol Stations	Competition intensity highlighted as a factor influencing supply chain integration (Lai, F et al. 2008; Wongpinunwatana & Lertwongsatien 2003; Zhu, Kraemer & Xu 2003) and its impact in developing countries (Dittmer 2008).
		Lack of Competition In terms of Petrol Providers	Saudi Aramco is the only petrol supplier in Saudi Arabia (Kobayashi 2007)
	Government Regulation	Lack of Government Surveillance	There is a great need for enhanced government supervision strategies, which has rarely been studied, to have a better and stronger implementation of building energy efficiency in China (Yao & Zhu 2011).

## 12.2 Contribution to practice

This research has implications for practitioners due to the identification of the technological, organisational and environmental (TOE) issues that influence the petrol supply chain. For example, by understanding the social issues that influence the petrol supply chain, Operations Managers will be able to better understand customer behaviour and this can lead to customer service improvement.

Using automated fuel management systems can assist petrol stations and fuel haulers to expedite the petrol supply chain processes, via understanding the TOE issues that influence petrol supply chain. This will enhance and strengthen the value chain between petrol supply chain members. The value chain between SC members can be enhanced and strengthened through the collaboration, the partnership, and the supply chain integration. The collaboration and partnership between the supplier, retailer and transporter in petrol supply chain management can be strengthened when the parties involved understand the technical, organisational and environmental issues that will impact them while making decisions.

For instance, culture is an issue in petrol supply chain management, particularly in terms of negotiation between customers and Saudi Aramco customer service. This is because customers in rural areas favour face-to-face negotiation, which usually ends up with positive agreement. However, if Saudi Aramco understands that culture becomes an obstacle in customer service, they will find a better solution to overcome the issue of culture. Saudi Aramco can use the technology available such as video conference in negotiation to overcome the face-to-face contact.

Moreover, language was found to be an obstacle that influences truck drivers who supply fuel from Aramco's distribution centres to customers. However, if Saudi Aramco understands that language becomes an obstacle in the petrol procurement and fuel loading process, Saudi Aramco will find a better solution to overcome the issue of language. Saudi Aramco can use technology, such as RFID and barcodes for the identification process and fuel loading process to overcome language barriers.

This research has led to several recommendations for both petrol stations and government. Firstly, the findings revealed that government should monitor Saudi Arabian petrol stations in order to eliminate the dishonest competition that leads to poor service quality due to the fraudulent behaviour amongst the expatriates and local individuals. For example, government regulations should necessitate business proposals from the owners to ensure that they are able to manage their petrol stations appropriately

otherwise they need to learn how to manage petrol stations. Education and training for petrol station owners and workers in order to share knowledge among them might be one possible solution to the problem of lack of knowledge. Given this, petrol station owners will be able to benefit from their petrol stations instead of leasing their petrol stations illegally to the expatriates.

Moreover, government should direct petrol stations' owners and push them towards petrol station supply chain integration by outsourcing some operations processes e.g. (technology installation, maintenance operations and logistics operations) to third party logistics providers. This is in order to minimise delays that are caused by traditional measurement and accounting processes in Saudi Arabian petrol stations. In addition, this can help to provide good service and ultimately reap some competitive advantage whilst keeping cost and lead-time low.

For example, the integration of Saudi Aramco distribution stations with petrol stations and haulers through ERP systems, such as SAP or web-based operation management systems, can lead to accurate petrol demand prediction and just-in-time petrol supply. However, the petroleum industry regulations in Saudi Arabia are loose due to lack of precise government organisation to manage the industry. Hence, the researcher sees the need for government authority to monitor these petrol stations and impose regulations.

### **12.3 Academic implications**

This research makes a contribution in providing a supply chain case study from an area with an unusual regulatory framework, with corresponding supply chain actor concerns and priorities. Therefore, this research has potential in contributing towards the literature on studies in Saudi Arabia and the supply chain management in developing countries. Moreover, this research is one of the first to be conducted in the area of the petrol station supply chain in Saudi Arabia and it provides an understanding based on a diagnosis of the current condition of petrol station operations management in Saudi Arabia. In addition, it discusses the factors that contribute to the technology and supply chain integration of Saudi Arabian petrol stations.

Furthermore, on the basis of the literature review on the petrol supply chain and the theory on the technological-organisational-environmental contexts proposed by Tornatzky and Fleischer (1990), it was noted that there was lack of attention in terms of petrol supply chain integration. In addition, the majority of literature reviewed for the purpose of the research that applied the framework of the TOE was mostly quantitative research. The qualitative nature of this research highlights its importance. The research was primarily aimed at addressing this inadequacy and exploring the research opportunity within this area of

knowledge. Moreover, this research has identified 17 sub-categories related to the technological, organisational and environmental factors (refer to Figure 12.1). By revealing these sub-categories, it provides a richer understanding of the SA petrol supply chain and it provides a richer diagnostic tool that the traditional TOE cannot provide, in order to understand how Saudi Arabian supply chains can be integrated.

In relation to the contribution of this research to theory, using the TOE framework in this research provided detailed account of the issues and challenges facing various organisations that make up the petroleum supply chain in Saudi Arabia. Rich insights into problems relating to supply chain integration are presented and based on the analyses and discussion, a modified TOE framework is developed.

This research revealed significant findings that were highlighted in the literature review and then it has been advanced in this research. For example, Wood (1997) highlighted that technology utilisation instead of reliance on manual systems is considered the fundamental stepping stone for building a supply chain infrastructure. Similarly, this research highlighted that RFID technology is very useful integrated tool that add value to petrol supply chain and led to petrol supply chain integration. Moreover, this research revealed that RFID technology proved 30 percent cost saving of petrol consumption of fleet vehicles in Saudi Arabia.

Another example, digital divide and poor IT infrastructure to conduct payments (secure transactions) for e-government services was hindering citizens' adoption of e-services in Saudi Arabia Sohail (2006). Similarly, this highlighted that research digital divide and poor IT infrastructure of rural petrol stations is considered hindrances of petrol supply chain integration in Saudi Arabia. However, it is encouraged in metropolitan stations, Saudi Aramco, fuel haulers and fuel third party logistics providers. There are also various of similar examples were highlighted in chapter 11 (tables 11.12, 11.13, 11.14).

## **12.4 Limitations Pointing To Future Research**

This study has some limitations that can provide direction for future research. This study focused only on two regions to diagnose and explore the petrol supply chain in Saudi Arabia. Moreover, the researcher selected three petrol stations those were located in Alkhurmah in the Western region, as well as three petrol stations and four fuel haulers in Riyadh, in the Middle region. The researcher interviewed fifteen interviewees from these respective units (petrol stations and fuel haulers).

One would ask why only three petrol stations and four fuel haulers not more. To answer this question, the researcher adopted the theoretical saturation approach, which posits the notion the researcher no longer needs to conduct further interviews once no new insights are obtained, no new themes are identified, and no issues arise regarding a category of data (Bowen 2008). When the researcher reached the fifth and sixth interviews, nothing further was being added to the data that has been collected. Hence, the researcher found that six petrol stations and four fuel haulers, was sufficient to build up the picture of the petrol supply chain in the rural and metropolitan areas, in Saudi Arabia. In addition, a good representation between the rural and metropolitan was achieved because it was discovered that no further interviews would add value to the findings.

The final limitation of this study, is that TOE may be perceived as too broad a concept. However, it has been found to be very useful and insightful in this study. This is because the broadness of this framework assisted in the identification of the factors that provided a rich understanding of how the Saudi Arabian petrol supply chain may lead to petrol supply integration.

In terms of future research, this study could be used to generate a set of hypothesis, which can then be tested quantitatively via surveys sent out to a large number of organisations. By utilising a quantitative approach, a greater number of organisations can be approached based on the same or other regions of Saudi Arabia. Having a large number of organisations involved in the study would then increase the generalisability of the results. Furthermore, this study could be replicated qualitatively, to explore, other regions in the Middle East, or Arab countries, to identify any similarities, and/or differences, by conducting cross-country studies.

The final potential area for future research is to explore the TOE factors that theoretically and practically contribute to this research on Saudi Arabian petrol station supply chain integration and replicate the same factors that are mentioned in the revised framework of this study, applied to a different industry. Still, future research could explore the same factors included in the revised framework of this study (refer to Figure 12.1) through the different lens of different theories.

Overall, this study highlights the factors that led to answer the primary research question, ‘How do the technological, organisational and environmental aspects of the Saudi Arabian petroleum industry impact on petroleum supply chain integration?’ based on the three contexts (technology, organisation, and

environment) of the TOE framework. In addition, this study explored the case study of Saudi Arabian petrol stations based on two areas, rural and metropolitan areas.

Furthermore, the researcher addressed the issues that occur in the Saudi Arabian petrol stations that hinder petrol supply chain improvement, such as the expatriates and individual local owners who rent petrol stations illegally and the lack of surveillance of domestic petrol industry by the government. It was found that both rural and metropolitan petrol stations in Saudi Arabia utilise traditional operations management processes in the petrol supply chain, such as manual measurement of petrol tanks, which led to an increase of lead-time and provide poor quality service.

Moreover, the discussion of Saudi Aramco provided a cohesive understanding of the operations management at distribution centres based on the TOE factors. For example, this study discussed the influence of types of technologies (i.e. actual technology, traditional technology and information technology) on Saudi Aramco's operations management such as ERP systems and Hydrocarbon Supply Chain Management Systems and their perceived benefits on the company. This study also explored the lack of technology in terms of the driver identification and petrol loading processes that could help to overcome language issues that were considered to influence customer service and operations management at Aramco's distribution stations.

In addition, the researcher derived the issues that accrued amongst fuel haulers as petrol station supply chain members. Those issues were constructed in context of the TOE framework: technology, organisation and environment. Technology arose as an important factor that aided fuel haulers in their fleet's operations management due to the complexity of the hauling fleets' management that need technology, such as RFID and databases to overcome this complexity. Fuel 3PL providers were also discussed in terms of technical solutions that helped to enhance petrol supply chain operations management. The study also identified several implications for practitioners and for future research.

In summary, the findings revealed that the Saudi Arabian petrol supply chain integration is influenced by the technological (i.e. relative advantage and IT infrastructure), organisational (i.e. culture, religion, firm size, and firm resources), and environmental (i.e. geographic location, competition intensity and government regulation) contexts. Hence, this study explored and diagnosed different factors that help to understand the issues related to petrol supply chain and how our understanding of the TOE factors can lead to Saudi Arabian petrol supply chain integration.



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## 12.6 Appendices

### Appendix A: Participant Consent Forms



School of Business  
Information Technology  
Level 17, 239 Bourke Street  
Melbourne VIC 3000  
Australia  
Tel. +61 3 9925 5969  
Fax +61 3 9925 5850

<b>COLLEGE OF</b> الكلية	Business	كلية إدارة الأعمال
<b>SCHOOL/CENTRE OF</b> القسم	Business Information Technology and Logistics	تقنية المعلومات الإدارية والتجسبة
<b>Name of Participant:</b> اسم المشارك		
<b>Project Title:</b> عنوان البحث	<b>The Role of Information Technology in the Saudi Arabian Petrol Station Supply Chain: An Exploratory Case Study</b> دور التقنية المعلوماتية في سلسلة امداد وتزويد محطات الوقود في المملكة العربية السعودية: دراسة استكشافية	
<b>Name(s) of Investigators:</b> اسماء الباحثين	<b>1-Principle Investigator: Ibrahim Alhawas</b> ابراهيم الحواس / الباحث الرئيسي	<b>Phone:</b> الهاتف
	<b>2-Senior supervisor: Dr. Konrad Peszynski</b> دكتور كونراد بيسنكي / المشرف الرئيسي	<b>Phone:</b> الهاتف
	<b>3-Second supervisor: Dr Leslie W. Young</b> دكتور ليسي يونغ / مشرف ثاني	<b>Phone:</b> الهاتف

1. I have had the project explained to me, and I have read the information sheet.  
1- تم شرح البحث لي وقرأت استمارة المعلومات
2. I consent to participate in the above project, the particulars of which - including details of the interview and to give the opportunity to the researcher to witness the live process of petrol purchasing and refuelling process - have been explained to me. I agree to be interviewed twice and to allow the researcher to witness the entire process of petrol purchasing and refuelling.  
2- أوافق على المشاركة في البحث المشار اليه اعلاه لإجراء مقابلة شخصية واتاحة الفرصة للباحث لمشاهدة عملية طلب شراء الوقود وإعادة التهيئة في المحطة. حيث تم شرح الخطوات التي ينوي الباحث اتباعها أثناء معيئة عملية طلب الشراء وإعادة التهيئة. لامنع لدي لاتاحة الفرصة للقيام بمقابلتين شخصيتين واحدة لشرح عملية الشراء والاخرى لمعينة اعادة التهيئة في المحطة.
3. I give my permission to be audio taped:  Yes  No  
3- لامنع لدي من التسجيل الصوتي للمقابلة  
 نعم  لا
4. I agree to meet the researcher in my office and my petrol station.  
4- لامنع لدي من مقابلة الباحث في مكنتي أو في محطة الوقود.
5. I consent to let the researcher set next to me while purchasing the petrol online.  
5- لامنع لدي من جلوس الباحث بجاني أثناء القيام بعملية طلب الشراء عن طريق الإنترنت.
6. I acknowledge that:  
اطلعت وفهمت التالي:
  - (a) I understand that my participation is voluntary and that I am free to withdraw from the project at any time and to withdraw any unprocessed data previously supplied.  
أن مشاركتي في هذا البحث تطوعيه ولي مطلق الحرية في الانسحاب من هذا البحث في اي وقت أو طلب سحب اي معلومات ادليت بها سابقا قبل تضمينها في هذا البحث.
  - (b) The project is for the purpose of research. It may not be of direct benefit to me.  
المشاركة في هذا البحث هي للغرض الأكاديمي ومن الممكن أن لا تعود بالنفع المباشر لي شخصيا.
  - (c) A plain language report of the project outcomes will be made available to me at the end of the project.  
سيتم ارسال تقرير بلغة واضحة وبمبسطة بمخرجات هذا البحث بعد الإنتهاء منه.
  - (d) The privacy of the personal information I provide will be safeguarded and only disclosed where I have consented to the disclosure or as required by law.  
جميع معلوماتي الشخصية سيتم الحفاظ عليها وبسرية تامة ولن يتم اعطاها لأي طرف ثالث إلا بعد موافقتي شخصيا أو تم طلبها قانونيا.

Appendix B: Participant Consent Forms



School of Business  
Information Technology

Level 17, 239 Bourke Street  
Melbourne VIC 3000  
Australia

Tel. +61 3 9925 5969  
Fax +61 3 9925 5850

COLLEGE OF  
SCHOOL/CENTRE OF  
Name of Participant:  
Project Title:

Business  
Business Information Technology and Logistics  
The Role of Information Technology in the Saudi Arabian Petrol Station  
Supply Chain: An Exploratory Case Study

Name(s) of Investigators: 1-Principle Investigator: Ibrahim Alhawas Phone: +(61 3) 9925-1666  
2-Senior supervisor: Dr. Konrad Peszynski Phone: +(61 3) 9925-1654  
3-Second supervisor: Dr Leslie W. Young Phone: +(61 3) 9925 1459

1. I have had the project explained to me, and I have read the information sheet.
2. I consent to participate in the above project, the particulars of which - including details of the interviews - have been explained to me. I agree to be interviewed.
3. I give my permission to be audio taped:  Yes  No
4. I acknowledge that:
  - (a) I understand that my participation is voluntary and that I am free to withdraw from the project at any time and to withdraw any unprocessed data previously supplied.
  - (b) The project is for the purpose of research. It may not be of direct benefit to me.
  - (c) The privacy of the personal information I provide will be safeguarded and only disclosed where I have consented to the disclosure or as required by law.
  - (d) The security of the research data will be protected during and after completion of the study. The data collected during the study may be published. Any information which will identify me will not be used.

Participant's Consent

Participant \_\_\_\_\_ Date: \_\_\_\_\_  
(Signature)

Any complaints about your participation in this project may be directed to the Ethics Officer, RMIT Human Research Ethics Committee, Research & Innovation, RMIT, GPO Box 2476V, Melbourne, 3001. The telephone number is (03) 9925 2251.  
Details of the complaints procedure are available on the [Complaints with respect to participation in research at RMIT page](#).

Participants should be given a photocopy of this Consent Form after it has been signed.



School of Business Information Technology  
Friday, 7 October 2011 Version 1

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## Appendix C: Ethics Approval



**RMIT University**

GPO Box 2476V  
Melbourne VIC 3001  
Australia

Tel. + 61 3 9925 1408  
Fax + 61 3 9925 5555  
[www.rmit.edu.au](http://www.rmit.edu.au)

**Ref: Ethics Appl. 1000350**

16 November 2011

Dear Ibrahim,

I am pleased to advise that your application for ethics approval for a Research Project, *The Role of Information Technology in the Saudi Arabian Petrol Station Supply Chain: An Exploratory Case Study*, has been approved by the Chair of the Business College Human Ethics Advisory Network. Approval has been granted for the period from 16 November 2011 to 19 July 2014.

The RMIT Human Research Ethics Committee (HREC) requires the submission of Annual and Final reports. These reports should be forwarded to the Business College Human Ethics Advisory Network Secretary. Annual Reports are due in December for applications submitted prior to September the year concerned. I have enclosed a copy of the Annual/ Final report form for your convenience. Please note that this form also incorporates a request for extension of approval, if required.

Best wishes for your research.

Regards,

Allison Tatchell  
Secretary  
Business College Human Ethics Advisory Network

Encl.

## Interview schedule (English)

### اسئلة المقابلة

The focus of the interviews is to study the individual experience of the business owners (petrol stations, intermediaries), Third Party Logistics providers TPLs (Logistics and supply chain managers), ARAMCO. in order to explore and gain more understanding about the petrol supply chain from different factors such as organisational, technological, and environmental factors from each organisation.

الغرض من هذه المقابلة هو الحصول على فهم دقيق وشامل لعملية سلسلة امداد وتموين محطات الوقود السعودية بناء على ثلاث عوامل رئيسية وهي: المنظمة التجارية، والتقنية، وبيئة العمل. وذلك من خلال خبرة الأفراد كأصحاب محطات الوقود والوسطاء (شركات نقل المحروقات) والوسيط اللوجستي الثالث (شركات النقل اللوجستية) وشركة ارامكو السعودية.

Section 1:

الجزء الأول:

### Organisational context

### المنظمة التجارية

Description about the organisation: owners (petrol stations, intermediaries), Third Party Logistics providers TPLs

وصف المنظمة التجارية

1. What is your type of business? (To observe the right description of type of business, for example petrol station business within the Saudi Arabian petroleum industry and maybe the interviewee provides further elaborations about the scope of their particular business).

ما نوع نشاطك التجاري؟ وما هو الوصف الدقيق لنشاطك التجاري؟

2. How long has this business been in operation? (age of business)

متى بدأت تشغيل هذا النشاط التجاري (عمر النشاط التجاري: محطة الوقود)؟

3. How many employees are employed in your organisation? (in order to find out the size of business based on number of employees)

كم عدد الموظفين الذين يعملون لديك في المحطة؟ ماهي المهام الموكلة لهم؟

4. Why do you select this type of business? (strengths of the business)

ما سبب اختيارك لهذا النشاط التجاري بالتحديد (محطة الوقود)؟

5. Does the customer treatment with your petrol station's employees affect your business? How?  
(Culture)

هل يؤثر تعامل الزبائن مع العاملين في المحطة على سير العمل؟ لماذا؟

Saudi ARAMCO

أرامكو السعودية

1. What is your position and responsibilities?

ما المسمى الوظيفي لسعادتكم وماهي المهام المناطة بكم؟

2. How long has Saudi ARAMCO been established? (age)

متى تم انشاء ارامكو السعودية؟

3. How many employee works in Saudi ARAMCO? (Size)

كم عدد العاملين في أرامكو السعودية؟

4. How many branches does Saudi ARAMCO have? (size)

كم عدد فروع ارامكو السعودية؟

5. How would you describe ARAMCO's role in the petrol supply chain in Saudi Arabia

من واقع خبرة سعادتكم .. كيف يمكن أن تصف لنا دور ارامكو السعودية في سلسلة امداد و تموين الوقود في المملكة العربية السعودية

6. Do employees have experience in IT? Would you please explain more? (IT internal experience)

هل العاملين في ارامكو السعودية لديهم الخبرة في تقنية المعلومات؟ هل من الممكن ان تفصل اكثر؟

7. Does the culture influence on Saudi ARAMCO's business in domestic business? (Culture)

هل للثقافة تأثير على ارامكو السعودية؟

Section 2:

الجزء الثاني:

**Environmental context**

بيئة العمل



Owners (petrol stations, intermediaries), Third Party Logistics providers TPLs

1. Why did you select this particular site? How far is it from the refinery? (in order to observe the influence of geographical location, for example the distance to refineries)

لماذا اخترتم هذا الموقع تحديداً؟ كم يبعد عن مصفاة تعبئة الوقود التابعة لأرامكو السعودية؟

2. How has competition affected your business? Can you please explain the current competition environment that affects your business? (Competition intensity)

ما مدى تأثير المنافسة على نشاطك التجاري (محطة الوقود)؟ هل من الممكن ان تشرح البيئة التنافسية الحالية ومدى تأثيرها على محطتك؟

3. In your opinion does the government influence on your business? How? (Government regulation)

من وجهة نظرك .. ما تأثير أنظمة وشروط الدولة على نشاطك التجاري (محطة الوقود)؟

4. Are there any other environmental issues surrounding your company? Does petrol get delivered on time? What is the role of your company in the petrol supply chain?

هل هناك أي مشاكل أخرى تخص بيئة العمل المحيطة بمحطتك؟ هل يتم إيصال الوقود لمحطتك في الوقت المحدد؟ ما هو دور محطتك في سلسلة إمداد وتموين الوقود؟

Saudi ARAMCO

1. How many refineries do ARAMCO have? Where are they located? (Geographic location)

كم عدد المصافي التابعة لارامكو؟ وما مواقعها؟

2. From your experience, were there any obstacles in supplying petrol stations with petrol? What happened? Who was involved? How was it resolved? (supply process)

من خلال خبرتك .. هل سبق وان واجهتم اي مصاعب او عقبات في امداد محطات الوقود؟ ما لذي حدث؟ وكيف تم حلها؟

3. Does Saudi ARAMCO have any competitor domestically? NO, then who are the partners and suppliers? (In order to investigate whether there is an involvement of TPL providers or intermediaries).

هل هناك منافسين لأرامكو السعودية محلياً؟ من هم الشركاء والمزودين؟

4. Have you noticed any delays in delivering petrol to your domestic supply chain members?

هل سبق وأن لاحظتم أي تأخير في توصيل الوقود لأي طرف في سلسلة إمداد وتموين الوقود (محلياً)؟

5. What about the customers, partners and suppliers, does the government support them in terms of legalisation and policies to preserve their rights? How? (legalisation)

هل للدولة دور من ناحية اللوائح والقوانين لدعم وحفظ حقوق الشركاء والمزودين والعملاء؟ كيف؟

6. From your experience do you think your customers (petrol stations) are satisfied? Were there any complaints from your customers (petrol stations) OR partners or suppliers? What happened? Who was involved? How was it resolved? (Customer pressure)

من واقع خبرتك .. هل تعتقد ان العملاء (محطات الوقود) راضين عن الخدمة المقدمة لهم؟ هل هناك اي شكوى من قبل العملاء (أصحاب محطات الوقود) أو الشركاء أو المزودين؟ ما لذي حدث؟ وكيف تم حلها؟

Section 3:

الجزء الثالث

### Technological context

التقنية

Owners (petrol stations, intermediaries), Third Party Logistics providers TPLs

1. Do you think that technology is important for organisation's success? Please explain why? Do you think your employees will be ready to use any type of technology? How? (IT Internal experience), (perceived benefits).

هل تعتقد أن التقنية مهمة لنجاح محطة الوقود؟ لماذا؟ هل تعتقد أن العاملين في المحطة مستعدين لاستخدام أي نوع من انواع التقنية؟ كيف؟

1. What are the key technologies for your organisation and what were the criteria used to select these technologies for your organisation? (type of technology)

ماهي التقنيات الأساسية المستخدمة في محطة الوقود؟ وعلى أي أساس تم اختيار هذه التقنيات؟

2. What type of technologies are planned to be used in the next five years? (future expectation)

ماهي التقنيات التي تخطط لاستخدامها في الخمس سنوات القادمة؟

3. How do you predict the petrol demand in tanks? How you predict the future demand of petrol in your organisation? (petrol demand prediction)

كيف يتم التنبؤ باحتياج المحطة للوقود؟

4. What type of technology do you use for purchasing and communication with your suppliers and partners? (communication and procurement processes)

ما نوع التقنية المستخدمة لشراء الوقود وللاتصال مع المزودين والشركاء؟ هل من الممكن ان تشرح عملية الشراء؟

5. What are the internal and external information technologies that your organisation has been utilizing? (IT Infrastructure and current use of technology)

ماهي تقنية المعلومات التي تستخدم في محطة الوقود سواءً داخل المحطة أو خارجها؟

Saudi ARAMCO

أرامكو السعودية

1. Do you think that technology is important for Saudi ARAMCO particularly in the domestic business? How? (perceived benefits)

هل تعتقد أن التقنية لها دور مهم لأرامكو السعودية محلياً؟ كيف؟

2. What are the key technologies for Saudi ARAMCO domestically, in purchasing, transportation and communication processes? (type of technology)

ماهي التقنيات الأساسية التي تستخدمها ارامكو السعودية محلياً في مجال طلبات الشراء, النقل, الاتصال؟

3. What type of technologies are planned to be used in the next five years? (future expectation)

ما أنواع التقنيات التي تنوي ارامكو السعودية استخدامها في السنوات الخمس المقبلة؟

4. Does Saudi ARAMCO use any type of technology to estimate the current domestic market demand? Would explain how? (petrol demand prediction)

هل تستخدم ارامكو السعودية اي نوع من انواع التقنية لمعرفة احتياج محطات الوقود المحلية؟ هل من الممكن ان تشرح كيف يتم ذلك؟

5. What are the internal and external information technologies that Saudi ARAMCO organisation has been utilizing? (IT Infrastructure and current use of technology)

ماهي تقنية المعلومات التي تستخدمها ارامكو السعودية سواءً داخل الشركة أو خارجها؟

### Recommendations and suggestions:

Are there any suggestions about organisational, technological or environmental factors that you would like to discuss?

هل لديك أي اقتراح تود طرحه فيما يخص العوامل الثلاثة المؤثرة على دور التقنية في سلسلة امداد وتموين محطات الوقود السعودية (المنظمة التجارية, وبيئة العمل, والتقنية)؟ سيكون لذلك دور كبير في دعم هذه الدراسة

Many thanks for your participation

شكراً جزيلاً لمشاركتكم

## Appendix E: An Example of Transcriptions

Mr Sami

Petrol station owner

Duration: 53 Min

Alkhurmah

13/12/2011

المنظمة التجارية

### Organisational context

ما هو وصف النشاط التجاري؟

وصف المنظمة التجارية **بيع مواد بترولية بالتجزئة**. Background

كم عمر النشاط التجاري؟

12 سنة age

كم عدد العمال المختصين بالتعبئة؟

4 عمال size

ما هي مهامهم؟

تعبئة المحروقات كل 2 وردية من الساعة 8 ص الى 8 م كل وردية يعني 12 ساعة لكل واحد مهامهم التعبئة والمحاسبة

سبب اختيار النشاط؟

استثمار في بيع المحروقات

هل هي مربحة اكثر من الانشطة الاخرى؟

هي مريحة لولا المنافسة لان المنافسة ينفصون عن سعر competition intensity. الدولة تعطي 9 هلات كريح للمستثمر في اللتر الواحد لكن المنافسين تصل بهم بانقاص ربحهم الى 5 هلات في اللتر الواحد.

مامصلحتهم؟

لكثرة المحطات في الطريق كثر العرض دعاهم للتنافس بالشكل هذا وهذا سبب الارباح ان تكون متوسطة.

هل يؤثر تعامل العمال على سير عمل المحطة؟ هل هناك مشاكل؟

نادرة حقيقة. مثلا بعض المتهورين يعي ويهرب وهذا يسبب عجز في دخل المحطة customer pressure بسبب الهروب هذا.

وحلها ان عاد مرة اخرى يأخذون مقدم منه.

هل يحاسب العامل؟

لو تكرر من العامل عدم الانتباه نعم يحاسب. لو كان جديد لأول مرة وحصل الحاصل لا يحاسب لكن لو تكررت من نفس الشخص ومع نفس العامل نعم يحاسب. لكن حصول هذه المشاكل نادرة وتعتمد على ذكاء العامل وانتباهه لان بعض العمال ذكي ويطلب من الشخص مقدما.

من ناحية تعاملهم مع العامل كونه اجنبي هل فيه مشكلة؟

عندنا لا يتعامل الزبون مع العامل والطرمبة مبرمجة بالسعر وكل شيء يرى الزبون قيمة البنزين ويحاسب عليه ونادر يحصل اشكال.

ماذا عن السعوية؟

لا يرغبون العمل في هذه المهنة علما اني لا أرى فيها اي اشكالية حقيقة في تعبئة الوقود.

Culture

هل فكرتم في عمل تعبئة ذاتية؟

لا هذه صعبة اولاً من ناحية السلامة والحرائق وامورها. هذه ناحية الناحية الثانية ليس كل شخص سيعبي ويذهب للمحاسبه الا ان كان هناك طرمبات تعبئة باستخدام بطاقة الكرت ويدخل المبلغ الذي يرغب التعبئة به وينتقل المبلغ من حساب لحساب وبدون الرصيد لن تتم العملية. واتوقع عدم امكانية تنفيذها الا بعد 10 سنوات او 15 سنوات.

IT infrastructure/ Organisational readiness

لماذا؟

لأنني لا أراها وحتى لو قمنا بوضعها كم شخص سيتعامل معها من الزبائن ويفهم التعامل مع الات حديثة او طرمبات حديثة من هذا النوع.

هل تعتقد ان تطبيق تقنيات من هذا النوع سيتأقلم عليه المواطنين والزبائن؟

في الوقت الحالي لا أضمن ذلك ستأخذ وقت طويل لتفعيلها والتأقلم عليها. ولان ليس كل زبون سريع في تعبئة سيارته سيحجز الطرمبة التي في المقابل لو كان عليها عامل لكان قام بتعبئة 3 سيارات في الوقت الذي استغرقه الزبون البطيء الذي اول مرة يستخدم التعبئة الالي.

Customer readiness/ IT knowledge / competition intensity.

انا في الحقيقة رأيت طريقة اخرى وهي ان العميل يذهب ويدفع المبلغ الذي يرغب التعبئة به لدى المحاسب داخل المحطة ويعطيه قطعة معدنية يضعها في الطرمبة فتعمل الطرمبة وتزوده بالترات بناء على المبلغ المدفوع مسبقا وعند الانتهاء تقفل الطرمبة. وبنهاية الوردية يقوم الموظف بجمع تلك القطع المعدنية لاستخدامها مرة اخرى وهكذا.

Suggestion

بيئة العمل

ماسبب اختيار هذا الموقع بالذات؟

بسبب قربه من مدينة الخرمة يبعد عن الخرمة 7 كيلو وخروج اهالي الخرمة للسفر لمكة او الطائف او الرياض يضطرون للمرور عليها. والسبب الثاني وقوعها على الطريق الرابط بين المنطقة الجنوبية والغربية. وهناك ناس تخرج من الخرمة للتنزه يعبون من المحطة ويعودون للخرمة. Location

هل هي بعيدة عن محطة توزيع ارامكو؟

بعيدة حقيقة 450 كيلو لو يضعون واحدة في الطائف لكان افضل لكن ارامكو لاتقيم محطات توزيع الا في المدن الكبرى هذا المعروف عن ارامكو. Geographic location

لو وضعت مثلا محطات توزيع قريبة منكم اليس افضل من الذهاب لمحطة التوزيع في جدة؟

طبعا افضل كل ماكانت قريبة اصبحت المصاريف اقل.

ما تأثير المنافسة على نشاطك التجاري غير نقطة انقاص سعر الربح لكسب العملاء؟

احيانا المنافسة تكون غير شريفة والمتضرر المستهلك competition intensity لأننا نسمع ان هناك محطات يخلطون 91 مع 95 أو مع الكيروسين كي يستفيد ماديا لو باع بمربح 3 هللات لا يغطي مصاريفه وان لم يبيع مثل المنافس ب3 هللات تضرر فيضطر للقيام بالتحايل والنتيجة تعطل سيارات العملاء.

الا يكفيه الربح؟

هو في الواقع لا يبيع بسعر الحكومة المحدد كربح للمستثمر هو يبيع بأقل وخصوصا الاجانب وبالذات المحطات المؤجره على اجانب وضمائهم معدومة فيقومون بالخلط بالاضافة الى انقاص نسبة الربح لجذب العميل competition intensity. مثلا سعر الدولة المحدد للربح في نوع البنزين 95 هو 65 هلله يقوم هو ببيعه ب60 هلله لجذب العميل و60 هلله ليست بالربح المرضي بالطبع لان تجارة محطات الوقود تعتمد على الدخل الضئيل (الهلات) وهو لديه من المصاريف والامور الاخرى الشيء الكثير فيقوم بخلط الاقل سعر وهو بنزين 91 بالاعلى سعر بنزين 95 ويعوض النقص في هذا المنتج (المغشوش).

لكن هل السعر هذا معن للزبون؟

الزبون يعرف سعر البنزين في الخرمة 65 هلله ويقوم العامل هذا بوضع لوحة على مدخل المحطة بان سعر البيع هو 60 هلله فقط لجذب الزبائن طبعاً والزبون لا يعلم عن مسألة الخلط والتحايل الذي تم بالخفاء.

وهذا الشيء حاصل في وقتنا الحالي؟

نعم حاصل وسبق وكتبت عنه الصحف المحلية لمكافحة الغش التجاري وان الظاهرة السلبية هذه اتلفت العديد من سيارات المواطنين. لكن ما هو علاج هذه المشكلة؟

نعم ماهو العلاج؟

علاجها وضع اليه لتشغيل نشاط محطات الوقود على الطرق العامة والسريعة. لان السبب الاساسي هو وجود محطات على الطرق العامة والسريعة بكثرة بدون مقاييس للكيلومترات Government regulation/geographic location. فتجد كل 50 كيلو ثلاث محطات بجوار بعضها وهذا يسبب الكساد ويضطرهم الى التنافس بالطرق الملتوية ومن ضمنها خفض السعر لجذب الزبائن بشكل اكبر.

لكن هل انظمة الدولة لاتنص على منع التجاور بالشكل هذا بين المحطات؟ هل لديهم آليه لضبط هذه الأمور؟

في الحقيقة هذه مناعة بالبيديات ووزارة المواصلات والدفاع المدني. لان الطرق العامة مسؤولية المواصلات لمدخل المحطة ومخرجها وسلامة الطريق والبلدية لإصدار الرخصة والدفاع المدني للسلامة.

بالنسبة لمحطتك كم المسافة بينها وبين التي تليها؟

المسافة قرابة كيلو واحد وبهذا المحطتين قريبة من بعضها البعض وهذا مايسبب المنافسة الغير شريفة.

من وجهة نظرك هل انظمة وشروط الدولة لها تأثير على محطة الوقود التي تمتلكها؟

في الحقيقة أنظمة مكتب العمل في عدم منح اصحاب المشاريع التجارية ايدي عاملة كافية تتسبب في توقف المشروع احيانا. Government regulation.

مثل ماذا؟

نعم انا لدي اثنين في ورديتين فقط ومكتب العمل لم يمنحني الا فيرتين لعاملين فقط

بناء على ماذا؟

لا اعلم على اي اساس قاسوها انا لدي مظلة ب 6 طرمبات بنزين ومظلة 4 ديزل يعني عشر طرمبات وكل مظلة تبعد عن الاخرى 30 متر. هم حسبوها كل وردية عامل واحد فقط لكن هل العامل الواحد سيعمل 12 ساعة على 10 طرمبات هل هذا منطقي؟. فمكتب العمل لايعطي العدد الكافي. المفترض أقل شي 2 لكل وردية يعني ورديتين 4 اشخاص على الأقل ولكن إذا قللوا كل وردية عاملين. واحد ديزل وواحد بنزين فهذا يسبب عجز نعاني منه الآن.

**Government regulation /the owner is looking for more workers which address the dependency on workers in Saudi Arabian petrol stations.**

وهل تعلم على اي اساس تم منح هذا العدد؟

لا أعلم والمفترض ان يرسلون مندوب من المكتب يقف على المشروع ويرى هل عامل واحد فقط يستطيع القيام بتغطية 10 طرمبات ومنها يعرف ان المشروع ليس وهمي.

هل هناك جهة اخرى تؤثر شروطها على نشاطك التجاري؟ مثلا ارامكو والبتروك والمعادن؟

البتروك والمعادن ليس لنا علاقة بهم فقط ارامكو. ارامكو اذا اموري مرتبه لا يوجد مشاكل. السائق يقول ان ارامكو تطلب فاتورة ورقية ولايكتفون برقم الطلب والتسليم لهذه الفاتورة يكون سواء عن طريق الفاكس أو مع السائق نفسه.

Technology / Hard copies

وماذا عن إجراءات الأمن والسلامة؟

فيها جور وظلم حقيقة مثلا الكفريات لو كان في الكفر تأكل نصفي يمنعون التعبئة في المرة الأخرى.

الأمر الآخر اتساح الخزان الخاص بالسيارة يؤدي لرفض التعبئة وبلغني الطلب الذي جاء من أجله السائق.

Regulations

هل التعطيل هذا يؤثر عليك؟

نعم انا عندي عدد لترات محددة تمشي 15 ساعة على مايروح ويرجع ولو رفض الطلب يصل التأخير 36 ساعة وانقطع انا من البنزين او الديزل.

Regulations/delay



هل سبق وحصل الشيء هذا؟

نعم سبق وحصل ويمكن يكون السبب من ارامكو واحيانا يكون عطل في السيارة لكن التأخير وارد.

ولو تاخر العامل عن مواعده او الغي الطلب لسبب ما من قبل ارامكو؟ مالحل؟ peak load

ان نحجز موعد ثاني في اليوم التالي واحتمال ان نجد موعد او ان تكون المواعيد كلها محجوزة فيزيد التأخير وخصوصا في الصيف او المواسم مثل الاجازات او الشعائر الدينية من حج او عمرة Religion يكون الطلب على الديزل كبير جداً Customer pressure/significant demand on diesel ولذلك تجد المواعيد على الانترنت في موقع الشراء محجوزة احيانا لثلاثة ايام ففي هذه الحالة لو اصبح تاخير سواء من جهة ارامكو ام السائق او السيارة سيتسبب في تاخير يصل لثلاثة ايام وانقطاع المحطة لمدة ثلاثة ايام Delay. الصيف دائماً يحصل فيه عجز الا اذا قمت انا بالترتيب Firm resources وكان لدي رأس مال قوي بحيث احجز مواعيد متتابعة ورسيدي يتحمل قيمة البنزين والديزل الذي سأقوم بطلبه كمواعيد متتابعة. الذي استطع تعباته أعينته في وقت الحجز أو يلغى الحجز لكن أكون أمنت وضعي بحجوزات متتابعة بناء على الرصيد لانه لا يتم الحجز للتعبة الا بناء على الرصيد المتوفر ب14 يوم . لكن اللي ماعنده راس مال ويبيغى 3 ردود و2 بنزين و2 بنزين يجب ان يحصل عنده انقطاع من البنزين او الديزل.

كم تصل مدة التأخير؟

تصل لخمسة ايام لان المواعيد في موقع ارامكو حجزتها لمدة خمسة ايام في اوقات الذروة الي ذكرناها.

طيب لو حصل الانقطاع مالحل؟

أقوم بطلب ناقل يمولني بالبنزين او الديزل او الجأ لمنافسيني لو كان عندهم طلب زائد عن حاجتهم احاسبهم عليه ويعطوني البنزين او الديزل ويسعفون بعدد لترات او بشاحنة تفرغ لي.

Competition intensity

كيف يخدمك الناقل؟

احول المبلغ ويرسل الشاحنة لأنه من الأساس لديه حمولة في السيارة جاهزة ويرسلها لي.

يبيعونه بنفس السعر؟

نعم ويأخذ أجار النقل. هذا حل لكن انا مضطر لهذا الحل المكلف لان الزبون ان اتى للمحطة ولم يجد بنزين او ديزل ولاحظ انقطاع البترول في المحطة يذهب لمنافسيني. لذلك صاحب المحطة يتصرف باي طريقة لتفادي الخسائر.

Customer pressure

من المسؤول؟

ارامكو عليها لوم في تاخير منح الأمر بسبب العجز الحاصل عندهم في توفير المنتج بناء على الطلب الزائد. واحيانا من صاحب المحطة  
نفسه ممكن عطل كفاتر او السيارة تتعطل يكون السائق نفسه.

ARAMCO's lack of products, truck driver, and the truck breakdowns are the reasons of petrol supply delay to petrol stations.

هل يتم ايصال الوقود في الوقت المحدد في امر الشراء؟

لا احيانا يعبي الحمولة ويستريح في الطريق ونحن لانجبره على وقت معين لأنه انسان يتعب من الطريق. لكن عادة نرتب انفسنا على  
36 ساعة او 15 ساعة يعني نصف يوم او يوم ونصف.

ملاحظه

يعني تقريبا عملية التمويل تتم في 20 ساعة. والتمويل يكون يوم بعد يوم.

Supply process

والسائق لامانع لديه من العمل لمدة 20 ساعة؟

لا ليس لديه مانع يوم ورا يوم.

هل سبق وكنت متعامل مع ناقلين؟

نعم وانا ليس لدي غير سائق واحد واحيانا ياخذ اجازة سنة اشهر اوقف الشاحنة عن العمل وارجع للناقلين لاني لم امنح من مكتب العمل  
الا تأشيرة واحدة فقط فلو كان لدي سائق احتياط لما تعطلت او اوقفت شاحنتي ولجات للناقلين. Government regulation

كيف يتم التواصل مع شركة النقل؟

بالجوال اعطيهم خبر حسب الموسم اذا كان في الصيف اطلبها قبل موعد التسليم ب24 ساعة او 36 ساعة بسبب الضغط عليهم وعلى  
ارامكو. لكن في الشتاء قبل موعد التسليم ب15 ساعة كافية لتوفير الطلب من قبل الناقل.

Supply process

هل للشركات العالمية دور في نقل المحروقات للمحطات مثل شركة فيدكس و يو بي اس وغيرها من الشركات العالمية؟

لا أبداً في السعودية مؤسسات النقل تابعة لأفراد ولم اسمع ابدا ان لها دور في نقل البترول.

Supply process and TPL providers

هل تجد ان الناقل ليست مربحة لك يجب ان يكون لديك سيارة خاصة بك؟

نعم انا اوفر النقل واجار الناقل.

Have own truck to save transportation costs

كم يأخذون الناقلين؟

1300 ريال

ولو خفض هذا السعر؟

افضل شيء سيارة لان الذي يعتمد على الناقلين احبانا يكون فاضي ويزودك واحبانا يقول لك انا مشغول لمدة خمسة ايام فنتعطل في هذه الحالة المحطة.

لو تم التواصل بينك وبين الناقل بشكل الي ولم تعد بحاجة الي الطلب قبل انتهاء المخزون وتم توفير الكمية التي تحتاجها في وقتها وبدون ان تشتري شاحنة وان يكون لديك سائق خاص هل تجد ذلك حل لهذه المشاكل؟

في الحقيقة لو كان لدي المقدرة لشراء الشاحنة ويكون لدي سائقي الخاص افضل من التعاقد مع الناقلين والاستغناء عن الاخرين.

ارتب اموري بنفسى وعملي بنفسى افضل.

ماذا عن بيئة العمل كمحطة وقود متكاملة كعامل جذب للزبون؟ Competition intensity

في الحقيقة الكل يشككي من مستوى محطات الوقود السعودية والكل يقول ان المحطات غير نظيفة ومنظرها سيء. نعم كلنا نتفق على ذلك لأن المحطة اذا كانت متسخة لاتجذب الزبون. وضع المحطات سيء فلذلك الرأي العام اتفق على ان المحطات في المملكة يجب ان تكون نظيفة ومرتبطة مثل محطات الدول الأخرى بما في ذلك المسجد والموتيل والبقالة والمطعم وليتم القيام بهذا الشكل من الترتيب يجب التقليل وتقنين محطات الوقود Gov. فنحن على سبيل المثال لدينا الموتيل الساعة المفترض ان تكون 25 او 35 ريال للساعة كأقل تقدير لأنني قمت بالصرف على هذا الموتيل مبالغ طائلة لكي يكون بالشكل المرضي للزبون وبالشكل الذي نرغب ان نكون عليه. لكن الأمر الذي يحصل اليوم أن السعر يصل الى 5 ريالات للساعة بما لايفي حتى بمصاريف الأثاث والترتيب الذي وصلنا له ليكون الموتيل بالشكل المرضي. في هذه الحالة يعتبر صاحب المحطة الذي يرغب في جعل المحطة نظيفة خاسراً. فإن لم أأجر الغرفة 5 ريال للساعة فسيزهد الزبون لغيري الذي سيعطيه غرفة سيئة للغاية ونظافة سيئة للغاية ومحطة بكامل منافعها تصنف بالسيدة. ففي هذه الحالة والخمسة ريالات هذه لن تفي بمصاريفي الشهرية والتي تتضمن راتب العامل الذي يقوم على تنظيف الغرف وتاجير الغرف والاشراف عليها والذي لن يعمل بأجر زهيد. فاليوم ليس هنالك عامل يعمل مقابل 800 ريال لتنظيف الغرف والقيام بالمهام الأخرى لارضاء العميل ولو قبل لن يعمل بالشكل المطلوب وفي هذه الحالة لن يسعى لرضا العميل وستبقى المشكلة متعلقة بي انا كمستثمر وخسارتي في جعل هذا المكان نظيفاً وبالمستوى المطلوب وستبقى المشكلة الأخرى وهي السعي لبيئة محطة وقود ترتقي لمستوى المملكة لا يمكن تحقيقها. (صغتها لكي يكتب في التحليل كمشكلة بيئة عمل) لكن انا مقابل ذلك يجب ان ارفع السعر ومع ذلك انا الان أأجر مع المصاريف التي دفعتها في الموتيل ب10 ريال للساعة ولو يجلس الزبون ساعتين او ثلاث لا نأخذ الا عشرة ريال فقط والليلة كاملة ب50 ريال. فمثلا لو ذهبت الى محطة x حيث الغرفة تؤجر ب150 ريال لليلة لانها محطة نظيفة يذهب الزبون للمحطة التي تليك ويسكن باقل الأسعار الممكنة لان المحطة سيئة ولم يتم الصرف على الموتيل بالشكل الذي يرضي العميل ومع ذلك يذهب الزبائن للموتيلات هذه. فأنا أعتقد أنه يصعب تنفيذ فكرة المحطات التي ترتقي لرضا العميل الا في حالة خصخصة محطات الوقود وتسليمها لشركات بدلا من احتكارها على الافراد فمثلا شركة واحدة تستلم طريق الرياض كاملاً وتوحد جميع الخدمات واسعارها تجبر النولة ممثلة في وزارة السياحة تجبر المحطات

بتوحيد الشكل والخدمات والأسعار بالشكل المطلوب حتى لو كانت المسافات بين المحطات متقاربة بين المحطة والأخرى 50 كيلو كما هو الوضع الحاصل حالياً. لأن الإدارة واحدة والخدمات نفسها وأسعارها موحدة بما في ذلك أسعار البنزين والديزل ولا يمكن التلاعب بها بهذه الطريقة ممكن جداً أن نصل للمستوى الراقي لمحطات الوقود في المملكة العربية السعودية **government regulations**.

لكن الوضع الحالي حتى أكبر الشركات اليوم على الطريق السريعة ما فيها النظافة المطلوبة لإرضاء العميل بل سيئة جداً. أنا ذهبت لعدة دول في الخليج ورأينا محطات مرتبة ونظيفة جداً وكانت على شكل مصغر ما فيها مطعم فيها بوفيه ولا فيها سكن هذي طبعا داخل المدن لكن تلك الدول ومنها الإمارات كانت شركات تدار من قبل الدولة.

لتطبيق رؤية الدولة السياحية يجب أن يكون للدولة دور وأن تقوم بخصخصة المحطات والا سيكون من المستحيل الوصول لهدف أن تكون محطات الوقود في المملكة متطورة. وذلك يكون بحصر الأفراد وفرض عليهم الشروط السياحية المطلوبة والا يقوم هؤلاء الأفراد بتأجيرها على الشركات والشركات تعطيم قيمة استثمارهم بشكل شهري. **فالدولة بشروطها لن تفرض عليه اقفال المحطة لكن ستعطيها من سيستثمرها بدلاً منه وبالشكل الصحيح** (هذه الفكرة تقودنا لحل مشكلة التستر ويكتفي المواطن بالمبلغ الشهري أو السنوي من الشركة المستأجرة لمحطته بدلاً من تأجيرها بالباطن على العمالة وحصول مالا تحمد عقباه).

أكثر الناس يقيم محطة ثم يؤجرها على عمالة تشغلها نادر جداً تجد سعودي يملك المحطة ويشغلها بل أن بعضهم يستأجر المحطة ويؤجرها على العامل ويأتي السعودي آخر الشهر ويأخذ مبلغ معين ولا يهتم بجودة الخدمة ولا النظافة ولا غيرها. **Organisational culture**

في الحقيقة الشعب فيه وعي ولكن أحيانا تأتي الإساءة من البعض فانا على سبيل المثال في محطتي وضعت عامل مخصوص لنظافة دورات المياه. لكن عندما أذهب إلى جدة أو الرياض أو القصيم أجد دورة المياه جميلة ونظيفة ووقت الصلاة بعد خروج المصلين تجد دورة المياه لاتزال بتلك النظافة التي كانت عليها وذلك لاخلاق المدينة والتربية. **Demography**

**Hints:** بما أن الصلاة الزامية وواجبة على جميع المسلمين فهناك ازدحام على محطات الوقود في الطرق السريعة وقت دخول الصلاة وذلك لانهم يريدون تأدية الصلاة وفي نفس الوقت يتزودون بالوقود وذلك يشير إلى أمرين الأمر الأول الريح لمحطات الوقود واطافة هذه الأوقات لأوقات الذروة اليومية لمحطات الوقود **Peak** والأمر الثاني اتساخ محطات الوقود يجعل البيئة غير نظيفة وشعور العامل اذا كان هناك عامل لنظافة المحطات يمل ويكل من التنظيف ويتركها على ماهي عليه ولو كانت بيئة العمل **organisation culture** نظيفة لأصبحت نظرة المجتمع للعمل في محطات الوقود أرقى مما هي عليه ومن المحتمل أن يقبل السعودي بالعمل في محطات الوقود.

## التقنية

هل تعتقد ان التقنية مهمة لنجاح محطة الوقود؟

نعم اسرع وأمن في التعامل. كنا قبل التقنية نرسل المال نقداً مع السائق او عن طريق شيك مصدق ونسلمها للسائق وهذه عرضة للسرقة. **IT knowledge**

المبالغ كانت كبيرة؟

نعم تصل 17000 ريال نقداً. وهذه عرضة للسيارة للسرقة وللسائق. والدفع الالي بالنت افضل بكثير. وكنا قبل نعمل فواتير يدوية وان لم يعبي من ارامكو يجب مراجعتهم في مدينة جدة لحل المشكلة. لكن الان ان حصل الغاء للتعبئة يعود الرصيد لحسابك في ارامكو ويتم عمل حجز اخر بعدها ب24 ساعة.

كيف يتم قياس المخزون؟

نحن نقيسه بقياس بدائي وليس علمي حقيقة.

قمنا بعمل مسطرة حديد وقمنا بتثبيت متر عليها ونقوم بقياس الخزان بهذه المسطرة كل ما اردنا التمويل بديزل او بنزين.

ونرى كم الارتفاع وبناء عليه نعرف كم لتر موجود في الخزان. Supply process/ measurement

كم سعة الخزانات؟

2 ديزل كل خزان فيه 45 الف لتر والبنزين 95 خزان واحد 45الف وخزان 45 الف 91.

نوعها حديد غير قابل للصدأ.

ماذا عن القياسات الالكترونية؟

سبق ورأيتها لكن ليس لدي خلفية عنها لكن اتوقع أن المختص الذي يقوم بعمل التمديدات للمحطة يضع عداد الكتروني في الخزان وكل وردية يشيك عليها العامل IT knowledge. وطبعاً هذا العمل مضبوط لكن عملنا عشوائي.

هل تفكر بوضعها في المستقبل؟

نفكر.

قياس الورديات لليرادات يكون عن طريق عدادات الطرمبات وإذا عرفت الذي تم استهلاكه في الوردية عرفت كم استهلك من

المخزون اليس كذلك؟ Supply process/ leaking test/ evaporation test

نعم ولكن بشكل تقريبي بعيد جداً عن الدقة وهذا عمل عشوائي حقيقة لأنه احتمال يكون هناك تسريب من التمديدات للطرمبات أو الخزان ولا تعلم إلا عن طريق التصفير وهذا لا يتم إلا إذا انتهى المخزون كلياً وأقفلت المحطة للتعبئة من الصفر وبعدها ننتظر أنت تنتهي حمولة الشاحنة 35 ألف لتر بعدها نعرف إن كان هناك فرق شاسع بين الذي تم تفريره في الخزان الأرضي وبين الذي تم بيعه وإن لم يكن الفرق كبير نعرف أنه ذهب في التبخر. فمثلاً التبخر المتوقع في الديزل في الصيف قد يصل إلى 100 لتر من الخزان كامل لكن إن كان الفرق المكتشف بعد عملية التصفير والبيع أكثر من هذا المستوى على سبيل المثال 2500 لتر فهذا يدل على أن هناك مشكلة تهريب سواء في المواسير أو الخزان الأرضي.

ملاحظه: ومن هنا نعرف أن التقنية ستستخدم في اكتشاف التسرب وضبط الكميات المفرغة في الخزان والمباعة وبشكل سلسل ودقيق.

ماذا عن التقنيات المتوفرة حالياً في المحطة؟

ليس لدينا اي تقنية في المحطة. فقط الطرّمبات كانت في السابق الطرّمبة نفسها هي التي تسحب المنتج من الخزان الارضي وتكون بطيئة جدا لكن الآن اصبحت مجهزة بغطاسات تسحب بشكل اقوى واسرع للتعبئة في سيارة الزبون. IT knowledge هناك بعض المدن فيها عدادات الكتروني ويتم الادخال في لوحة التحكم وطرّمباتنا يدوية.

ماذا عن الخمس سنوات القادمة ماهي التقنيات التي ترغب في استخدامها في محطتك؟

مستقبلا ممكن اركب قاريء الكميات في الخزانات. اما العداد الإلكتروني لست حريصا لتلك الدرجة. حاليا احاول اركب قطعة على الخرطوم المدمج في الطرّمبة لو حصل وتحركت السيارة سواء عمدا او خطأ والخرطوم في فوهة خزان السيارة تقوم هذه القطعة وهي عبارة عن صمام يقطع الدائرة الكهربائية عن الطرّمبة وبهذه الطريقة نقلل خطورة حدوث الحريق لاسمح الله وغيره من الاخطار الجسيمة. لان السائق احتمال ينشغل بالجوال ويعتقد ان العامل انتهى من التعبئة فيتحرك وتحصل المصيبة.

Most points that participants focus on are safety matters.

هل هناك اعلانات توعوية وتحذيرية تضعونها في المحطة مثل ممنوع التدخين ممنوع استخدام الجوال او نزول الاطفال من السيارة؟  
لا فقط لوحة ممنوع التدخين وهذه هي التي طلبها الدفاع المدني فقط.

هل لديك اي اقتراح تود طرحه فيما يتعلق بالعوامل الثلاثة بيئة العمل والتقنية والمنظمة التجارية؟

اقترح على فرع وزارة التجارة في كل مدينة متابعة اسعار بيع المحروقات والتاكيد على بيعها بتسعيرة الدولة وعدم السماح نهائيا للمنافسة في اسعار المحروقات المحددة من الدولة واذا اتضح لمندوب التجارة ان اي محطة تلاعبت بالتخفيض او الزيادة يلفت نظره واذا استمر تغلق المحطة او القيام بعمل غرامات عليها حفاظا على ممتلكات المواطنين وحفاظا على المنافسة الشريفة. وتحديد مسافات بين محطات الوقود.

Competition intensity/ government regulation