INNOVATION CAPABILITY AND ADOPTION OF INNOVATION IN NAMIBIA'S ROAD FREIGHT TRANSPORT INDUSTRY

by

Anna Tusiloshenda Kangombe

Dissertation presented for the degree of Doctor of Philosophy in the Faculty of Economics and Management Sciences at Stellenbosch University

Promoter: Dr Firoz Khan

March 2017

DECLARATION

By submitting this thesis electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

March 2017

ABSTRACT

Freight transport costs and prices in Namibia are among the highest in the Southern African Development Community (SADC) region. Yet, the country's road transport development agenda is premised on infrastructure development with limited knowledge on the ability of road freight transport firms to utilize that capacity and competitively support economic transformation activities. While innovation is arguably a pillar of competitiveness and growth for countries and firms around the world, research has not attracted required attention on innovation capacity of firms in Namibia, including in priority development sectors such as transport and logistics. This study, which applied empirical mixed method survey design, combines a non-linear inputs of innovation capability model with the probit model of Diffusion of Innovation (DoI) theory to assess road freight transport firms' ability to innovate in a low skilled, less regulated industry of a small developing economy.

The findings of the research submits that overall, Namibia's road freight transport firms have capacity to provide efficient transport services to the economy, but rewards and attitudes towards novelty are lower. With the exception of micro enterprises, size and age of firms do not significantly affect innovation behaviour as per theoretical predictions because in Namibia's road freight transport industry, most SMEs are owned and or managed by experienced former employees of larger firms.

In spite of high levels of innovation capability observed among firms, the idiosyncratic ability of some constructs appear to have eroded into mainstream competencies as the study distinctively identified intra-organizational learning as the only construct highly associated with firm performance. The manifestation of poor reward systems on employees' willingness to share knowledge and participate in creative innovative activities was also observed as a critical, yet ignored organizational detail. In adopting technological innovations, the results found that senior managers, especially in the early phases of the adoption process, follow a 'political man' syndrome where ideas from the floor are overlooked causing a disconnect between adoption and actual utilization of innovation in service provision.

For firms, the solution for moving away from merely 'enabling' employees to meaningfully 'engaging' them in the innovation process lies in the promotion of psychological and job related employee well-being. This is especially important because, despite high levels of intra-organizational learning (a construct that is strongly associated with firm performance),

innovation capability in the industry has not strongly translated into efficient transport services, hence the country's high transport prices.

At policy level, this study recommends the introduction of protective compensatory measures accompanied by industry-specific incentives, which are currently lacking. The similarity of innovative behavioural traits between large, medium and small firms in the industry also calls for inclusive development support programs that are appreciative of micro size enterprises' limited innovative capacity.

By combining innovation capability and adoption of innovation based theories, this study pioneered a comprehensive application of firm-level innovation capacity assessment in Namibia. The new praxis aggregates innovation results and introduces an innovation results spectrum which comprises a firm's generation capabilities (human factor), absorption abilities (technology factor), actual utilization (socio integrative effect) and firm performance (bottom line). In applying this approach, this study underscores the missing link between employees, capital and state in the provision of efficient road freight transport services and firm growth in Namibia.

OPSOMMING

Vragvervoerkoste en -pryse in Namibië is van die hoogste in die Suider-Afrikaanse Ontwikkelingsgemeenskap-streek (SAOG). Tog berus die land se padvervoerontwikkelingsagenda op infrastruktuurontwikkeling met beperkte kennis oor die vermoë van padvragvervoerfirmas om hierdie kapasiteit te benut en aktiwiteite vir ekonomiese transformasie mededingend te steun. Al is innovering stellig ’n steunpilaar van mededingendheid en groei vir lande en firmas regoor die wêreld, het navorsing nie die nodige aandag op die innoveringskapasiteit van firmas in Namibië gefokus nie, insluitende in voorkeurontwikkelingsektore soos vervoer en logistiek. Hierdie studie, wat empiriese opnames toegepas het, kombineer ’n nie-liniêre-insette-van-innovering-vermoë-model met die probitmodel van Diffusie-van-Innovering-teorie (Diffusion of Innovation of DoI) om padvragvervoerfirmas se vermoë om in ’n lae geskoolde, minder gereguleerde bedryf van ’n klein ontwikkelende ekonomie te innoveer.

Die bevindings van die navorsing stel dit dat, in geheel, Namibië se padvragvervoerfirmas die kapasiteit het om doeltreffende vervoerdienste aan die ekonomie te voorsien, maar belonings vir en houdings teenoor nuutheid is laer. Met die uitsondering van mikro-ondernemings, beïnvloed grootte en ouderdom van firmas, soos per teoretiese voorspellings nie, nie innoveringsgedrag beduidend nie, want in Namibië se padvragvervoerbedryf is die meeste KMO’s in besit van of onder die bestuur van ervare voormalige werknemers van groter firmas.

Ten spyte van hoë vlakke van innoveringsvermoë waargeneem onder firmas, het dit geblyk dat die idiosinkratiese vermoë van sommige konstruksies na hoofstroomvaardighede geërodeer het, aangesien die studie intra-organisasie-leer kenmerkend geïdentifiseer het as die enigste konstruksie wat in ’n hoë mate met firmaprestasie geassosieer is. Die manifestering van swak beloningstelsels op werknemers se gewilligheid om kennis te deel en aan kreatiewe innoverende aktiwiteite deel te neem is ook waargeneem as ’n kritieke, maar geïgnoreerde organisasiedetail. By die aanneem van tegnologiese innoverings het die resultate getoon dat senior bestuurders, veral in die vroeë fases van die aannameproses, ’n ‘politikus’-sindroom navolg, en dat idees vanaf die gewone werkers oorsien word, wat ’n skeiding tussen aanname en werklike benutting van innovering in diensvoorsiening veroorsaak.

Vir firmas lê die oplossing om weg te beweeg daarvan om werknemers bloot ‘toe te rus’ na sinvolle ‘gesprekvoering’ met hulle oor die innoveringsproses daarin om sielkundige en werkverwante werknemerwelsyn te bevorder. Dit is veral belangrik, want, ten spyte van hoë

vlakke van intra-organisasieleer (’n konstruksie wat sterk geassosieer word met firmaprestasie), word innoveringsvermoë in die bedryf nie sterk oorgedra na doeltreffende vervoerdienste nie, wat lei tot die land se hoë vervoerpryse.

Op die beleidsvlak is die aanbeveling van hierdie studie die bekendstelling van beskermende kompenseermaatreëls, in samehang met industriespesifieke insentiewe, wat tans ontbreek. Die gelyksoortigheid van innoverende gedragseienskappe tussen groot, medium- en klein firmas in die bedryf doen ook ’n beroep vir inklusieweontwikkeling-steunprogramme wat waardering toon vir mikrogrootte-ondernemings se beperkte innoveringskapasiteit.

Deur ’n kombinasie van innoveringsvermoë en die aanname van innoveringsgebaseerde modelle, het hierdie studie die weg gebaan vir ’n uiteenlopende assessering van innoveringskapasiteit op firma-vlak in Namibië. In spesifieke terme wys die studie die vermiste skakel tussen kapitaal, werknemers en staat in die voorsiening van doeltreffende vervoerdienste en firma-groei uit.

DEDICATION

This work is dedicated to Fransiska Ndiitela nkelo Kangombe. Ondapandula nkelo.

ACKNOWLEDGEMENTS

I would like to express my profound gratitude and appreciation to the following people who made this learning journey possible.

Dr Firoz Khan, my promoter, for critically reading every single draft and unconventionally challenging me with every submission.

Ms. Christine Steenkamp, Operations Coordinator at the Namibia Logistics Association, and Mr John Dias, Secretary General at the Namibia Transporters Association, for their industry support throughout the process.

To the members of the Namibia Logistics Association and the Namibia Transporters Association, for making time to participate in the study.

Special thanks to the first four respondents to the survey questionnaire: Mr Manns of Eden International, Mr Pronk of Wesbank Transport, Mr Kleinhans of AAA Trucking, and Mr Uys of FP du Toit Transport, for giving me hope that this study can be done.

To the Walvis Bay Corridor Group, Namibian-German Centre for Logistics, Namibia Statistics Agency and the Ministry of Trade and Industry (MITSMED) for their guidance during the early exploratory stage of this study.

To my family and friends for their unconditional love, support and relentless encouragement.

To the Graduate School of Economics and Management Sciences (GEMS), Dr Jaco Franken and Prof Martin Kidd - at the Statistics department - for their generosity and support.

To my fellow Graduate School of Economics and Management Sciences PhD candidates, for their priceless encouragement and feedback through our weekly seminars.

To Tutaleni I Asino and BFS for keeping me sane.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
ASYCUDA	Automated System for Customs Data
BTU	British Thermal Unit
CEO	Chief Executive Officer
CO2	Carbon Dioxide
COMESA	Common Market for Eastern and Southern Africa
CVRS	Computerized Vehicle Routing and Scheduling System
DoI	Diffusion of Innovation
EAC	East African Community
EDI	Electronic Data Interchange
EU	European Union
FESARTA	Federation of East and Southern African Road Transport Associations
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GPS	Global Positioning System
GVM	Gross Vehicle Mass
HIV/AIDS	Human Immunodeficiency Virus/ Acquired Immune Deficiency Syndrome
ICT	Information Communication Technology
INSEAD	Institut Européen d'Administration des Affaires
IPCC	Intergovernmental Panel on Climate Change
IRF	International Road Federation
ITS	Intelligent Transport System
LaRRI	Labour Resource and Research Institute
LPI	Logistics Performance Index

LSD	Least Significant Difference
MOA	Ministries/Offices/Agencies
NamBIC	Namibia Business Investment Climate
NATA	Namibia Transporters Association
NATAU	Namibia Transport and Allied Workers Union
NCRST	National Commission on Science and Technology
NCT	Noticing, Collecting and Thinking
NDP3	National Development Plan Three
NDP4	National Development Plan Four
NLA	Namibia Logistics Association
OECD	Organization for Economic Cooperation and Development
R&D	Research and Development
RFID	Radio-Frequency Identification
S&T	Science and Technology
SADC	Southern African Development Community
SATAWU	South African Transport and Allied Workers Union
SME	Small and Medium Enterprise
TEU	Twenty-Foot Equivalent Unit
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNFCC	United Nations Framework Convention on Climate Change
USD	United States Dollar
WIPO	World Intellectual Property Organization

CHAPTER ONE: INTRODUCTION

1.1 Background to the Study

For decades before independence in 1990, Namibia's road freight transport industry suffered the *hinterland*[1] development bias. Transport planning was aimed at exploiting natural resources for export to western countries, and in later years, to its then apartheid colonial master, South Africa (Simon, 1986). Like many Sub-Saharan African colonies at the time, the country had a relatively well-developed rail infrastructure, with fragmented roads linking well-resourced areas to the main ports. At independence, Namibia adopted a national economic development transport approach aimed at connecting wide-base local production to markets, while providing a gateway for trade to neighbouring countries. Road freight transport has since remained an important mode of transport in the country's economy, moving 29.9 percent of total exports and 59.9 percent of total imports (Namibia Statistics Agency, 2015:15). Transhipment and transit traffic along Namibia's roads has also increased from 117 000 Twenty-Foot Equivalent Units (TEUs) in 2006 to 283 000 by 2012 (African Development Bank, 2014:7). Saushini (2014) estimates that most domestic goods are transported by road.

Since independence, Namibia's road transport development programs (as reflected in the country's first three National Development Plans, covering the period 1995 to 2011) focused on physical infrastructure. Other transport services that make up the bulk of transport prices did not receive developmental attention until 2009, following the review of the third National Development Plan (NDP3), which called for economic diversification as a means to create employment. By 2012, transport and logistics services were added to infrastructure development, and is now among the country's priority development sectors (National Planning Commission, 2012; National Commission for Research Science and Technology, 2014).

The current national development framework, consisting of the fourth National Development Plan (NDP4), the *Industrial Policy* and the *Growth at Home Strategy*, acknowledges the important role of efficient freight transport services for industrialization. What this framework lacks, however, is substantial knowledge of the road freight transport operators' capacity to competitively support the country's economic transformation activities while responding to growing transit traffic along the Walvis Bay Corridor. This amidst the fact that freight transport costs and prices are among the main

[1] "Hinterland" is defined by Kruk (2006) as the area to be reached from the port to collect goods for export, and distribute imports.

factors constraining the growth of productive sectors in Namibia (Kadhikwa & Ndalikokule, 2007; Institute for Public Policy Research, 2013; Meyn, Peruzzo & Kennan, 2013).

1.2 Namibia's Road Freight Transport and Economic Development

Namibia is endowed with mineral and marine resources, as well as an agricultural sector, which all form part of the country's main economic activities. These and other sectors in the economy, such as manufacturing and the service industry, rely on efficient road transport services to carry inputs to production sites and outputs to markets (African Development Bank Group, 2002). Even though the quality of Namibia's roads at independence was good, the design (managed from South Africa) did not serve national economic activities, as it aimed "to promote the policy of apartheid" (Ministry of Works Transport and Communication, 2000b:7). Transport services were also regulated by the state, which protected the railway industry with its outdated policies (Ministry of Works Transport and Communication, 2000a).

To extend the provision of efficient road transport services to previously disadvantaged areas, the government enacted laws to liberalise the industry by, among other things, commercializing some transport development functions such as road funding, road management and construction functions (Runji, 2003). The reform process also led to a growing private sector, which now provides transport services to economic activities (Bruzelius, Poolman & Ravenscroft, 2000; Savage, Fransman & Jenkins, 2013a, 2013b).

The development of transport services in Namibia is driven by two goals. Firstly, transport services are being aligned to economic transformation activities to move away from exporting raw materials and focusing on importing manufacturing inputs, and subsequently exporting final and semi-processed goods to markets (Ministry of Trade and Industry, 2013). The second goal for developing transport services is that although Namibia has a small economy, which in 2013 only represented 1.9 percent of the total Southern African Development Community (SADC) GDP, the country has a geographic advantage in that it serves the entire sub-region through the Walvis Bay Port (Japan International Cooperation Agency, 2015:2). This port is currently being expanded to double its capacity from 350 000 TEUs to about 750,000 TEUs per year (*ibid.*). As a result, the country has also developed a master plan to become an international logistics hub for the region. Even though the World Bank (2012) claims that road freight transport services along Namibian corridors is currently expensive, they also acknowledge that the planned increased capacity carries potential to reduce transport prices so as to be competitive with other corridors in the region. Already, the country's national accounts show that 21.1 percent of the growth recorded in the transport, storage and

communications sector in 2013 came from the subsector freight by road (Namibia Statistics Agency, 2013:16).

1.3 Namibia's Road Freight Transport Infrastructure and Services

Namibia has since independence managed to maintain and expand the road infrastructure network inherited from the apartheid administration (Ministry of Works Transport and Communication, 2000a; Runji, 2003; National Planning Commission, 2013). Trade links which before independence were exclusively through South Africa, with no connections to neighbouring countries and no direct shipping line connections, were also established with other countries (Smith, 2013). By 1998, Namibia had constructed its first corridor route to Botswana, and in 2012, the country became a gateway for moving goods from Europe, the Americas and South Asia into the SADC region and vice versa through the Walvis Bay Port, as indicated in Figures 1.1 and 1.2 below.

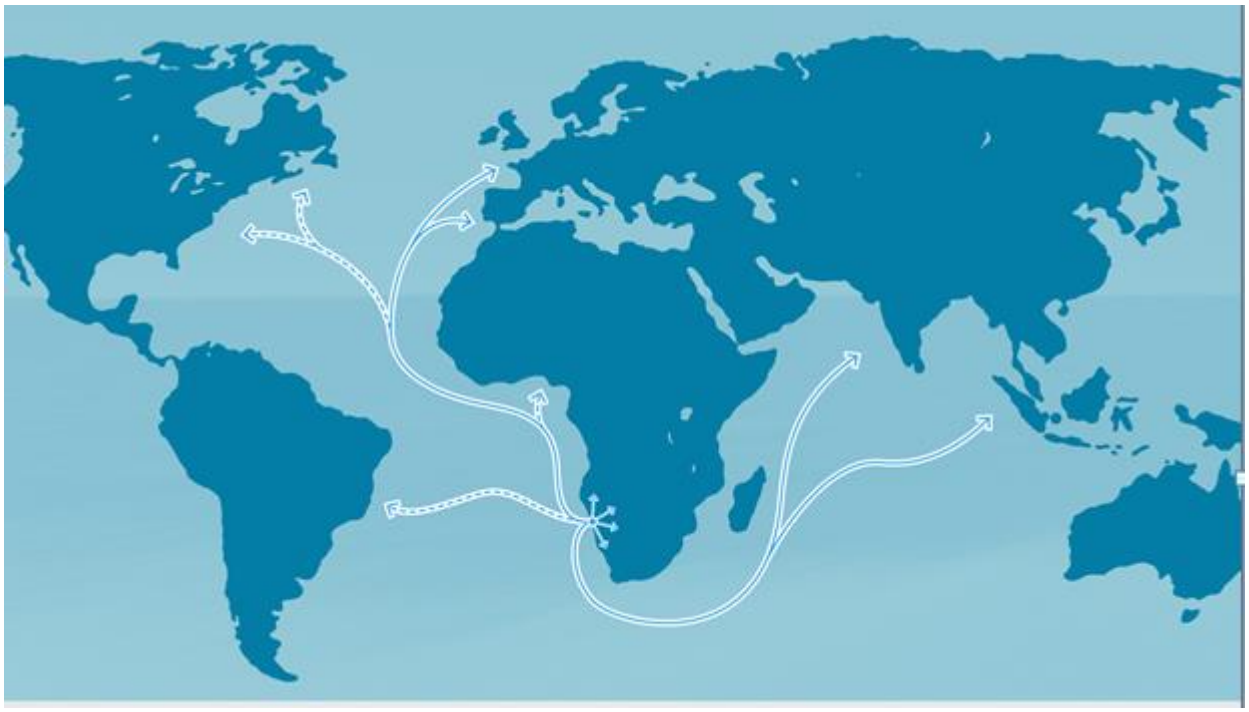

Figure 1.1 Walvis Bay Corridor International Routes
Source: Walvis Bay Corridor Group (2013:13)

The Walvis Bay Corridor, illustrated below, is a network of routes made up of the Trans Kalahari Corridor, Trans Cunene Corridor, Trans Oranje Corridor and Trans Caprivi corridor and running into Botswana, South Africa, Angola, Zambia, Zimbabwe and Democratic Republic of Congo (Walvis Bay Corridor Group, 2013a).

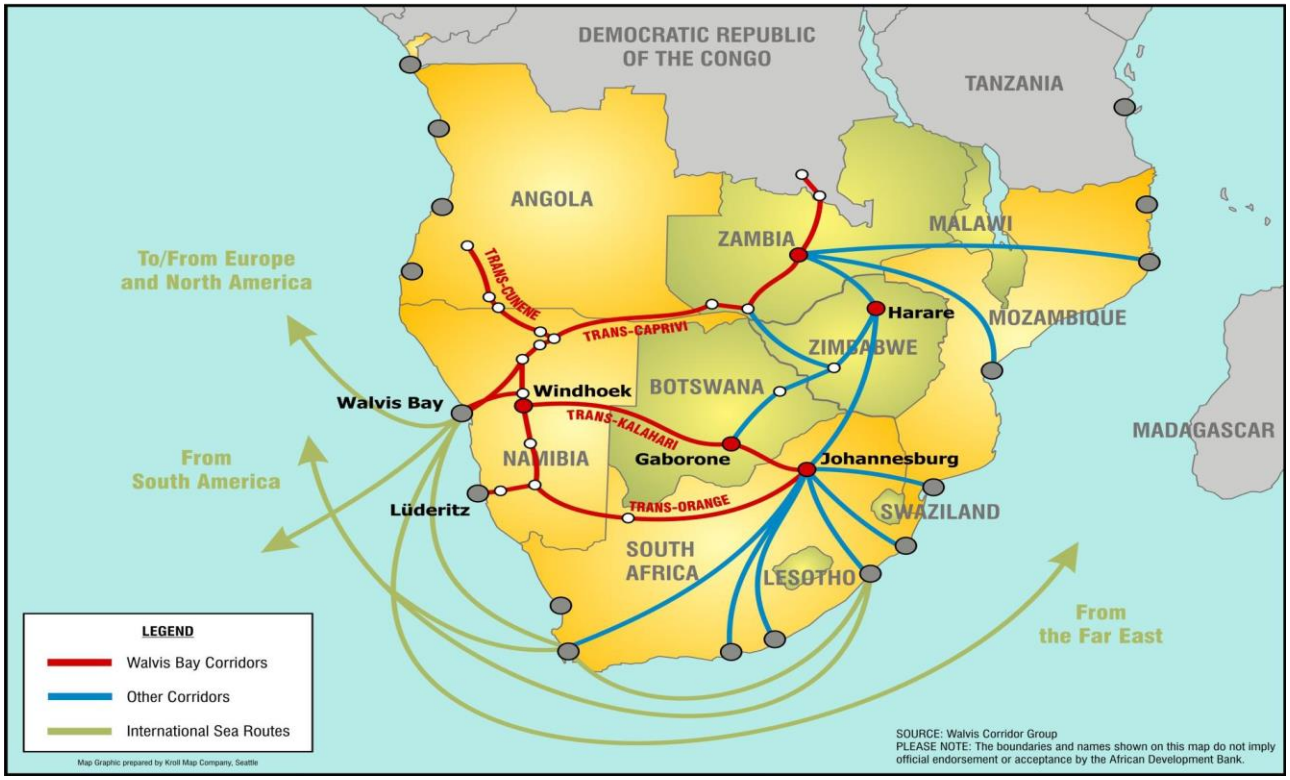

Figure 1.2 Map of the Walvis Bay Corridor Regional Routes

Source: African Development Bank (2014: xii)

Studies by both local and international institutions have attributed the growth of Namibia's road freight traffic to the development of the Walvis Bay Corridor. This traffic more than doubled from 145 000 Twenty-Foot Equivalent units (TEUs) in 2005 to 337,000 TEUs in 2012 (National Planning Commission, 2012; World Bank, 2012; African Development Bank, 2014:7). From 2012 to 2013, traffic volume along the Walvis Bay Corridor recorded the highest total increase to date of 54 percent (Walvis Bay Corridor Group, 2014b:23). Although Namibia's freight traffic is growing, the African Development Bank (2014:7) argued that the increase is mainly in transit shipment (serving landlocked SADC countries) and transhipment (serving South, Central and West African coastlines), which represents the bulk of container traffic at the port of Walvis Bay.

Thus, in spite of all the positive developments in Namibia's road freight transport, the industry is faced with issues of competitiveness. Firstly, Namibia's road transport costs are higher than most commonly used routes into the SADC region, namely the Durban and Dar es Salaam routes (Sherbourne, 2010; World Bank, 2012). Secondly, Namibia does not have "third country rule" bilateral agreements with other SADC countries, causing trucks to run empty on long distances (World Bank, 2012). For instance, on their way back from the Democratic Republic of the Congo, Namibian trucks cannot pick up cargo from Zimbabwe destined for Zambia because (i) the trucks are not registered in either of the countries and (ii) the goods are not transiting through Namibia (World Bank, 2012).

Globally, production systems are turning to transport and logistics services as a source of competitiveness, putting pressure on freight transport carriers to become more efficient. In today's economy, competitiveness is achieved through innovation, defined by Freeman (1982) as novelty in how value is created and distributed. Results from a previous study on Namibia's transport and logistics industry show that Namibia's road freight transport operators are preoccupied with the mainstream daily activity of securing the 'next load' (Savage *et al*., 2013b:6). While finding and carrying loads is important for freight transport carriers, the constant infusion of novelty into the process is required to create competitive value in the industry. This study therefore explores the innovation capacity of Namibia's road freight transport operators.

1.4 Research Problem

While innovation remains a pillar of competitiveness and growth amongst countries and firms all over the world, there is currently only limited research on innovation in Namibia, including priority development sectors such as freight transport and logistics. The inclusion of transport and logistics services as a priority sector in Namibia's development framework has raised new concerns regarding the ability of the industry to support the country's productive sectors during the ramped-up economic transformation process. In his address at the Growth at Home conference held in November 2013, the then Minister of Trade and Industry expressed this concern when he stated:

> Manufacturers or processors need a reliable supply of raw materials from the primary resource industries. They also depended [sic] on the availability of industrial skills and research and development outputs from the higher education and research institutions. Without efficient transport and logistics services to move inputs and finished goods, manufacturing becomes less viable or unsustainable. Domestic markets must be accessible through a well-functioning retail and distribution network and foreign markets must be penetrated with competitive products (Minister of Trade and Industry, 2013:6).

Until recently, research on road freight transport in Namibia has focused on infrastructure and policy development, with a few studies describing the generic functional and operational abilities of freight transport operators. A recent study by the Walvis Bay Corridor Group (2013a) identified an array of over 20 challenges facing Namibia's road freight transport operators. The challenges range from technical aspects of vehicle maintenance and safety concerns to operational planning and strategic management. Even though these challenges may appear generic to firms, especially among small and medium enterprises, for Namibia's road freight transport operators, they have a unique backdrop.

Firstly, distances travelled by road freight transport carriers in Namibia were manageable before independence, as most towns were intrusively[2] established closer to or along the railway lines, seaports and or airports (Watson, n.d.). However, after the country's independence in 1990, the government adopted an indigenization[3] approach, which led to the proclamation of new towns and villages that are situated away from sea, air and rail transport infrastructures. The proclamation of new towns and settlements translated into long distances between ports and centres of economic activity, and road freight carriers have had to adapt to this (World Bank, 2012).

In addition to historical influences, Namibia is a vast country (824 292 square kilometres) with a small population of 2 104 900 (Namibia Statistics Agency, 2012). To road freight transport operators, a small population scattered around a large geographical area means covering long distances to reach small pockets of populations (Savage *et al.*, 2013b). The vastness of the country also means long distances from ports to the regional markets of Angola, Zambia, South Africa, Zimbabwe and the Democratic Republic of Congo (*ibid*.).

Secondly, according to data from the Walvis Bay Corridor Group (2013a), Namibia's freight traffic recorded along international transit corridor routes is one-directional. This means that full trucks enter Namibia from South Africa and return empty or with fewer goods, while for the rest of the regional markets, trucks leave Namibia full and return empty (World Bank, 2012). One-directional freight traffic over long distances can be costly, especially given that costs are calculated on round trips (Krajewska & Kopfer, 2006). In cases where trucks leave and return full, costs are shared across the full trip (*ibid*.). However, when trucks have to cover half of the distance empty, prices become unattractive to shippers, as the cost has to be passed on to consumers, making a shipper's goods less competitive.

The inefficient use of Namibia's road freight transport company assets has also been linked to poor rail services that cannot be used to leverage hauling costs for suitable cargo like copper, coal and construction material (National Planning Commission, 2012a). Consequently, the overall transport costs for using the Walvis Bay Corridor are amongst the highest in the SADC region (World Bank, 2012).

[2] Intrusiveness refers to the establishment of towns and settlements arising from the needs of an outside community, such as missionaries and colonial settlers (Watson, n.d).
[3] Indigenization refers to the establishment of towns and settlements directed by the needs and growth of the indigenous community (Watson, n.d).

Even though Namibia's road freight transport firms are not new to long distances, there are four factors that will require the industry to adapt by introducing measures that enable them to offer competitive value in terms of time and reliability to their customers: one-directional traffic; poor alternative land-based transport; the dynamics of economic transformation; and the increased competition in the region[4].

According to Walvis Bay Corridor Group (2013a) and Savage *et al*. (2013b), service provision in Namibia's road freight transport industry has for long suffered from skills deficit, with customer service levels being at their lowest. While acknowledging the high quality of road infrastructure in Namibia, Schuler (2013), the World Bank (2012) and Savage *et al*. (2013b) have all questioned the capacity of road freight transport operators to transcend providing good services *to* excellent services, given the fierce regional and international competition. As the National Commission on Research Science and Technology (2014:61) has conceded, 'even if the infrastructure issues could be resolve[d] overnight, it is unlikely that Namibia would have a successful logistics industry. To do so, much wider, and softer, issues such as attitude, culture, service and training would need to be addressed'. Currently, the capacity of Namibia's road freight transport industry to innovate is not known, raising the questions that this research explores, i.e.:

1) What is the innovation capability of Namibia's road freight transport industry?

2) How does Namibia's road freight transport industry adopt innovations?

3) How does the innovation capacity of Namibia's road freight transport industry affect its performance?

1.5 Research Aims and Objectives

The aim of this study is to explore Namibia's road freight transport firms' capacity to adapt to changes in the business environment, and to provide competitive services to productive sectors in the economy. The focus on firms (i.e. road freight transport operators), as opposed to other actors in the innovation system (such as the state and the university), is based on the premise that growth and

[4] Namibia shares land and maritime borders with South Africa, the country with the highest connectivity to global liner shipping in the SADC region, which also enjoys an equal-distance advantage to the SADC, Europe, West Africa and the Americas (UNCTAD, 2011; World Bank 2012). Similarly, the government of Angola, which borders Namibia to the north, is busy upgrading its transport infrastructure, destroyed during the civil war between 1975 and 2002. At present, the Angolan market, which in 2011 accounted for 41 percent of total transhipment freight through the Walvis Bay Corridor, is primarily served by Namibian road freight operators (World Bank, 2012).

industrialization are primarily functions of innovating firms in the economy (Earl & Gault, 2006; Lundvall, 2007; Malerba & Brusoni, 2007). To achieve the goal of this study, the following objectives are addressed:

- To assess the innovation capability of road freight transport firms in Namibia.
- To explore the adoption of innovations among Namibia's road freight transport firms.
- To analyse the effects of innovation capability and adoption of innovation on the performance of the road freight transport firms in Namibia.

1.6 Theoretical Perspectives and Research Design

According to seminal research on innovation by Hurt, Joseph and Cook (1977), innovativeness is conceptualized through the willingness to change to improve one's current position. At firm level, willingness to change is associated with the ability to generate and adopt innovation (*ibid.*). The ability to generate innovation is known as innovation capability, which is defined by Lawson and Samson (2001) as a higher-order integrative ability aimed at continuously transforming new ideas into new value for customers. Firms that foster their innovation capabilities are able to integrate external knowledge with organizational resources and culture to generate and implement new ideas (Xu, Chen, Shou & Liu, 2012). As a result, many of these firms are also able to frequently adopt new processes, products, strategies and business models (World Bank, 2011a).

The adoption of innovation refers to the ability of a firm to identify, evaluate, adopt and implement new ideas that are created elsewhere (Damanpour & Wischnevsky, 2006). Using the theory of diffusion of innovation, Rogers (2003:11) has defined adoption of innovation as a 'process through which innovation is communicated through certain channels over time among members of the social system'. The theory of diffusion of innovation is a model that has been used since the 1960s by researchers of innovation systems to understand and assimilate processes of innovation across different disciplines (Sahin, 2006).

Existing studies on firm innovation have only focused on one of these two streams at a time, and can therefore be divided into those that analyse the capability of firms to generate innovation, and those that analyse the uptake and spread of innovation among firms. This study, however, focuses on both the innovation capability approach and the adoption of innovation approach. A detailed discussion of the two approaches is provided in Section 1.6.

1.6.1 Innovation Capability Theories

Two basic theories are used to understand innovation capability at firm level: the resource-based view, and the dynamic capabilities theory. The resource-based view is concerned with exploring and analysing those resources that create competitive advantages in a firm and the acquisition thereof (Hamel & Prahland, 1990; Hamel & Prahland, 1994). The dynamic capabilities theory, on the other hand, goes further in understanding how firms develop capabilities to exploit resources. Even though some authors such as Xu *et al*. (2012) have expounded the two theories as unconnected, others such as Lawson and Samson (2001) consider the dynamic capabilities theory as a further development of the resource-based view.

The innovation capability based non-linear model employed in this study is derived from the dynamic capabilities theory. The reason for using this model is motivated by the following rationale. Firstly, the model provides a broader view of inputs of innovation by going beyond the traditional linear inputs such as research and development. Secondly, the model has universal applicability to both product and process innovation oriented industries. And lastly, the non-linear model fits the composition of Namibia's road freight transport industry. This industry is made up of small and medium enterprises which, because of their size, lack access to resources such as finance and human resources, which are necessary for investing in linear inputs of innovation (World Bank, 2012; Institute for Public Policy Research, 2013; Saunila & Ukko, 2014).

Although the innovation capability based non-linear model has increasingly gained popularity throughout recent innovation research, the model also has weaknesses. For instance, the model does not provide standard constructs of non-linear inputs of innovation capability. These are left to the discretion of the researcher to accommodate industry dynamics (Saunila & Ukko, 2014). In other words, although the model minimizes inconsistencies in the results of innovation research, it does not eliminate them. Another weakness in the model is that because the model only provides a framework, it is difficult for firms to determine the degree to which each construct of non-linear input of innovation capability contributes to the overall innovativeness of the firm prior to the development of such constructs (Lawson & Samson, 2001). This is partly because the value of innovation capability is derived from input synergy effect, and not from individual constructs (*ibid*.).

1.6.2 Adoption of Innovation Theory

There are four main theoretical frameworks used to study the adoption of innovation: the technology acceptance model (TAM), network agency theory, institutional action theory, and the diffusion of innovation (DoI) theory (Pearson & Grandon, 2005). With the exception of the diffusion of innovation theory, which provides a broader framework on all elements of adoption (i.e. *innovation,*

communication channels, *time* and *social system*), all theories are focused on individual adoption elements (Vega, Chiasson & Brown, 2011). As Depietro (1990) cited in Dedrick and West (2003) has argued, adoption of innovation in firms cannot be fully understood by focusing on a single adoption element. It is for this reason that this study utilises the diffusion of innovation theory.

The diffusion of innovation theory was developed by Everett Rogers in the 1960s to initially explain the uptake of innovation by farmers. The theory has since been adapted to firms, and its applicability has been confirmed through empirical evidence of both old and new studies (O'Neal, Thorelli & Utterback, 1973; Nabseth & Ray, 1974; Johansson, Ruivo, Oliveira & Neto, 2012; Ruivo, Oliveira & Neto, 2012). The DoI theory has two models that are widely used across adoption of innovation studies: the epidemic model and the probit model. According to the epidemic model, adoption of innovation in firms is influenced by information availability regarding the benefits of that particular innovation (Geroski, 2000; Kiesling, Günther, Stummer & Wakolbinger, 2012). The model implies that adoption of innovation is communicable, and that the speed of uptake increases progressively with every adoption. According to Rogers (2003) and Delre, Jager and Janssen (2007), the '*if, then'* linearity approach of the epidemic model does not explain why some firms with adequate information about the benefits of certain innovations do not adopt them. This argument is advanced through the probit diffusion model, which asserts that the decision of a firm to adopt an innovation is influenced by a number of factors that are a result of its circumstances (Bishop, Shumway & Wandschneider, 2010; Delre, Jager, Bijmolt & Janssen, 2010; Kassie, Jaleta, Shiferaw, Mmbando & Mekuria, 2013). The probit model thus focuses on the characteristics of innovation adopters (i.e. size of firm, age of firm and interaction with other members of the social system), also referred to in the literature as determinants or predictors of adoption of innovation (Bishop *et al.*, 2010; Nan, Zmud & Yetgin, 2014).

Even though the DoI theory is supposedly a comprehensive approach, practical application is complex. Empirical studies using the DoI theory have therefore resorted to leaning more on one of the models at the expense of the other. This study gravitates towards the probit approach to identify structural and behavioural characteristics of innovation adopters in Namibia's road freight transport industry, while maintaining some aspects of the epidemic model to determine the level of adoption of technological innovations.

One of the main weaknesses of the DoI theory lies in its assumption that all innovations need to be adopted (Rogers, 2003). This weakness is reflected in the adoption of innovation decision model, where the decision path is whether to adopt the innovation *now* or to *defer*, instead of *whether* or *not* to adopt (Hall, 2006). In acknowledging this limitation, the current study does not attempt to assign

adopter categories on the basis of 'earliness' of adoption. Instead, the study probes firms on the decision process of adoption of innovations and reasons for non-adoption.

1.6.3 Empirical Research Design and Method

In breaking from past research on innovation in firms, which have either focused on innovation capability or adoption of innovation, this study seeks to assess both aspects of innovation simultaneously. To achieve this, the study applied a survey design and used a mixed method to collect quantitative and qualitative data from road freight transport operators in Namibia. For collecting *quantitative* data, a *questionnaire* was employed (to determine the level of innovation capabilities, the diffusion of selected technological innovations, effects of innovation capacity on firm performance and identify barriers for adoption of innovation). This was followed by *semi structured interviews* to *collect qualitative* data for developing a better understanding of innovation decision processes, utilization of adopted technological innovations and probing further on reasons for non-adoption.

The study is rooted in the premise that firm-level innovation is a planned process which commences from developing a firm's capabilities to search, create and absorb innovation. In service industries, firms develop their absorption capacity by engaging in fundamental behavioural activities outlined by Lawson and Samson (2001), Martensen, Dahlgaard, Mi Park-Dahlgaard and Grønholdt (2007) and Skarzynski and Gibson (2008). These activities include:

- Commitment to learning - reflects the value that a firm places on acquiring new knowledge;
- Attitude towards intra-organizational learning - reflects how a firm organizes itself to allow for units/departments to learn from each other;
- Attitude towards risk - determines the organization's willingness to experiment with new ideas;
- Reward system for innovation - shows how firms encourage and appreciate creativity; and
- Strategy and organizational leadership - shows how a firm establishes and nurtures a culture of novelty, and how it directs the innovation activities of the firm.

Cumulatively, these activities constitute a firm's innovation capability, which facilitates the creation and adoption of innovation. Innovation in service industries is primarily achieved through adoption of innovation. Thus, a firm's competitive advantage, reflected in its performance, is determined by both innovation capability and adoption of innovation, giving rise to a new and more comprehensive approach for assessing innovation capacity employed in this study, see Figure 1.3 below.

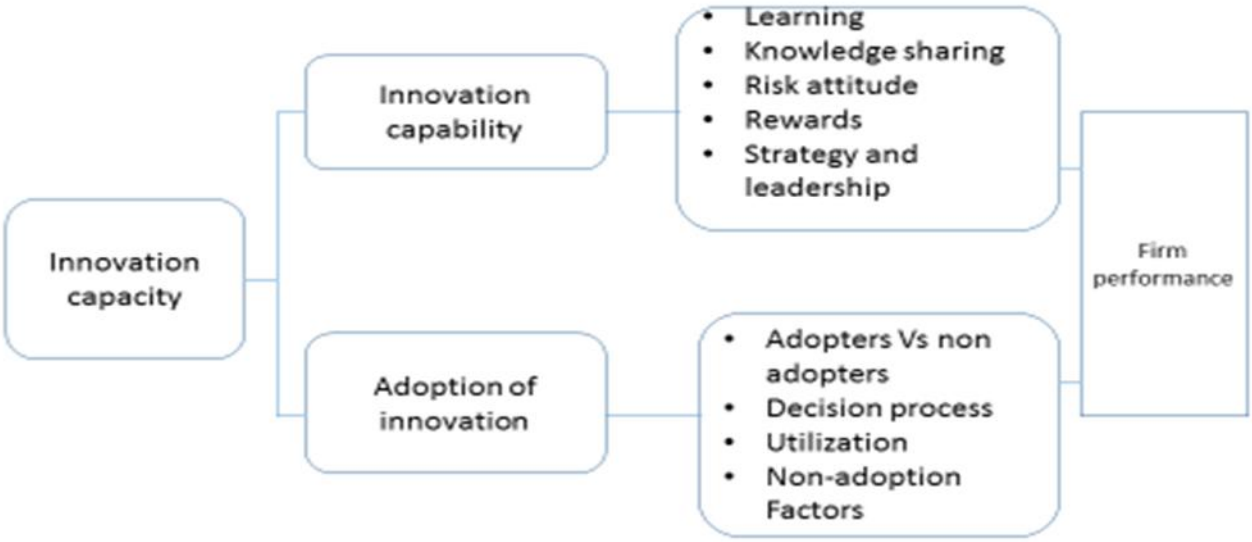

Figure 1.3 Innovation Capacity Assessment Approach

Details of innovation capability and adoption of innovation are described in Section 1.6, and in Chapter 3. Before presenting the role of innovation in firms, the frame for understanding the different perspectives of innovation is provided, starting with the definition.

1.7 Conceptualization of Innovation

1.7.1 Defining Innovation

Innovation is defined by Schumpeter (1942) as a socio-economic phenomenon for commercializing new combinations of resources, which results in the introduction and/or use of new products, new methods of production, new sources of inputs of production, new markets, and new ways to organize and structure business. Several definitions that encompass all five types of innovations defined by Schumpeter (1942) or specific to a particular innovation have since emerged. For instance, Freeman (1982:7) defined innovation as "the first commercial transaction involving new products, process, systems or devices". This definition is in line with Schumpeter's categorization of innovations. Also, according to the Organisation for Economic Co-operation and Development (2005:46), innovation is defined as 'the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace

organization or external relations'. Although it embraces Schumpeter's categories of innovation (1942), this definition differs significantly from the Organisation for Economic Co-operation and Development (1997) definition, which is solely based on technological innovation.

With regard to innovation specific definitions, Neely, Filippini, Forza, Vinelli and Hii (2001) define innovation based on two broad categories, namely product innovation and process innovation. Their definition of product innovation is 'the development of and introduction of new or improved products or services that are successful in the market', whereas process innovation is 'the adoption of new or improved methods of manufacture, distribution or delivery of service' (*ibid*: 114).

While acknowledging different definitions of innovation throughout the literature, this study adopted the UK Department of Trade and Industry's definition (as cited in Adams, Bessant & Phelps, 2006:22), namely, that innovation is 'the successful exploitation of new ideas'. This definition is used because it is simple, clear and arguably addresses several dimensions that have raised debates in innovation circles.

One of the debates concern the difference between invention and innovation, arguing that the line between the two is not always clear. Rogers (2003) pointed out that some inventions are instant innovations while others have to undergo several changes over long periods of time. Another debate linked to the difference between invention and innovation relates to determining factors of innovation. According to Fagerberg (2006), for an undertaking to qualify as an innovation, it has to be novel and successfully commercialized. Commercialization in innovation refers to the exploitation of new ideas to create value. Thus, an invention only becomes an innovation once it is commercially exploited.

The arguments above demonstrate that innovation is multi-perspective, and researchers have to consider this, especially at firm level. Some of these perspectives are said to be the cause of the incomparable results that have been reported across empirical studies on innovation (Ibrahim, Zolait, Subramanian & Ashtiani, 2009). These inconsistencies make it difficult for managers to apply the principles of innovation for value creation in firms (Tidd, 2001). Below are some of the dimensions of innovation that frame the context of this study.

1.7.2 Innovation Typologies

Following Schumpeter's five categories of innovation, there are a plethora of studies covering different types of innovation. Given the well-documented evolution of different types of innovation (Damanpour, 1987; Damanpour, Szabat & Evan, 1989; Organisation for Economic Co-operation and Development, 1997; Garcia & Calantone, 2002; Oke, Burke & Myers, 2007; Varis & Littunen, 2010), this study situates its review in innovation typologies that have in recent years gained popularity: product/service innovation, process innovation and management innovation.

Product innovation/service innovation: Product innovation is defined as the introduction of new goods and services to the market (Essmann, 2009). Products are considered new when they 'differ significantly in their characteristics or intended uses from products previously produced by the firm' (Organisation for Economic Co-operation and Development, 2005:48). Product innovation is also referred to as outputs of innovation, or front-end innovation.

Process innovation: Process innovation is the use of new methods and techniques to produce goods and services (Swann, 2009). The aim of process innovation is to create efficiency in the production process and in the delivery of goods and services. While process innovation may improve the quality of goods and services, it does not necessarily result in new products (Deschamps, 2008). Process innovation is also known as inputs of innovation, or back-end innovation.

Management innovation: Management innovation is defined as the introduction of new managerial processes and techniques aimed at administratively improving the performance of the firm (Hamel, 2006; Birkinshaw, Hamel & Mol, 2008). The literature reviewed has interchangeably used concepts such as administrative innovation, ancillary innovation, organizational innovation and managerial innovation with management innovation. Unlike product and process innovation, which are primarily aimed at novelty in producing and delivering new products to clients, management innovation focuses on internal firm efficiency (Damanpour & Aravind, 2012).

1.7.3 Characteristics of Innovation

One of the most widely documented cross-cutting dimensions of innovation is the degree of change in novelty. The degree of change can either be in the innovation itself or in the adjustments that the innovating member has to undertake to allow for change (Damanpour & Aravind, 2012). Innovations that require minimal adjustments are known as *incremental* innovations, while those that need major adjustments are referred to as *radical* innovations. The key differentiator between the two is that incremental innovation is about making changes to existing systems without changing the functional features, while radical innovation reconfigures the system (Swann, 2009; Xu *et al.*, 2012).

1.8 Innovation and Competitiveness in Firms

1.8.1 Innovation as a Competitive Factor

The concept of innovation comes from the field of Sociology, where it was initially used to explain changes in society (Sundbo, 1998). From as early as 1800s and 1900s, economists adopted innovation to explain changes in economic development (Schumpeter, 1942). During this period, there were two factors driving economic development: 'changes in technology and changes in the organization of production' (Sundbo, 1998:56). According to Schumpeter (1942; 1954), these factors were controlled

by entrepreneurs/innovators. From the 1920s, firms grew larger and the manager, through the organization of work structures, became the creator of value. The manager's role as an innovator led to mass production and full product standardization until markets reached saturation (Nelson, 2007). Today, markets are demanding unique products and services that are tailored to specific needs. Huhtala and Parzefall (2007) have described innovation in the 21st century as an everyday process that is not just reserved for entrepreneurs or managers, but for almost all employees in the firm. In order to satisfy changing market demands, firms adopt different strategies (described below).

1.8.2 Firm Type and Innovation

The way in which innovation is achieved in firms is central to this study. According to Damanpour and Wischnevsky (2006), there are two main complementary perspectives on how firms innovate. The first perspective relates to those firms that primarily generate innovation outputs, while the second perspective deals with firms that primarily adopt inputs of innovation. Firms that primarily generate innovation are associated with activities that relate to the realization of innovation outputs, namely exploration activities. Exploratory activities refer to those activities that require searching for creative solutions to undefined, abstract problems (Deschamps, 2008). As pointed out by March (1991) and Thérin (2007), exploratory activities relate to tasks and attributes such as creativity, experimentation, chance, chaotic, flexibility, discovery, play, variation, risk taking and uncertainty.

On the other hand, firms that primarily adopt innovations are associated with activities that are aimed at implementing innovation input. Exploitation activities refer to the selection of solutions for specific problems (Deschamps, 2008). Tasks and attributes linked to the exploitation of innovation include choice, refinement, implementation, efficiency and production (March, 1991; Thérin, 2007).

Firms that primarily generate innovation outputs need different capabilities from those that primarily adopt inputs of innovation. As Damanpour and Wischnevsky (2006:271) have pointed out, 'innovation generating firms depend on their technological knowledge and market capabilities to develop and commercialize innovation while innovation adopting firms rely on their managerial and organizational capabilities to select and assimilate innovations'. The focus of innovation-generating firms is on managing front-end product creativity, while innovation-adopting firms focus on managing back-end production process efficiencies (Deschamps, 2008).

It should be noted that while this conceptual framework has highlighted the distinction between organizational behaviours and activities of innovation-generating firms and innovation-adopting firms, in reality it is difficult to find organizations that are exclusively generators or adopters (March, 1991, He & Wong, 2004). All organizations regardless of whether they are generators or adopters, need to be competitive by creating and developing innovation capacity.

1.8.3 Creating Innovation in Firms

The ability of a firm to create innovation is referred to as innovation capability. Firms develop innovation capability through linear and non-linear inputs of innovation. Linear inputs of innovation capability are described as tangible factors that firms use to explore and exploit new ideas. These factors include human resources, money and equipment (Saunila & Ukko, 2014). Investing in linear inputs of innovation requires considerable resources, which most firms in developing economies – especially small and medium enterprises – do not always have.

Non-linear inputs of innovation capability, on the other hand, are an outcome of a firm's behavioural aspects (Lawson & Samson, 2001; Martínez-Román, Gamero & Tamayo, 2011). They are derived from what Saunila and Ukko (2014:33) refer to as 'intangible inputs' of innovation, namely motivation, knowledge and culture. Non-linear inputs of innovation are a reflection of how a firm deals with changes, and its attitude towards novelty. There are many behavioural aspects of innovation which differ across industries and across different business models. The most fundamental ones, as described in Section 1.6.3, are learning orientation, risk attitude, reward system, intra-organizational learning, and strategies and leadership.

Unlike linear inputs of innovation, the value of non-linear inputs of innovation requires the integration of all fundamental innovative behaviours (Lawson & Samson, 2001). For instance, if an organization is highly committed towards learning but lacks tolerance for risk, novel ideas will not be explored any further. Similarly, if the leadership does not provide a culture that values novelty, new ideas will not be implemented. Firms need to develop organizational cultures that foster all fundamental innovative behaviours, since this will lead to the generation of innovation (Buxton & Davidson, 1996; Neely & Hii, 2012). In most instances, especially in service industries, the generation of novelty requires a firm to adopt innovation (addressed below).

1.8.4 Adopting Innovation in Firms

In addition to creating innovation capability, a firm's competitiveness is also determined by its ability to embrace and adopt new behaviours and technologies that allow it to adapt to change. Firms adopt innovations for different reasons. For instance, some organizations will adopt innovations to reduce costs, increase market share, enter new markets, or to increase product quality (Organisation for Economic Co-operation and Development, 2005). There are several factors that influence the adoption of innovation by firms when using the probit approach. For this study, two types of applicable factors, namely organizational and environmental factors, are examined in detail. Organizational factors, in this instance, comprise the structural characteristics of firms, namely, size, age, and the type of incorporation (Damanpour & Schneider, 2006). Firms with similar characteristics

are expected to make similar innovation decisions (Peansupap & Walker, 2006). For instance, when deciding what type of vehicle tracking system to purchase, a large freight transport operator will likely study what other bigger firms in the industry are using. Although some authors, such as Larsen and Ballal (2005), have equated this structural relatedness behaviour to imitation and risk averseness, its significant influence on adoption of innovation is undisputed owing to the novel nature of innovation.

Environmental factors, according to Zhu, Kraemer and Xu (2006), are those aspects that have an effect on a firm's ability to adopt innovation, but they are outside of the adopting organization; they are elements of the social system. The role of environmental factors in the adoption of innovation process is best described by the National Innovation System (NIS) analytical framework, which argues that the diffusion of innovation by firms is moderated by other actors in the system – suppliers, distributors, the state, research institutions and others (Fagerberg & Srholec, 2008; Lundvall, 2009). In Ghana, for example, the Labour Union has for a long time prevented technological innovations at the port of Tema in favour of manual labour, a phenomenon which is common in many West African countries (Pederson, 2003; Teravaninthorn & Raballand, 2009).

The prominent role of nation states[5] (as regulators and facilitators of innovation) and universities[6] (as providers of technical knowledge in innovation systems) has dominated academic debates since the 1970s and the 1990s respectively (Etzkowitz & Leydesdorff, 2000). But, as Karo and Kattel (2016) have noted, these debates often ended with analyses of institutional requirements for innovation rather than addressing the craft of innovation policies, i.e. the coordination and the collaboration that lie behind these institutions. The analysis of institutional dynamics in the creation and adoption of innovation is important because globally, especially for public institutions, roles are increasingly evolving from passive, exclusive, traditional functions to active investments through well-designed 'public-private investment strategies' that are able to 'shape and create markets'[7] (Tassey, 2013:293; Mazzucato, 2014:2). In most Sub-Saharan African countries, however, innovation-led growth has

[5] Scholars started paying considerable attention to the role of the state in innovation systems during the Cold War era, as governments were funding large R&D programs in pursuit of influencing the world through military powers. It is during this period that Jorge Sabato developed the Sabato Triangle, which is an analytical model used to highlight the leading role of the nation state in innovation and its contribution thereto (Etzkowitz & Leydesdorff, 2000).

[6] In the late 1990s, scholars of innovation developed the Triple Helix model, an analytical framework that puts emphasis on the university's leading role in the production and provision of knowledge for generating and adopting innovation (Etzkowitz & Leydesdorff, 2000).

[7] According to Mazzucatto (2014), governments need to go beyond fixing market failures, providing tax relief and relaxing regulations to actively pioneer the transformation of industries that will stimulate private investments.

remained slow, partly due to a lack of meaningful collaboration and coordination between the state, the industry and universities (Dzisah, 2011; Oyelaran-Oyeyinka, 2012).

Even though the focus of this study is on firms, a discussion of social system effects is provided in Chapter 4, in the form of an analysis of Namibia's innovation policy landscape, and its mechanisms for influencing the adoption of innovation in the road freight transport industry through a) new ideas, b) infrastructure development and c) the provision of incentives. The role of universities and research institutions is also examined in Chapter 6.

1.9 Innovation, Competitiveness and Namibia's Road Freight Transport Industry

Innovation in Namibia, like in most of Sub-Saharan Africa has historically been limited to science and technology (Southern Africa Innovation Support, 2014). The emphasis placed on hard science based research and development has resulted in a policy landscape that has for long neglected the commercial exploitation of novel developments (Iizuka, Mawoko & Gault, 2015). Namibia does not have an innovation-specific policy, and innovation initiatives, projects and activities are contained in different national policies and growth strategies, such as Vision 2030, National Development Plan 4, the Growth at Home Strategy, the Research Science and Technology Act, and the Industrial Policy amongst others (Marope, 2005; Southern Africa Innovation Support, 2014). Having realised the competitive value of innovation, in 2014, the country established a National Commission on Science and Technology (NCRST) to 'coordinate, develop and facilitate the promotion of research science and technology' (Minister of Education, 2014:14). Unique about the NCRST is its dual function of promoting innovation activities in the country by providing an enabling policy environment and offering funding resources (National Commission on Research Science and Technology, 2014).

Global statistics[8] by the *Global Innovation Index* show that Namibia is among nations with 'below-par performance (Cornell University, INSEAD & WIPO, 2015:30). At the regional level however, Namibia's system of innovation is among the highest; ranked 5th, just after South Africa, Mauritius, Rwanda and Botswana (Cornell University, INSEAD & WIPO, 2016). The primacy of this ranking reflects high investment in the country's inputs of innovation, especially in the freight transport infrastructure. For instance, according to the *Global Competitiveness Report 2014/2015,* Namibia's road quality ranking, is 28th, the highest in Africa and on par with the United Kingdom (World Economic Forum, 2014: 429). An industry specific survey, the *Logistics Performance Index* (LPI)

[8] See a detailed discussion on Namibia's rankings on the Global Innovation Index, Global Competitiveness Index and Logistics Performance Index (LPI) in Annex 4.

also shows that Namibia's logistics performance fares well in Sub-Saharan Africa, and that the country is among the top three performers in the SADC region (Arvis, Saslavsky, Ojala, Shepherd, Busch & Rajet, 2014). A closer analysis of the country's scores over the past 8 years (see Table A4.4 in Annex 4) reveal that even though the ranking has increased, the overall scores for Namibia have not changed much. This signals slow improvements in the country's logistics industry, which could explain Namibia's poor performance in its income group.

Summing up Namibia's innovation context, Schuler (2013:5-6) maintains that the country's competitive position, which is a reflection of its system of innovation 'is falling, because others are improving' and that Namibia is 'standing still while others race'. Since this observation has also been expressed several times by the Namibia Business and Investment Climate Survey[9] from 2009 to 2013, it is important to examine what it means for Namibia's road freight transport industry (Institute for Public Policy Research, 2013).

1.10 Organization of the Study

After providing the context and introducing the conceptual framework of the study in Chapter 1, Chapter 2 will outline the economic importance of road freight transport in Sub-Saharan Africa. This chapter also presents issues and challenges affecting the efficient provision of road freight transport services in the industry, with emphasis on Sub-Saharan Africa, namely poor infrastructure, different rules of origin, negative externalities, allocation of load systems and safety and security of cargo. These issues and challenges set the scene for innovation by road freight transport operators discussed in Chapter 3. Specifically, Chapter 3 analyses issues that affect how road freight transport operators develop their non-linear innovation capabilities, and how these translate in the adoption of technological innovation in the industry. The technological innovations discussed in this chapter are those aimed at addressing challenges that are critical to Sub-Saharan Africa's road freight transport operators, i.e. long periods spent at border crossings, long-distance empty running, and safety and security.

Chapter 4 contains the enquiry for the current empirical research. The chapter describes the methodology which was used to collect data from road freight transport operators in Namibia, and

[9] The Namibia Business and Investment Climate (NamBIC) Survey is a series of annual reports that monitor the improvement of the regulatory business environment, including access to and cost of finance, border procedures taxes, government services and public administration (Institute for Public Policy Research, 2013).

presents the analytical tools used. Thereafter, the results of the current study are presented in Chapter 5, followed by a discussion of the results in Chapter 6. The study ends with a conclusion, which includes contributions of the study, implications and recommendations for future research (Chapter 7). The structure of the study is illustrated graphically in the diagram (Figure 1.3) below.

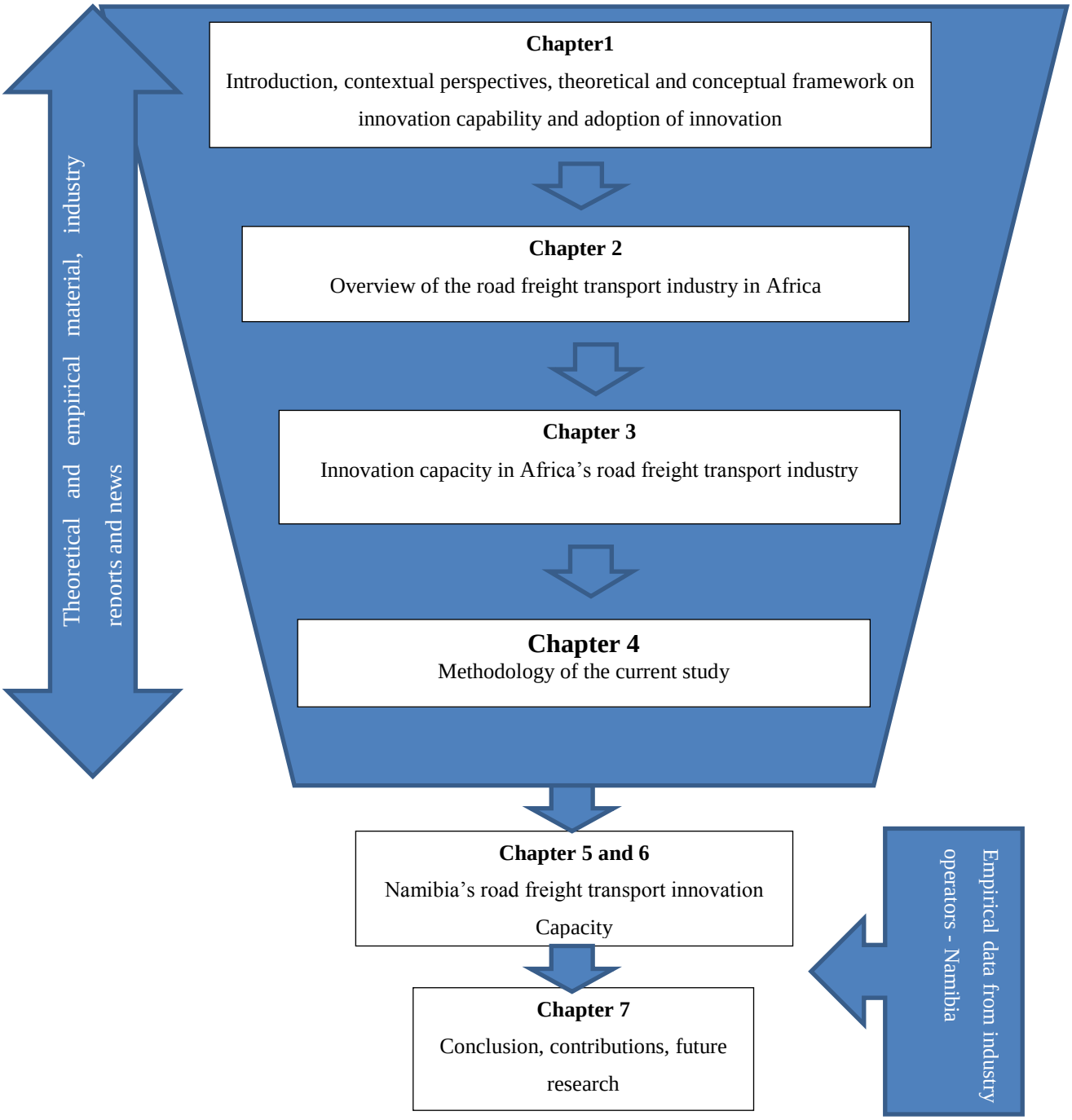

Figure 1.4 Structure of the Study

CHAPTER TWO: OVERVIEW OF THE ROAD FREIGHT TRANSPORT INDUSTRY IN THE ECONOMY

> *Every item on every store shelf, in every office and in every home has at one point of its production or distribution been on a truck* (International Road Transport Union, 2015:8, emphasis added).

2.1 Introduction

Until the 1980s, road freight transport was considered a mere physical distribution activity of moving goods from one place to another (Hesse & Rodrigues, 2004). Today, road freight transport is an integral mode of moving goods through sophisticated logistics systems in many economies around the world. A notable feature of road freight transport is its flexibility to adjust to different routes and different capacity requirements (World Bank, 2009; Grant, Trautrims & Wong, 2013). In some areas, especially the rural areas in Africa, road transport is the only mode of moving essential goods around communities (Gwilliam, 2011).

Over the past three decades, the road freight transport industry has undergone changes in order to keep providing quality transport services. These changes are visible across the world, where transport operators are seen using modern fleet management systems, route planning systems, tracking systems and so forth. This chapter presents an analysis of the factors that have contributed to the transformation of the road freight transport industry from a loading-carting-unloading function to a source of competitiveness for economies around the world, with particular emphasis on Sub-Saharan Africa. The chapter also advances the indispensable role of road freight transport services in Africa, which provides the framework for discussing the importance of innovation in the industry in the subsequent chapter (Chapter 3).

2.2 The Role of Road Freight Transport Services in the Economy

The role of freight transport in any economy is to move goods from where they are, to where they are needed (Gubbins, 2003). Over the past several decades, the movement of goods has increasingly shifted from rail to road in most Sub-Saharan African countries (Simuyemba, 2000, Pederson, 2003; World Bank, 2009). Today, road freight transport in Africa is the main enabler of international and regional trade, moving between 75 and 90 percent of goods across the region (Kumar, 2013:22; Infrastructure Consortium for Africa, 2013:2). Trade, which is the exchange of goods among nations, regions and people, is identified by the African Development Bank, OECD and UNDP (2014) as a channel for reducing poverty in Africa. Key industries such as the agricultural sector, which employs

78.2 percent of the poor[10] in Africa, rely on road freight transport to access markets for their goods (Chuhan-Pole, 2014:21).

According to figures presented by Infrastructure Consortium Africa (2013:2), 20 percent of product costs in Africa is made up of freight transport prices. In some landlocked countries such Rwanda and Zambia, long-haul transport prices make up 40 percent of final product costs (African Development Bank *et al*., 2014: 150, 178). This observation matters because it establishes the importance of efficient road freight transport services in lowering input costs for local producers (i.e. reducing the prices of machinery, seeds, fertilizers and so forth). In their paper on transport in Sub-Saharan Africa, Beuran, Gachassin and Raballand (2013:2) argue that in order to 'enable growth and reduce poverty on the continent, investments in road transport services should receive the same attention provided to investments in infrastructure development programs'. As recent studies on road freight transport prices in Africa have demonstrated, high prices are not only making local goods less competitive, but are also stunting exports (Teravaninthorn & Raballand 2009; De Bod & Havenga, 2010; Raballand & Macchi, n.d). Figure 2.1 below shows that transport prices in Africa are up to three times higher than those in other developing regions.

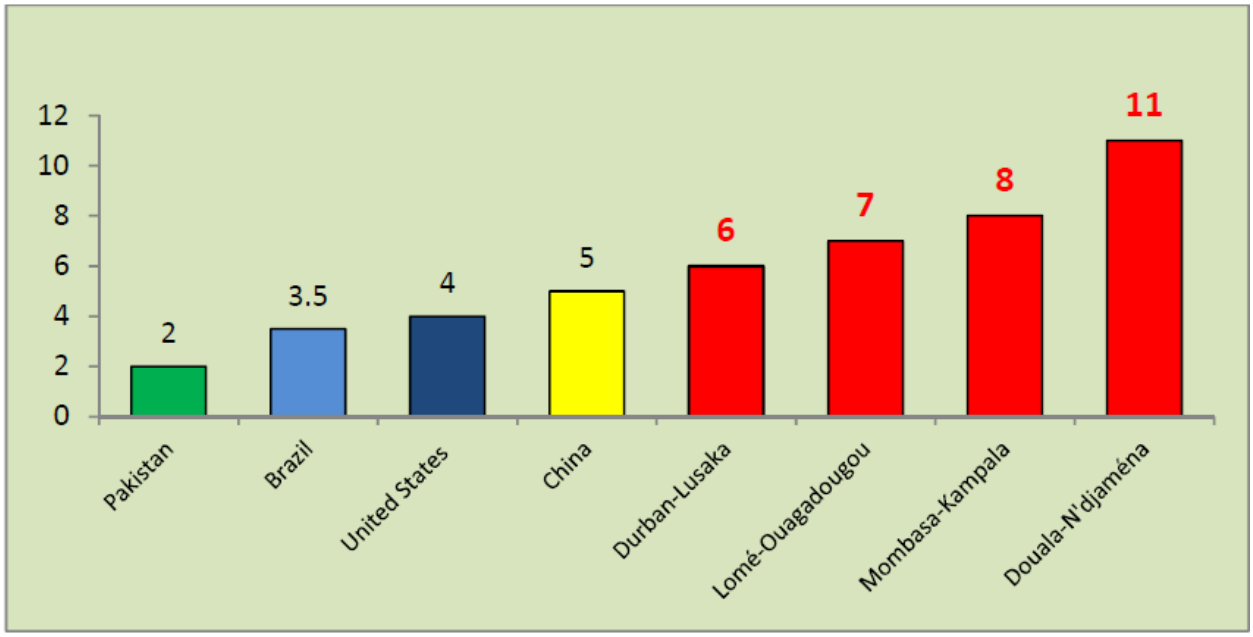

Figure 2.1 Global Comparison of Average Transport Prices
Source: Teravaninthorn and Raballand (2009:14)

[10] According to World Bank statistics, 46.8 percent of the Sub-Saharan African population live below the poverty line of USD1.25 per day (World Bank & International Monetary Fund, 2015:19).

Trade facilitation is not the only economic benefit derived from road freight transport. In fact, the industry is also a source of employment for thousands of people on the continent. The road freight transport industry employs an average rate of more than one driver per truck plus an assistant, dispatch managers, administrators, workshop personnel and loading staff (World Bank, 2009). A study of heavy truck drivers in Botswana reported an employment rate of 1.67 truck drivers per vehicle (Ngcongco, 2014:13). Statistics from a study in Uganda indicate that in 2011, there were 31 588 truck drivers in that country (Knowledge Management and Communication Capacity - Uganda, 2014:11). Countries with comprehensive national disaggregated figures, such as South Africa, show employment records of over 300 000 people in the road freight transport industry in the same year (SATAWU, as cited in WWF-SA, 2013:4).

Around the world, road freight carriers have become major intermodal transport links for regional and global supply chains (African Development Bank *et al.*, 2014; Arvis *et al.*, 2014; European Commission, 2014). As such, road freight transport services are not only subjected to dynamics forces in the local economy, but also to a number of global supply chain related conditions. The section below provides a brief discussion of some major developments that have driven and continue to drive changes in road freight transport operations across Africa.

2.3 Drivers of Innovation in the Freight Transport Industry: Towards Innovation

The process of providing road freight transport services in Africa is littered with issues, such as poor road infrastructures, high road traffic congestions, inadequate capacity to implement transport regulations, and obsolete technologies (Barka, 2012). These hurdles are in addition to increased pressure from shippers, regulators, and the public to provide efficient transport services, while at the same time ensuring road safety and reducing environmental costs (Perego, Perotti & Mangiaracina, 2011). Specifically, road freight transport operators are required to be flexible in responding to shifts in global production systems, rules of origin and the introduction of new policy instruments, externalities, shortening product life cycles, and security threats (discussed below).

2.3.1 Shifts in Global Production Systems and Trade Liberalization

Trade liberalization in the 1980s and 1990s differentially impacted various spheres of the economy. In the freight transport industry, liberalization changed the geography and frequency of moving goods by creating a global market with increased global sourcing dynamics (Kumar, 2001:59). Phenomena such as the adoption of the just-in-time inventory method (which requires specific amounts of materials to be delivered at specific times) and the relocation of large production plants to developing countries (where labour costs are low, with attractive foreign direct investment incentives) marked

the advent of efficient transport services as a source of competitiveness (Hesse & Rodrigue, 2004; Freund & Rocha, 2010; Grant *et al.*, 2013).

The integration of road transport with other freight transport systems (i.e. rail, water and air) also increased expectations for road freight carriers to adopt new practices at intermodal terminals, which required new technologies such as fork lifts and cranes to speed up the movement of unitized freight through containers and pallets (Pederson, 2001; 2003). With the spread of supply chains across countries and continents, the need for efficient communication also compelled the industry to adopt information technologies such as Electronic Data Interchange (EDI) and Radio and Frequency Identification (RFID).

2.3.2 Rules of Origin and Trade Policy Instruments

The history of humans has always been characterized by the need to exchange goods and services between neighbours and villages; and in later years, between towns and countries (Seydack, 2011). In pursuit of cross-border trade facilitation and the creation of larger markets, countries have established regional economic integration groupings (World Bank, 2011). Regional integration, according to the results of earlier studies (e.g. Geda & Kebret, 2008; Ndulu, 2006; Draper, 2010; Hartzenberg, 2011), has not improved intra-regional trade among developing regions at the same rate as in developed regions. In 2007, intra-regional trade among the EU countries amounted to 74 percent of total exports and only 13 percent for Latin America's largest trade blocs (Guerrero, Lucenti & Galarza, 2009:iv). Similarly, in 2011, total intra-trade for North America and the Association of Southeast Asian Nations was recorded at 40 percent and 30 percent respectively, with Africa's intra-regional trade accounting for only 10 percent of total trade (African Union, 2012:2). As illustrated in Table 2.1 below, the slow pace of intra-regional growth is also observed at sub-regional levels, where intra-trade, in for instance Eastern and Western Africa, has declined.

Table 2.1 Intra-regional Trade in Africa 1996 -2011

% of total exports/imports	Exports			Imports		
	1996-2000	2001-2006	2007-2011	1996-2000	2001-2006	2007-2011
Developing Africa	**9.7**	**9.8**	**10.9**	**13.3**	**13.5**	**12.7**
Eastern Africa	12.4	14.1	13.9	8.8	9.3	7.1
Central Africa	1.2	1.0	1.3	2.6	2.5	3.1
Northern Africa	3.2	2.9	3.9	2.6	2.5	3.1
Western Africa	10.2	10.0	9.0	11.3	12.5	10.2
Developing America	19.1	17.6	20.6	17.6	19.0	21.1
Developing Asia	41.5	45.1	50.1	40.6	49.3	53.0

Source: Infrastructure Consortium for Africa (2013:10)

In SADC, intra-regional trade also remained steady at around 10 percent from 2000 to 2010, with South Africa accounting for the largest share (World Bank, 2011:19). Figure 2.2 presents the breakdown of SADC intra-regional trade between 1998 and 2008, a trend that still persists.

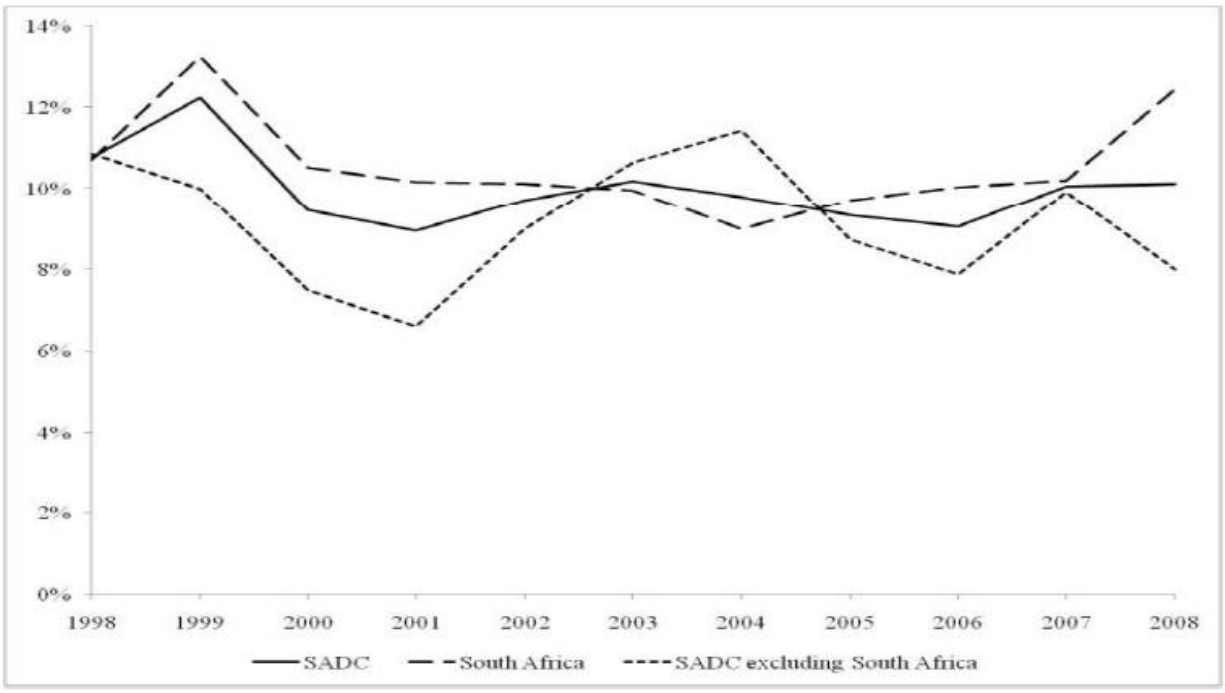

Figure 2.2 SADC Intra-Regional Trade 1998 – 2008
Source: World Bank (2011:19)

Critics have questioned the effectiveness of Africa's regional integration programs in promoting intra-regional trade, citing the multiple memberships and differing national transport strategies as deterrents (Mouchili & Prinsloo, 2008). Others, such as Draper (2010) and Hartzenberg (2011), even questioned the fundamental relevance of the EU-based linear market regional integration model (free trade area – customs union – common market – economic union) to Africa.

The complexity of intra- Africa trade is not a recent phenomenon. The first wave to integrate Africa's economy with world markets was colonialist (1800s) to facilitate exploitation of raw material for European markets (Fieldhouse, 1961). In return, African markets became destinations for Europe's industrial revolution products (Ocheni & Nwanko, 2012). The pre-mature integration of Africa's economy with the outside world has destroyed internal regional production systems that are required for a linear integration model (Simuyemba, 2000). As a result, the linear integration model is doing more harm than good by undermining intra-African trade while promoting trade with outside regions as illustrate in Figure 2.3 below (Draper, 2010).

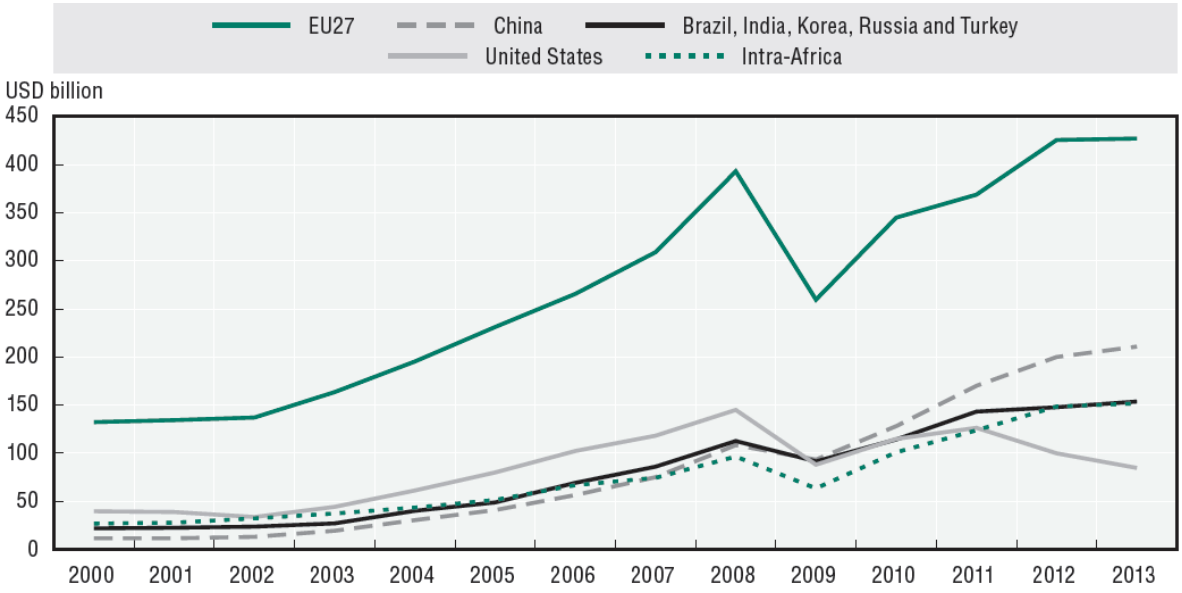

Figure 2.3 Africa's Total Trade Flows with Selected Partners, 2000-2013

Source: African Development Bank, OECD & UNDP (2015:vi)

Two of the most fundamental, yet overlooked challenge of using the linear economic integration model is that it increases road transport costs (due to differing border-crossing and loading requirements across countries) and promotes increased investment in old trading route infrastructures that link well-resourced areas to ports at the expense of intra-regional road networks (Simuyemba, 2000; Mouchili & Prinsloo, 2008; Raballand & Macchi, 2008; Teravaninthorn & Raballand, 2009). According to Padeco (2011:1), the cost of crossing borders in Africa for trucks in 2011 was 3-5 times higher than in Asia and Latin America, with about 19 hours spent at border crossings. This cycle of different rules of origin, with its effect on freight transport costs, is undermining the principles of regional integration in Africa. As evidenced by Hanouz, Geiger and Doherty (2014) in Figure 2.4 below, Sub-Saharan Africa is ranked lowest on six of the seven trade-enabling pillars, which include measures of domestic market accessibility, efficiency and transparency of border administration, and availability and quality of transport services.

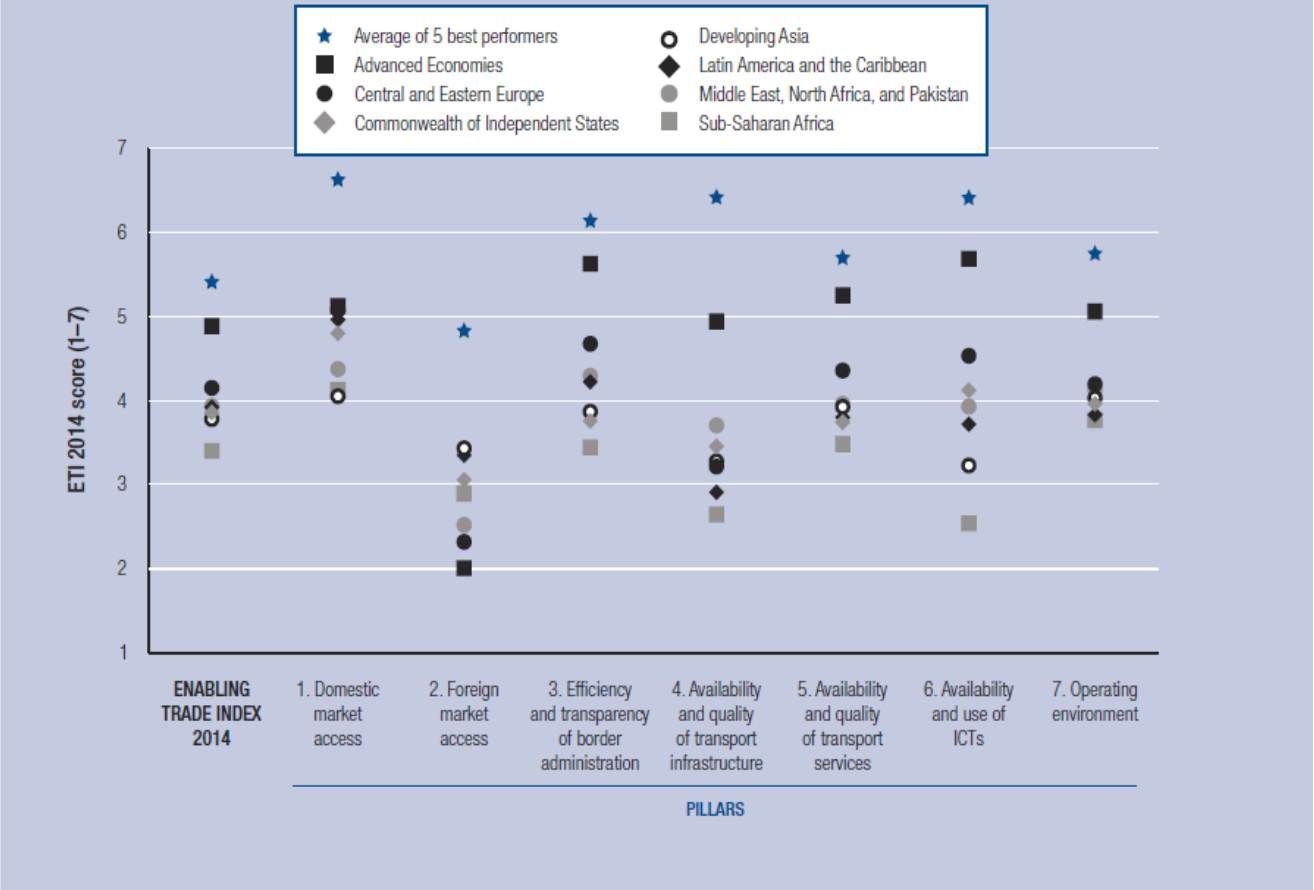

Figure 2.4. Global Enabling Trade Index 2014
Source: Hanouz *et al*. (2014:9)

To overcome the challenges associated with border-crossing delays on long-distance hauls, poor infrastructure and differing load requirements, road freight transport operators are adopting new systems and technologies. For instance, some industry operators have introduced the use of lifting axles to comply with different load requirements while saving on fuel and tyre costs. Others who have freight-forwarding functions in their firms have adopted customs-processing systems such as the Automatic System for Customs Data (ASYCUDA) to reduce customs clearance and border-crossing time. The details of these technologies are discussed in Chapter 5.

2.3.3 Increased Externalities

Freight transport and especially road freight transport worldwide is associated with numerous social and environmental challenges. Some of the negative effects of road transport include accidents, congestion, road damage, intrusions, vibration, noise and air pollution (Taniguchi & Thomson, 2003). While congestion, intrusions, vibration and noise pollution are generally associated with urban agglomeration, accidents, road damage and air pollution present specific road freight problems.

The first and most visible external cost of road freight transport is road accidents. Truck crashes are not only a danger to the lives of the drivers, but also endangers other road users. The Sub-Saharan Africa Transport Policy (2012; 2013) program has conceded that, globally, most road deaths occur on busy trade corridor roads. In the United States, for example, accidents involving trucks accounted for 3 921 deaths and 104 000 injuries in 2012 (National Highway Traffic Safety Administration, 2014:1). While these figures are difficult to obtain in most African countries, statistics from South Africa recorded a 109 percent increase in the number of trucks involved in fatal accidents between 2009/2010 and 2010/2011 (Road Traffic Management Corporation, 2011:49). Some countries, such as Swaziland, have resorted to banning freight trucks from their highways during peak hours in order to curb the increase of fatal accidents involving trucks in the region (Federation of South and East African Road Freight Associations, 2014).

The second social challenge associated with road freight transport relates to road damage. Overloaded trucks in Africa are widely regarded as the main cause of road deterioration. Some of the most recent statistics show that between 10 and 50 percent of trucks on Eastern and Southern African roads are overloaded, while in West Africa, the rate is even higher, at 60 to 70 percent (Pinard, 2010:xvi; Samb, Fall, Berthaud & Bendboudjema, 2015:20). With these levels of overloading causing deterioration, road maintenance and rehabilitation in half of African countries lags behind the required levels by 40 percent (African Development Bank, World Bank & Infrastructure Consortium Africa, 2011:56).

The third challenge linked to freight transport is the high emission of greenhouse gases and carbon dioxide (CO2). As noted by the Intergovernmental Panel for Climate Change 2007 Report[11] and the International Transport Forum (2010:5), transport has remained one of the main sources of greenhouse gas (GHG) emissions since 1970, and increased by 45 percent between 1990 and 2007. In 2005, the transport sector accounted for 14.5 percent of the total global greenhouse gas emissions, with road transport contributing the largest share of 73.3 percent (International Transport Forum, 2010:7). Figures 2.5 and 2.6 illustrate this graphically.

[11] The Intergovernmental Panel on Climate Change (IPCC) is a joint forum set up by the World Meteorological Organization and the United Nations Environment Program to provide scientific assessments on climate change across the world (IPCC, 2007)

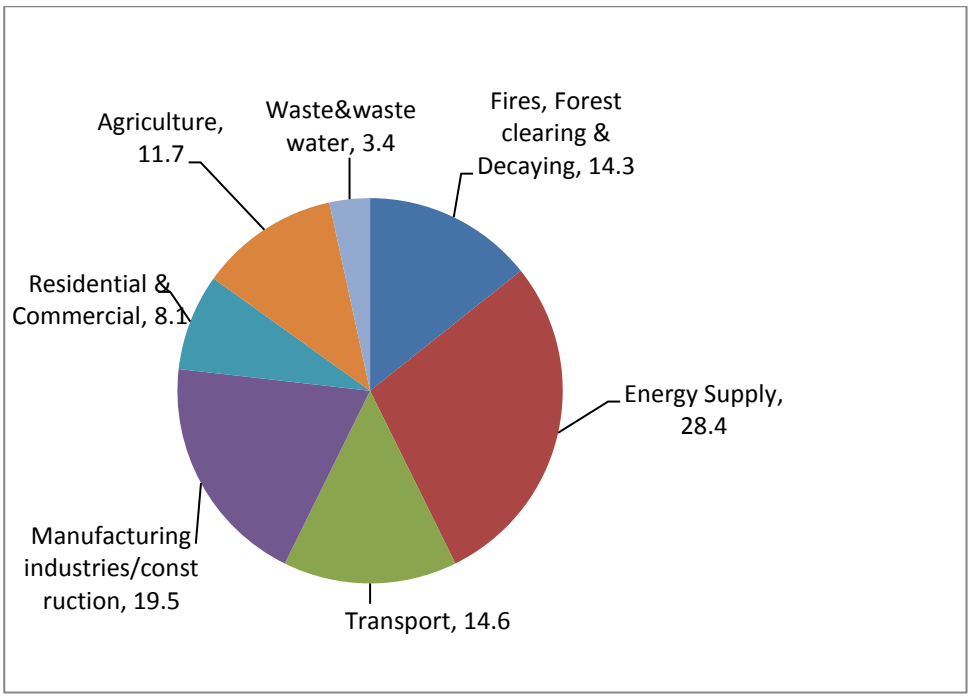

Figure 2.5 Global Green House Gas Emissions by Source:

Source: Adapted from International Transport Forum (2010:7)

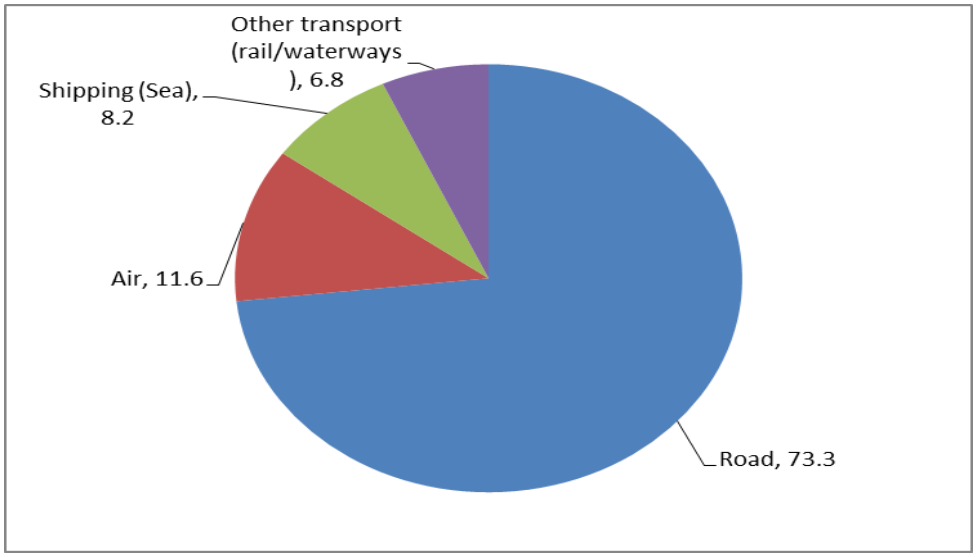

Figure 2.6 Share of GHG Emission by Transport Mode in 2005:

Source: Adapted from International Transport Forum (2010:7)

The Energy Information Administration (2010:110) predicts world transport energy consumption to increase from 109.0 quadrillion British Thermal Unit (Btu) in 2015 to 142.1 quadrillion Btu in 2035 (see Figure 2.7). The increase in energy consumption derived from economic development activities will result in higher GHG emissions. Not surprisingly, as Figure 2.7 indicates, over a third of the

world's transport energy will be consumed by freight transport, and based on historical data, road freight transport will represent the lion's share of this consumption.

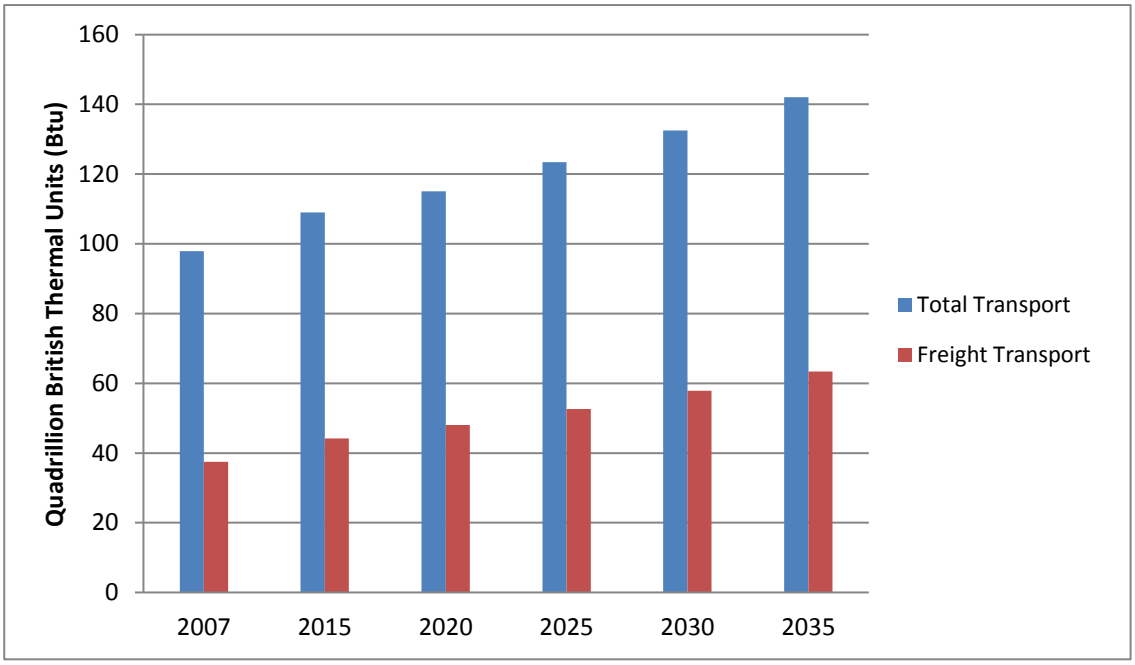

Figure 2.7 Global Transport Energy Consumption 2007 – 2035

Source: Author, Data from Energy Information Administration (2010:110-111)

Although some countries, such as China and United States, evidently contribute more greenhouse gas emissions than others, the negative impacts are not confined to national borders. At worst, the impact of GHG emissions is severe in regions where emissions are relatively low (United Nations Economic Commission for Africa, 2011). Since 1992, countries around the world have collectively committed to reduce greenhouse gas emissions through the United Nations Framework Convention on Climate Change, United Nations Environment Program and other multilateral platforms (United Nations Environment Program, 2012). The implementation of these actions, which include the use of more fuel-efficient vehicles, modal shifts from road to rail, and transport planning, has led to the introduction of both technical and organizational innovations in the transport sector (IPPC, 2007). In response to changes in transport environmental policies, innovations introduced by road freight transport include the adoption of computerized vehicle routing and scheduling systems (CVRS), backloading, and increased collaboration with production systems related to the efficient packaging of goods (Piecyk & McKinnon, 2009).

2.3.4 Short Product Life Cycles and Reliability Concerns

Over the past two decades, providing efficient and sustainable transport services has become more arduous for transport operators because while freight transport distances have lengthened (as a result of global sourcing), most product life cycles – especially those of consumer goods – have shortened (Hesse & Rodrigue, 2004). One of the main indicators of freight transport efficiency is the value of reliability, which refers to the safe delivery of goods (Dullaert & Zamparini, 2013). Freight transport has two safety risks: the risk of damage and the risk of theft (*ibid*.).

In order to preserve cargo quality, freight transport operators are required to provide appropriate infrastructure for goods that are temperature-sensitive or require special handling. For instance, a report on cut flowers in Kenya found that flowers transported by trucks that do not provide the required temperature of 0-1 ºC sell for less at the market than those transported under the right conditions (Dutch Ministry of Economic Affairs, Agriculture and Innovation, 2012:30). Increasing quantity assurance, on the other hand, is also a challenge for road freight transport operators. It requires the constant assessment of risk situations along different routes, and the implementation of security measures to avoid high incidences of theft (Freight Watch International, 2013). The map below (Figure 2.8) presents the level of freight theft across the globe, with Africa showing high and medium levels of theft. The exceptions in Africa are South Africa, which has severe incidences of freight theft, as well as Botswana, Namibia, Guinea-Bissau, Western Sahara and Tunisia, where the risk is elevated.

Figure 2.8.Global Cargo Theft Risk Assessment
Source: Freight Watch International (2013:8)

Some of the technological innovations used by road freight transport operators to maintain the optimal quality and quantity of goods by tracking the condition, location, direction and speed of vehicles

include the Global Positioning Systems (GPS), temperature monitors, fleet management systems, and mobile phones (Al-Khedher, 2012; Maurya, Singh & Jain, 2012). Despite the introduction of these innovations in Africa's road freight transport industry, efficient transport service in the region is still a dilemma. The next section discusses obstacles facing the industry in providing efficient transport services.

2.4 Sustainable Road Freight Transport and the Effects of Industry Regulations

Since the 1970s, the demand for freight transport, and in particular for road freight transport, has followed the growth of economic activities (Energy Information Administration, 2010). This relationship, known as coupling, is associated with a high consumption of fossil fuels by trucks, which leads to increased greenhouse gas emissions, as illustrated in Figure 2.9 (Lehtonen, 2006; Mraihi, 2012).

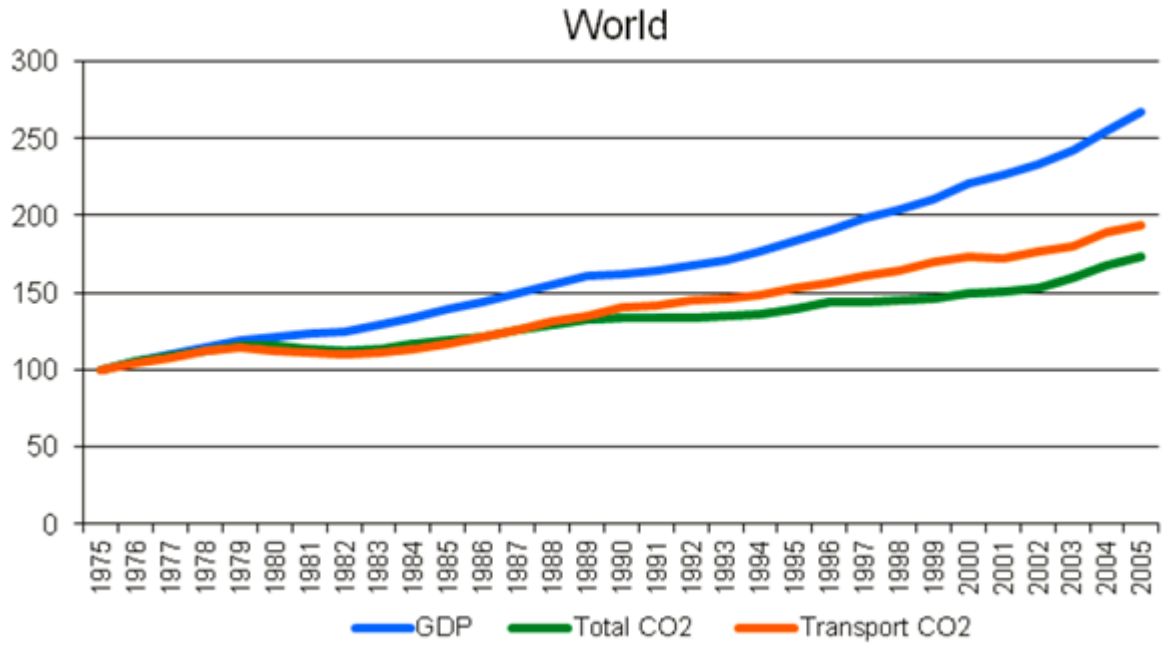

Figure 2.9 Global GDP, Total CO2 Emissions, Transport CO2 Emissions 1975-2005
Source: Finel and Tapio (2012:6)

The move towards sustainable transportation in the early 1990s changed the perception of this relationship with the introduction of policies aimed at 'decoupling' road freight transport from economic growth activities (Lehtonen, 2006; Verny, 2007). Decoupling in this context refers to the provision of efficient freight transport services without increasing the negative social and environmental effects (Gray, Anable, Illingworth & Graham, 2006). Using the coupling and decoupling principles, it can be concluded that Africa's high transport emissions as indicated in Figure 2.10 shows room for improvement.

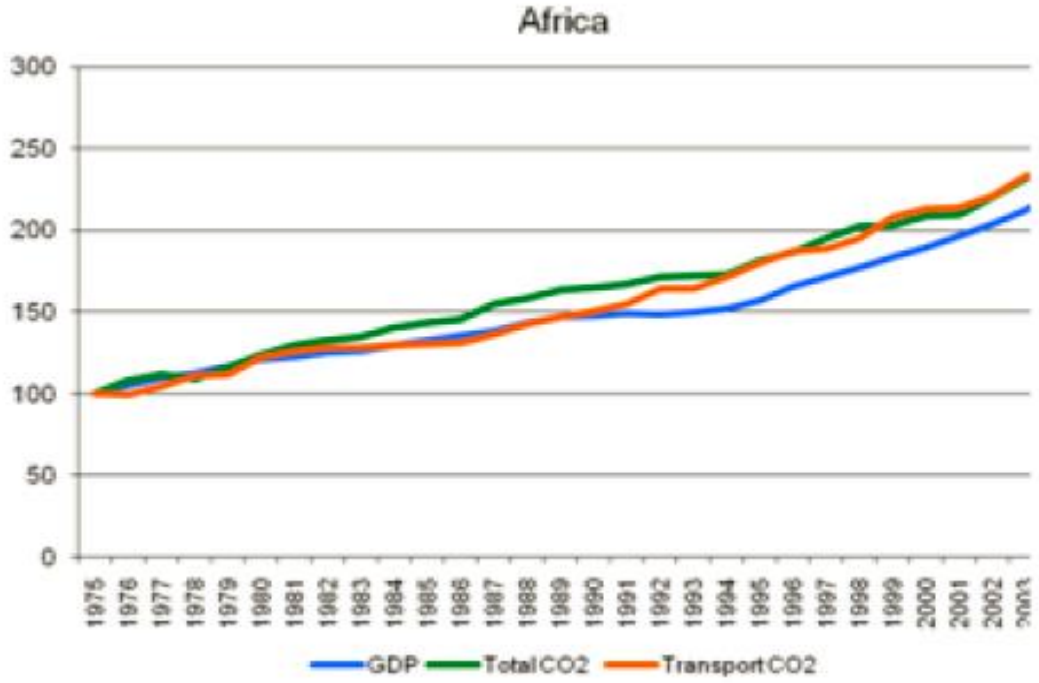

Figure 2.10 GDP, Total CO2 Emissions, Transport CO2 Emissions in Africa 1975-2003
Source: Finel and Tapio (2012:7)

When compared to other regions in the world, cumulatively, Africa's consumption of fossil fuels and its greenhouse gas emissions are low. Consequently, the region is under no global obligation to reduce greenhouse gas emissions to any level, such as is required of other regions by the United Nations Framework Convention on Climate Change (UNFCC) and the Kyoto Protocol (United Nations Environment Program, 2012). Nonetheless, the effects of greenhouse gas emissions (prolonged draughts, seasonal floods and extreme temperatures) are more severe in Africa than on other continents, threatening the livelihood of millions of people (United Nations Economic Commission for Africa, 2011). Thus, even though Africa contributes less than 4 percent of greenhouse gas emissions, the negative impact of climate change on the region is reason for implementing sustainable development practices (African Development Bank, 2013).

Innovations used to decouple road freight transport from economic activities include the use of fuel-efficient techniques and the improvement of truck utilization (Lehtonen, 2006). In most African countries, however, the optimal utilization of trucks is constrained by a number of factors, among them government regulations. (The two main types of regulations obstructing efficient transport services in the region are discussed below).

2.4.1 Freight Sharing Schemes and Queuing Systems

A freight sharing scheme is a method used to allocate transit freight quotas between coastal country transporters and transporters from the country of destination (Teravaninthorn & Raballand, 2009). These quotas, which are defined in bilateral agreements, are typically enforced by shippers' councils in the ports (Nathan Associates, 2012). The queuing system is similar to the freight sharing system, with the exception of it applying to trucks of the same country. In the queuing system, trucks are registered on arrival, and freight is allocated in the chronological order of arrival (*ibid.*). In both systems, cargo owners do not have the privilege of negotiating transport terms, and each trucker is assured to receive a load (Raballand & Macchi, 2008).

Part of the shortcomings of these regulations is that they promote complacency among transport firms due to lack of competition. The inefficiencies created in the transport system are characterized by an oversupply of old, poorly maintained trucks, most of which lack fuel-efficiency capability (Teravaninthorn & Raballand, 2009). For instance, as indicated in Table 2.2 below, the average age of trucks from West and Central Africa (where these schemes are common) is 12 years and older, with poor utilization compared to trucks from the Eastern and Southern African regions (where freight allocation is determined by the market).

Table 2.2 Productivity of Trucks on Selected African Corridors

	Average yearly mileage (Kilometres)	Average age of fleet (years)
Southern Africa (North South Corridor)	100,000 -144,000	5
West Africa (Lomé – Ouagadougou)	40,000 – 50 000	Over 12
East Africa (Mombasa – Kampala)	100,000 – 144,000	7
Central Africa (Douala – Chad)	60,000 – 70,000	12

Source: Raballand, Kunaka and Giersing (2008:24)

Another common occurrence under these systems is the empty running of trucks. Empty running of trucks is caused by the fact that the time each truck has to wait for an allocation is uncertain and undefined, leading to long periods of vehicle idleness (Raballand *et al.*, 2008). In summary, the freight sharing scheme and the queuing systems are contributing towards the inefficient use of vehicles, and an oversupply of old trucks. Old vehicles, as submitted by United Nations Environment Program (2007), use old technologies and emit more greenhouse gas emissions than new trucks.

2.4.2 Third Country Rule and Cabotage

The third country rule is a rule that prevent trucks from a third country to carry goods between two other countries in which it is not registered (World Bank, 2012). An exception is permitted if the route transits through the third country or if there is a bilateral agreement (Infrastructure Consortium for Africa, 2013). Unlike freight sharing schemes and queuing systems, which are mainly practised in West and Central Africa, the third country rule is practiced across all Sub-Saharan African regions. Cabotage, which is also practiced across Africa, is a system used to prevent trucks that are not registered in a country from transporting domestic goods (Raballand *et al.*, 2008). Cabotage protects domestic markets, and specifically benefits local micro and small enterprises. Even though trucks can obtain cabotage permits in some countries - like South Africa and Namibia - other countries, such as Zambia, do not issue cabotage permits (Ward & Barreto, 2011).

Thambiran and Diab (2011) have suggested that in order to prevent the empty and unnecessary running of trucks, road freight transport service providers can use technological innovation for load planning. However, the manifestation of freight sharing schemes, queuing systems, the third country rule and cabotage is preventing transporters from providing sustainable road freight transport services. Instead, governments are introducing instruments such as carbon taxes, a cost that all trucking firms are expected to carry (Transport World Africa, 2012).

2.5 Summary of the Chapter

This chapter highlighted the importance of road freight transport in the economy. In Africa, road freight transport is the main facilitator of trade and a source of thousands of jobs. In some areas, road freight transport is the only economic artery linking communities to markets and enabling the rural poor to participate in commercial activities. Despite these positive effects of road freight transport, the industry is also associated with high social and environmental costs.

In recent years, the road freight transport industry has been faced with the challenge of providing competitive services to shippers, while minimizing the negative effects of transport activities on society and on the environment. In spite of the ongoing regulatory reforms to deepen regional integration in Sub-Saharan Africa, the problems of poor infrastructure, different rules of origin, freight sharing systems and queuing systems increasingly reproduce observed inefficiencies in the industry.

The next chapter turns to different innovations used by road freight transport operators to enhance the sustainability of their transport services.

CHAPTER THREE: INNOVATION IN THE ROAD FREIGHT TRANSPORT INDUSTRY

3.1 Introduction

Until the 1990s liberalization programs in Africa, competition in the road freight transport industry was negligible as a result of own-account trucks[12] used by big firms and government-owned enterprises (Alila, Khayesi, Odhiambo & Pederson, 2005; Nathan Associates, 2012). Since then, private transport operators have entered the industry, and the number of trucks for hire has more than doubled in most countries across the continent. In Zimbabwe, for example, the number of registered trucks has gone from 27 400 in 1990 to 75 000 in 2009, while in Kenya, the number increased from 7 700 in 2000 to 25 800 in 2002 (Alila *et al.*, 2005:18-19; African Development Bank, n.d:16).

As mentioned earlier, competition in West and Central Africa, where freight sharing schemes and queuing systems are common, is relatively low compared to Eastern and Southern Africa, where operators secure loads based on bilateral contracts with cargo owners (Raballand *et al.*, 2008; Nathan Associates, 2012). The option for cargo owners to negotiate transport prices exerts pressure on transport operators to offer competitive services. This chapter presents an analysis of how road freight transport operators develop their innovation capabilities, and the types of technological innovation they adopt for competitiveness. The chapter argues that, like in any industry, both organizational and technological innovations are essential for road freight operators to remain competitive. But before trying to understand how these industry operators compete, it is important to first provide a brief description of the industry.

3.2 Structure of the Road Freight Transport Industry in Africa

Generally, the road freight transport industry in Africa consists of many micro and small enterprises, with a few medium and large firms (Raballand *et al.*, 2008). The micro and small enterprises mainly operate in domestic (national) markets, where they move freight from production sites to markets and vice versa (Kunaka & Carruthers, 2014). A large number of micro and small transport firms operate

[12] The term "own-account trucks" refers to a practice whereby owners of goods used their own trucks to transport their products, as opposed to using third-party transport operators (Alila *et al.*, 2005).

old fleets, often purchased in second-hand markets. Typically, the micro and small firms are managed by their owners, who hire drivers and, in some instances, a few loaders (Alila *et al*., 2005).

Medium and large firms, on the other hand, normally serve international transit and transhipment traffic markets. They provide newer, more reliable fleets, and their management structure is more formal. Most medium and large trucking firms, especially in the SADC, also include freight forwarding, storage and distribution functions in their organizations to speed up the movement of cargo (Kunaka & Carruthers, 2014).

Owner-operator trucking enterprises in Africa are a mixture of formal and informal firms. Informal owner-operators normally serve local markets, while formal owner-operators are more often than not flexible and (therefore) serve both domestic and international routes. Given that the characteristics of road freight transport operators were presented, the next section focuses on their organizational innovation capabilities. Specifically, the section explores how these firms acquire knowledge, take risks, reward novelty, share knowledge and maintain a culture of innovation.

3.3 Innovation Capability of Road Freight Transport Firms

In the road freight transport industry, innovation capability refers to those activities that transport operators engage in to ensure that new ideas, techniques and technologies are assimilated successfully. Fagerberg and Srholec (2008) and World Bank (2011b) refer to these activities as absorption capacity. Studies on innovation have found that firms with high absorption capacity are faster at generating novelty and are more competitive than others (Martínez-Román *et al.*, 2011; Yang, 2012).

Acclimatizing the road freight transport workforce to a culture that promotes innovation differs from other service industries. Factors affecting absorption capacity development in road freight transport firms include the high mobility of truck drivers, the perceived low stature of employees, the high safety risks associated with the movement of cargo, and the scarcity of skills in the industry. Specifically, road freight transport firms have to consider the following: what is the best way to encourage truck drivers, who sometimes spend up to 20 days on a trip away from their families, to generate and share new ideas in the firm? How does a firm create a culture that promotes experimentation with new ideas in an industry where change in behaviour can lead to high safety risks? How does a firm challenge employees who often have very low levels of formal education to value continuous knowledge acquisition, and plough their new knowledge back into the firm? As in

any other industry, road freight transport firms have to develop their innovation capability through learning, knowledge sharing, and providing a culture that supports and rewards novelty.

3.3.1 Learning and Skills Development

All firms, regardless of size or industry, are in constant competition to respond to changes in the business environment. Learning and skills development provides firms with the ability to acquire knowledge that enables and empowers them to adapt. Liebowitz (2001) has defined knowledge acquisition as a process in which knowledge is defined, sourced and manipulated to enhance the competitiveness of a firm. Knowledge acquisition in firms is achieved through both formal and informal learning (Malerba & Vonortas, 2009). Formal learning is often provided through certified training programs, while informal learning is gained through different types of interactions with suppliers, customers, industry associations, competitors, consultants, government agencies and research institutions (Quintas, 2002; Ramjin & Albaladejo, 2002; Earl & Gault, 2006; Okamura & Vonortas, 2009).

The learning function in the road freight transport industry is concerned with, among other things, gathering knowledge about driver requirements, costing structures, load planning and securing of loads, transport planning systems (routing and scheduling), vehicle maintenance systems, tracking systems and regulations in different countries. Through learning, firms are able to improve their safety standards, comply with regulations, positively impact employee behaviour, empower and retain staff, increase customer satisfaction, and improve profitability (MacLeod & Clarke, 2009).

Regrettably, learning in Africa's road freight industry has not kept up with the demand for skills and new knowledge. The industry is faced with a severe skills shortage at both managerial and operational levels (Landman, 2015). Some of the main factors contributing to this shortage of skills in the industry include the poor image associated with road transport careers, the increase of HIV/AIDS among drivers, and a lack of training and testing facilities. These factors are described in detail below.

3.3.1.1 Skills and Careers in the Road Freight Transport

A study by Heyns and Luke (2012:118) found that while transport management was ranked among the top 10 most important skills for logistics and supply chain managers in China, in South Africa, it ranked only 29th. The same study also found that skilled truck drivers, transport planners and transport managers are among the most difficult positions to fill in South Africa. All across Africa, road freight transport is considered a blue-collar career with few growth opportunities (PricewaterhouseCoopers International Limited, 2012). As a result, the road transport industry does not attract students with

good grades. Truck driving in particular is regarded as a fall-back career for males who did not manage to further their education after primary and high school (Naysmith & Rubincam, 2012). A study of 103 truck drivers in Uganda revealed that 47.6 percent of truck drivers and their assistants had primary education, while 52.4 percent had high school education (International Organization for Migration, 2008:19). A similar study of 451 truck drivers in Nigeria found that 28.2 percent had no formal education at all, with 60.1 percent only possessing primary school education (Atilola, Akpa & Komolafe, 2010:170).

Non-truck-driving careers such as transport planning and transport management in Africa are seldom occupied by people with transport and logistics qualifications (PricewaterhouseCoopers International Limited, 2012). Instead, most of the transport management functions in the industry are performed by people from other disciplines like Business Administration and Marketing. A study of 24 transport and logistics managers in one of the largest transport and logistics firms in Zimbabwe confirmed this occurrence by submitting that only one person had a diploma in transport management, while the rest had degrees in other disciplines (Cronjé, 2015). The poor image and shortage of skills in the transport and logistics industry are not unique to Africa. PricewaterhouseCoopers International Limited (2012:6) has described the image of the sector at the global level as follows:

> Transportation and logistics as a sector isn't viewed as attractive by most job seekers – when it's considered at all. Many transport jobs are considered to be low-paying dead-ends. Higher skilled logistics roles with good pay and advancement potential don't even make the radar screen of many talented graduates. The problem is compounded by a dearth of training programs in many areas and an insufficient focus on learning and development within individual companies.

One of the consequences of not enough young people entering the industry is that road freight transport firms are struggling to fill key positions. The situation is further aggravated by the fact that the current workforce is ageing and exiting through retirement, while some are also being lost through occupational health related conditions such as HIV/AIDS (Parker, 2009; Naysmith & Rubincam, 2012; Manpower Group, 2014).

3.3.1.2 Truck Drivers and Spaces of Vulnerability

The impact of HIV/AIDS on truck drivers in Africa is widely documented. Truck drivers in Africa are referred to as a vulnerable risk group when it comes to the HIV/AIDS pandemic (World Health Organization, 2008). The vulnerability of truck drivers stems from being away from their families for

long periods of time and spending time in what the International Organization for Migration (2010) and UNDP (2011) have referred to as 'spaces of vulnerability', among them; truck ports, border posts, sea ports and hotspots along corridor roads. In these spaces of vulnerability, truck drivers come to associate with high-risk groups such as commercial sex workers, road wives and same-sex partners, thus increasing their rate of exposure to HIV/AIDS infections (World Health Organization, 2008). A 2014 multi-sectoral HIV/AIDS study in Uganda reported higher HIV prevalence rates among truck drivers compared to the prevalence rate of the general population (Knowledge Management and Communication Capacity - Uganda, 2014). These findings are similar to those by earlier studies covering Botswana, Namibia, Lesotho, Malawi, South Africa, Swaziland and Zimbabwe, which also found high HIV prevalence rates among transport workers, especially truck drivers, than among the general population (International Labour Organization, 2005).

Notwithstanding the life endangering and death risks associated with spaces of vulnerability, it is also in these spaces where truck drivers make contact with drivers from other countries, customs officials and clearing agents who are potentially sources of new ideas. With the 'right approach' and the 'right incentives', these spaces can also serve as platforms for informal learning. There is a lot more to learn for truck drivers than just good driving skills. As Parker (2009) has pointed out, truck drivers need to learn how to perform emergency mechanical procedures, assess hazardous road conditions, apply required defensive driving techniques, identify problems with load securements, and use satellite tracking equipment and other on-board information systems.

Thus, what is currently perceived as 'spaces of vulnerability' could potentially be the most opportune spaces for truck drivers to gain new knowledge about the industry and functions. Other spaces and sources for learning in the road freight transport industry are elaborated in the next section.

3.3.1.3 Other Sources of Learning and Resource Allocation

With an ever-increasing number of higher learning institutions providing courses on transport and logistics, coupled with the introduction of workplace training programs and support from donors in the road transport industry, it would appear that learning platforms for road freight transport operators are adequate. The wide availability of internationally accredited road transport training programs to road transport associations, road transport operators and training institutions across all countries also affirms this perception (International Road Transport Union, 2013). In Africa, however, the review of the literature on road freight transport persistently highlights the inadequacy of training programs and testing centres in the industry (Naysmith & Rubincam, 2012).

Over the years, resource allocation for transport programs in Africa has continued to favour policy and infrastructure development over capacity development programs for transport operators. For example, for the period 2009 to 2015, the Sub-Saharan Africa Transport Policy Program received in excess of USD 24.8 million for supporting regional integration activities, transport management, and development of transport guidelines and policies, with no allocation and/or commitments made towards capacity development for road transport operators (Sub-Saharan Africa Transport Policy, 2013:35). Programs aimed at promoting Africa intra-regional trade, such as those by the International Trade Centre, focus on supporting producers of goods in terms of value addition and creating business linkages, rather than on the transporters of such goods (International Trade Centre, 2012:6). Similarly, institutions such as the African Development Bank, the World Bank and the Japan International Cooperation Agency continue to extend resources to African governments for road infrastructure and policy development, which adds to their national budgets.

By contrast, road transport associations, which are directly involved in providing new information and facilitating learning opportunities for road freight transport operators in Africa, are under-resourced (Ward & Barreto, 2011). According to Naysmith and Rubincam (2012), the costs of training and testing programs in Africa are unaffordably high. Most transport operators do not have the required resources to enrol their employees in these programs, and the handful that can afford it experience high staff turnover rates (Simon, 2014). The bias of investing in road infrastructure at the expense of road freight transport services is best described by Beuran *et al.* (2013:2):

> It is usually forgotten that a road infrastructure is only part of the investments needed for improved mobility and accessibility. Transport services, typically provided by the private sector, are equally important. However, the public sector sometimes proceeds to invest in infrastructure only to realize the private sector does not follow through in providing transport services. In order to maximize returns, it is important that investments in both are realized.

One of the few approaches that road freight transport operators use to encourage long-term, affordable learning for their employees is in-house training programs. Some big international operators like Imperial Logistics, which operate throughout Africa, have established in-house training academies to train their employees and offer industry-specific expertise to new graduates across the continent (Landman, 2014; 2015). Others have established in-house accredited programs for scarce skills, which are otherwise only provided outside of their countries, such as heavy truck driving courses and dispatcher skills programs (Ngcongco, 2014). A few road freight transport operators have also

developed in-house programs that effectively combine both soft and hard skills required in the industry (Cronjé, 2015).

Another source of learning that is overlooked in the current literature on Africa's road freight transport is suppliers/distributors of trucking equipment, who are often the architects of technological innovation in the industry. Some suppliers, such as Scania Trucks Africa, Volvo Trucks and Renault Trucks, have product-specific training programs complementary to the innovations they provide (see Section 3.3.3 for a detailed discussion of these programs).

Now that the learning orientation of the road freight transport industry in Africa has been presented, the next section hones in on how acquired knowledge is shared inside organizations to create value.

3.3.2 Intra-Organizational Learning

Intra-organizational learning is a knowledge management process that allows functional units in an organization to share, create and transform knowledge through what Nonaka and Konno (1998:53) refer to as 'shared spaces'. Recent studies by Hu and Randel (2014) and Shipilov, Gulati and Kilduff (2014) found a strong association between intra-organizational learning in firms and process innovation. As part of a service industry, road freight transport operators primarily compete through process innovation, which requires the sharing of intrinsic and behaviourally ingrained tacit knowledge (Miller, Zhao & Calantone, 2006). There is undeniably much explicit knowledge shared within road freight transport firms through emails and physical documents, e.g. changes to regional integration regulations. However, for most core processes in the road freight transport industry, personal interactions are required to deepen learning. Below is an example of a road freight core process, taken from the South African National Standard on the transportation of dangerous goods, to illustrate how skills in road freight transport core processes are embedded in behaviour more than in coded information.

When loading dangerous goods, the driver is expected to ensure that:

> The vehicle is correctly parked for loading or offloading, and wheel chocks are in place for heavy vehicles with GVM [Gross Vehicle Mass] equal to or greater than 3500 kg and are placed appropriately under wheels on non-steering axles. Vehicle fire extinguishers (where required in terms of national legislation) to be placed where not provided by the loading/offloading point (South African National Standard, 2010:10).

The coded information above describes what the driver should do when loading dangerous goods, but lacks details on how to manoeuvre the vehicle so that it is placed at the right angle. A driver that follows these instructions will know *what* to do but not *how* to do it. With personal interaction, the driver will not only learn what to do but also how to do it better, saving time and avoiding unnecessary wear and tear on the vehicle. The basis for sharing information on most core processes in the road freight transport follows the same logic.

Sharing tacit knowledge requires physical shared spaces (Miller *et al.*, 2006). In the road freight transport industry, however, intra-organizational learning spaces are dispersed because core processes are not collocated (Levy, 2015). For instance, knowledge sharing for performing emergency mechanical processes occurs in workshops, with qualified mechanics showing employees how to detect different types of problems. In depots, employees share knowledge on how to load and secure different types of goods onto different types of vehicles. In the case of heavy truck drivers, knowledge sharing takes place on trips taken with experienced drivers (sometimes for several months), where new recruits learn how to control vehicles under different road conditions (Ngcongco, 2014). As for other functions, such as the use of transport management systems, the office is used as a sharing platform.

The challenge with having scattered organizational learning spaces is that senior management does not always have control over such spaces. According to Gubbins (2003), the delegation of knowledge sharing to such spaces should be accompanied by standard procedures to guide the process, without taking away the creativity needed in each situation. Yet in practice, providing guiding parameters in itself does not always foster the formal and informal social relations required for knowledge sharing to take place among employees (Lee & Ahn, 2007). Organizations therefore have to provide a culture of trust, and create positive attitudes among employees (Tohidinia & Mosakhani, 2010; Jo & Joo, 2011). The next section discusses the risk-taking culture in the road freight transport industry, which allows employees to explore new ideas and subsequently absorb new knowledge.

3.3.3 Attitude Towards Risk

Risk in organizations is defined as the degree to which firms are willing to experiment with new ideas. Firms determine their attitude towards risk by defining acceptable boundaries of trying out new ideas and for managing the consequences arising from experimentation (O'Connor, Zhao & Calantone, 2008; Bruce, 2014). A review of both older and recent literature on attitudes towards risk has revealed a positive correlation between risk-taking and firm innovativeness (Ling, Simsek, Lubatkin & Veiga, 2008; Latham & Braun, 2009). The findings nonetheless acknowledge that levels of risk do not

necessarily positively correlate with innovation. For instance, while low risk tolerance might stunt the innovativeness of a firm, high risk tolerance can also increase the failure rate of firm innovation (Caggese, 2012; Hvide & Panos, 2014; De Araújo Burcharth, Lettl & Ulhøi, 2015). Thus, at best, innovation requires a healthy risk appetite wherein firms can manage uncertainties.

The consequences of taking risks in the road freight transport industry can spill over beyond a firm. Putting a truck on the road to test new, fuel-efficient loading techniques would not only be expensive, but also dangerous and against the law. Similarly, bombarding drivers with new on-board technologies without even checking their effects on concentration could result in fatal accidents (Newnam & Goode, 2015). Thus, careful planning and controlled environments are required for most experimentation activities in road freight transport.

There are a few simulation programs available that transport operators can test new ideas on. Testing centres and suppliers/distributors of road freight transport technologies are some of the notable providers of simulation programs across many countries in Africa (Simon, 2014). Specifically, most suppliers of trucks have simulation programs ranging from crash scene safety programs and driver development programs to fleet management software trials (Transport World Africa, 2014). Some suppliers, like Scania Trucks, have even established incentive-based competitions for industry operators and their employees to experiment with different efficient techniques under controlled conditions (Tancott, 2014).

In summary, creating a culture that embraces and encourages taking risks in the road freight transport industry is no different from other service industries. All innovation activities carry inherent risks, and require planning and a culture of experimentation to promote them (Aven, 2007; Martínez-Román *et al*., 2011; Yang, 2012). The next section discusses a way of promoting innovation in Africa's road freight transport firms, and the effect this has on innovative behaviours in the industry.

3.3.4 Reward System for Innovation

Innovative behaviour, as discussed earlier, carries risks and requires perseverance to explore beyond the individual's mainstream tasks (Huhtala & Parzefall, 2007). Studies in organizational psychology have conclusively established the influence of employees' well-being (which includes physical health, workplace safety, job and financial security) on their ability and willingness to engage in creative activities for innovation (Van der Doef & Maes, 1999; Ramamoorthy, Flood, Slattery & Sardessai, 2005; Rasulzada & Dackert, 2009). This argument is supported by an observation by the International Labour Organization (cited in Demba, Ceesay & Mendy, 2013:1) that 'no company in

the long run, has been able to jump to a high level of productivity without making sure that the work environment is safe'.

Transport is one of the three sectors with the highest occupational risk in the world. This risk is higher in developing countries than developed countries. For example, a study by Alli (2008:5) reported that 'fatalities among transport employees in Kenya are 10 times those in Denmark'. This is arguably related to transport policies and regulations in Africa paying little to no attention to working conditions in the sector (particularly in the road freight transport industry) (International Labour Organization, 2005:1; Demba *et al*, 2013:1). Countries that do have legislation lack enforcement capacity and, with the exception of road accidents, occupational injuries and diseases often go unreported (Matiko, 2010; Okojie, 2010). Common work-related diseases and injuries in the road freight industry include accidents, musculoskeletal disorders caused by whole-body vibrations and prolonged sitting, organ distress (such as kidney and lung failure), fatigue, and post-traumatic stress disorder (International Labour Organization, 1996; Benstowe, 2008; International Labour Organization, 2010).

A review of both older and recent literature on workers' compensation revealed that jobs with high risks are rewarded with higher wages, also known as risk premiums (to counterbalance risk conditions by contributing to the general well-being of employees) (Dorsey & Walzer, 1983; Huhtala & Parzefall, 2007; Powell, 2012). Africa's road freight transport industry poses many risks; being characterized by long working hours, unsafe roads, traffic congestion, old technologies (trucks, cranes) and victimization by the police and militia (when driving through conflict zones), and yet it does not provide employees with attractive compensation (IRIN News, 2008; Teravaninthorn & Raballand, 2009; Fleming, 2015). Although the majority of African countries have Decent Work Country programs which recognize employees' rights to engage with employers on their working conditions, the effectiveness of these programs is often undermined by shippers who switch contracts to non-unionized transport firms that have long, irregular working hours with low pay (*Lusaka Times*, 2011; Ndhlovu, 2012; Hussain, 2013; Tancott, 2013; International Labour Organization, 2014; International Transport Workers' Federation, 2014; 2015).

There have been several violent cases of road transport industry strikes in recent years (Lusaka Times, 2011; Kamhungira, 2015). In a recent event, for example, a large road freight transport firm in Kenya deployed police and security services to violently intimidate employees who were demanding better working conditions (International Transport Workers Federation, 2015; Lassen, 2015). In light of this and many similar events across the industry, even unionized employees are working under poor conditions for fear of losing their jobs (IRIN News, 2008; Iroegbu, 2012; Fleming, 2015). A survey

by CNR Africa (cited in Teravaninthorn & Raballand, 2009) noted that the average salaries of truck drivers in Africa were up to 24 times less than those of drivers in Europe, where working conditions are far better. This suggests that working conditions in Africa's road freight transport industry, especially with regard to fair pay, security and social protection, do not provide a creative environment wherein employees feel valued and willing to engage in innovative activities.

Industry best practices suggest that performance measures for every employee in a road freight transport firm should be determined according to their working conditions (Lockridge, 2015). A truck driver's rewards, for example, should be aligned to measures associated with their functions, such as distance driven, safety measures, fuel efficiency, hours driven, value of the load, timeliness of vehicle service and so forth (Dills, 2015). Rewards for non-truck-drivers should also reflect measures which are within the employees' control. From an industrial psychology perspective of people management, having control over one's work improves an employee's well-being and increases innovative behaviour (Van der Doef & Maes, 1999). In the next section, the elements that craft and guide the innovation process in firms are presented, namely strategy and leadership

3.3.5 Strategy and Leadership

Road freight transport firms, like other service firms in competitive industries, pursue growth through competitive strategies such as cost leadership, differentiation and focus strategy (Porter, 2008; Ortega, 2010). There are two distinct trading areas along which road freight transport operators in Africa build their competitive strategies. Among the transporters of domestic freight, cost leadership strategies are common because of the large number of micro and small enterprises in the industry (Nathan Associates, 2012). For international and transit freight, the few medium and large operators compete through a differentiation and focus strategy by providing reliable and specialized transport services (Alila *et al*., 2005).

According to Coyle, Bardi and Novack (2000), road freight transport strategies hinge on three types of strategic relationships with cargo owners. The first type of relationship is the arm's length relationship, which is entered into for low-value and time-insensitive goods. The contractual relationship, the second type, is based on commitment of specific transport services by transporters over a period of time; while a partnership, the third type of relationship, includes a wide range of other logistical services such as storage, consolidations and break bulk (among others).

Even though competitive strategies are theoretically linked to specific relationships and to specific firm sizes, in practice, firms in the road freight transport industry do not adopt a single strategy (Coyle *et al.,* 2000). They explore and adapt their strategies to the business environment. For instance, large firms use cost strategies to bid for international low-value cargo, while at the same time applying a

differentiation strategy with clients that require specialized transport conditions, i.e. cold systems. As Gubbins (2003) has pointed out, the strategy that a road freight transport firm employs should aim to allocate the right types of vehicles to the right type of cargo at the right price. This argument, however, only presents part of what an effective strategy should address. In addition to vehicles, a good strategy should also allocate skilled human resources, provide them with authority over their job, incentivize them, and furnish functioning equipment. But even with that, most of the senior managers, as leaders in Africa's road freight transport firms, are unable to provide basic work resources (Teravaninthorn & Raballand, 2009; Nathan Associates, 2012). In Senegal, for example, an entire locally operated fleet was reported 'obsolete' (Hamilton, 2010). A recent study by Michelin Tyre (cited in Transport World Africa, 2015:17) reported that '60 percent of South African trucks are not roadworthy'. Across the continent, road transport firms are operating poorly maintained trucks with mechanical failures, worn-out tyres and faulty brakes (Ranganathan & Foster, 2011; Megevand, Dulal, Braune & Wekhamp, 2013). The shortage of skilled truck drivers and equipment operators also reflects the inadequate resources that employees in the industry are presented with (Alli, 2008; Droppa, 2014).

As shown in the literature reviewed, work resources (trucks, staff and loading equipment) affect the creativity and innovation ability of employees (Rasulzada & Dackert, 2009). There is overwhelming evidence that most managers in Africa's road freight transport industry are not providing their employees with sufficient work resources to stimulate creativity (Van der Doef & Maes, 1999).

Section 3.3 discussed issues facing the organizational innovation capability of road freight transport operators in Africa. Specifically, the section focused on non-linear innovation capabilities. The next section looks at the adoption of technological innovation in the industry.

3.4 Adoption of Technological Innovations in the Road Freight Transport Industry

Technologically, the road freight transport industry has evolved from an era of animal-drawn carts to modern trucks with the ability to cater for specialized delivery requirements (Simon, 1996; New Tracking Technology, 2006). One of the reasons for this evolution has been the continuous adoption of new technologies by road freight transport operators. Technological innovations in the road freight transport industry are inputs of innovation, used to improve the process of delivering efficient and reliable transport services. Most technological innovations in the industry are able to simultaneously improve more than one of the triple bottom lines, namely to increase economic productivity, to reduce environmental pollutants and to decrease negative social impacts (McKinnon, 2009).

This section presents an overview of the adoption of technological innovation in Africa's road freight transport industry. It commences by broadly discussing the diffusion of technological innovations, then moves to examine the different types of technological innovations. The section then analyses the

literature on the introduction and adoption of innovations in Africa's road freight transport industry. Finally, it discusses factors affecting the adoption of technological innovations in the industry.

3.4.1 Adoption of Technologies

Technology in the road freight transport industry refers to the means by which transport services are produced, while a new technology refers to the changes in the means by which transport services are produced. Technologies, by their very nature, are evolutionary (Stoneman, 2002). Those technologies that fail to change for the better become obsolete and are replaced by new ones (Bresnahan, 2007). The constant change in technological innovations can make their adoption more complex, as firms may not have the embedded knowledge accumulated in that technology (Verspagen, 2007:44). This is especially true for imported technologies. Lall and Pietrobello (2003:1) affirmed this observation by indicating that 'firms in developing countries often lack the expertise to determine which new skills, technical knowledge and organizational techniques are required to make newly imported technologies function at optimal levels'. Acquiring a technology in itself does not necessarily imply effective use. The adoption of technological innovations is thus influenced by a number of other factors in the social system. But before discussing these factors, it is important to widen the debate by discussing the different types of technological innovation in the road freight transport industry.

3.4.2 Types of Road Freight Technological Innovations

There are different types of technological innovations in the road freight transport industry. Some authors, such as Davies, Mason and Lalwani (2007) and Marchet, Perego and Perotti (2009), have discussed specific categories of innovations, e.g. information communication technologies (ICT), while others such as Christensen, Glaeser, Shelton, Moore and Aarts (2010) have discussed technologies based on their engineering design. McKinnon (2009) has provided a more inclusive classification of road freight transport technologies, covering both ICT and non-ICT innovations, as indicated in Figure 3.1 below.

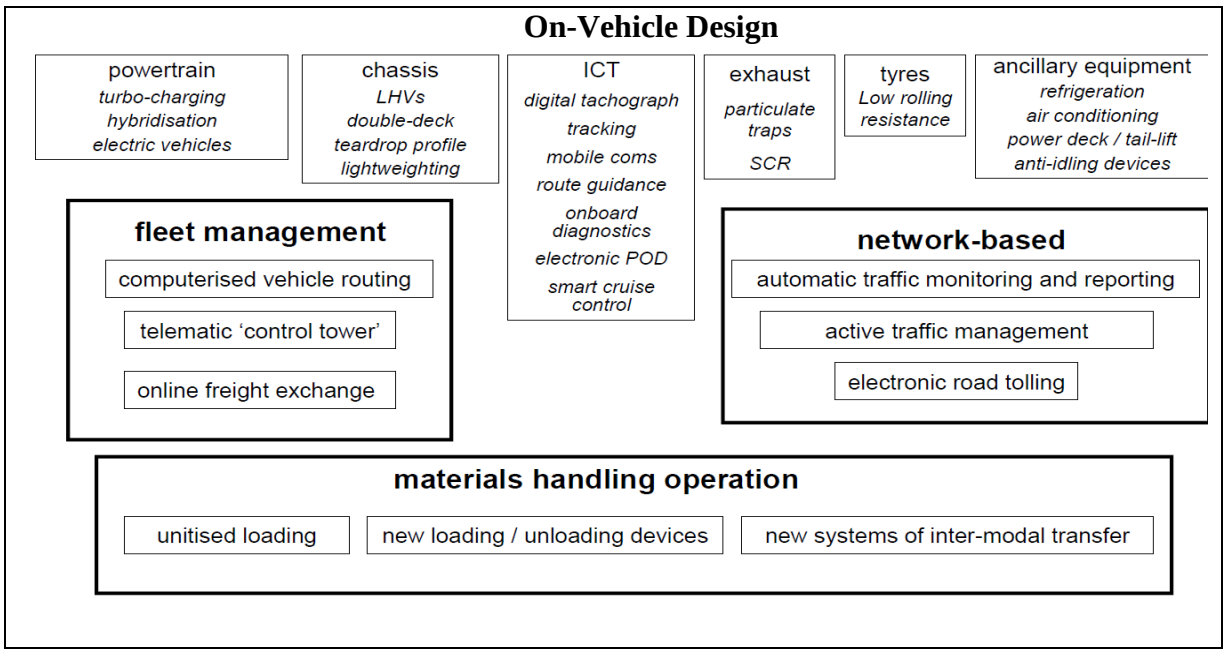

Figure 3.1. Classification of Road Freight Technologies

Source: Adapted from McKinnon (2009:4)

The technological innovations presented in Figure 3.1 are classified under road freight transport functional areas, i.e. on-vehicle related technologies, fleet management technologies, network-based technologies and materials handling technologies. For this study, ICTs, by virtue of their cross-cutting nature, are discussed jointly with fleet management and network-based technologies.

3.4.2.1 On-Vehicle technologies

On-vehicle technologies are those technologies that define how efficient the design of a vehicle is (McKinnon, 2009:4). On vehicle-technologies include power trains (relating to the engine and transmission system), chassis (relating to the shape and carrying capacity of the vehicle), ICTs (relating to on-board electronic devices), exhaust systems, tyres, and ancillary equipment such as refrigeration or liftable axles for raising or lowering loads. The primary function of most on-vehicle technologies is to reduce fuel consumption, which then translates into both economic and environmental benefits (Christensen *et al.,* 2010). In Africa, fuel costs represent between 38 and 80 percent of variable costs, followed by tyres, which average between 9 and 48 percent (Teravaninthorn & Raballand, 2009:69; Transport World Africa, 2013).

Exhaust systems, on the other hand, do not provide direct economic benefits. Exhaust system technologies are designed to complement fuel-efficient technologies by reducing harmful emissions and minimizing noise pollution (Lin, 2011). The adoption of these technologies is driven by atmospheric pollution prevention regulations, both at global and national level.

3.4.2.2 Fleet Management and Network Based Technologies: Intelligent Transport Systems (ITS)

The application of information communication technologies (ICT) to the transport and logistics sector is commonly referred to as intelligent transport systems (ITS) (Van Rooyen, 2010; Perego *et al.*, 2011). Intelligent transport systems include Global Positioning Systems (GPS), mobile communication systems, speed-measuring cameras, Radio-Frequency Identification (RFID) tags, online electronic data interchange (EDI) and motion detector sensors; and are used to integrate and share information among stakeholders in the industry (Ranaiefar, 2012). Over the past few years, ITS have experienced radical changes and are now integrated into application systems able to perform numerous road transport functions such as the monitoring of the location and condition of goods, routing and scheduling trips, monitoring driver behaviour, producing electronic proof of deliveries, measuring vehicle fuel consumption, producing reports and allowing for data exports to other applications. Advancement in network-based ITS, which in the past was mainly used by transport authorities, now allows transport operators access to information on road and traffic conditions for better planning (Fukui, Nishinari, Yokoya & Ishibashi, 2009).

Empirical results show that transport firms that adopt fleet management and network-based ITS are better able to reduce their traveling times and keep to their delivery schedules (Mirzabeiki, 2013). Efficient fleet utilization is linked to economic and environmental benefits, while the tracking ability provided by intelligent transport systems is also associated with improved safety and security of cargo, drivers and other road users (International Road Federation, 2008; Vanderschuren, 2008).

3.4.2.3 Materials Handling Technologies

Materials handling technologies are the means by which cargo is moved from one platform and offloaded onto another. The emergence of cargo unitization, which is defined by Christensen *et al.* (2010) as the combination of several pieces of individual cargo into a single unit, has transformed cargo handling from a manual function to a mechanized one. Unitization containers, pallets, intermediate bulk containers, flexi bags, safe slip-sheets, roll cases, fork lifts and cranes are all examples of material handling technologies (Ganapathi & Nandi, 2014). Along with ITS such as RFID sensors, materials handling technologies speed up the loading and offloading of cargo, in addition to facilitating border crossings (*ibid.*). As pointed out by FESARTA (2013), other benefits offered by materials handling technologies include the minimization of corruption incidences, damages and theft of goods.

Having presented the different types of technological innovations in the road freight transport industry, the next discussion focuses on the introduction and adoption of these technologies in Sub-Saharan Africa.

3.4.3 Introduction versus Adoption of Technological Innovation

Information on adoption patterns and exploitation of technological innovations by road freight transport operators in Sub-Saharan African markets is limited. In spite of this lack of academic attention, a website review of suppliers of road freight transport technologies revealed that the introduction of these technologies in Africa is on an increase. Most truck manufacturers, e.g. Nissan Trucks, Mercedes Benz, Scania, Volvo and Renault are continuously introducing new generation engines, ancillary technologies, new vehicle designs, and new ITS in the Sub-Saharan African market through their distributors (Transport World Africa, 2009; 2014). Newspapers and transport magazines have also kept records of the introductions of most technologies, with scant industry surveys that sometimes mention the use of ICTs.

Given the on-going introduction of road freight transport technological innovations into Africa and their benefits, it would be problematic to assume non-adoption in the region. Technological innovations ranging from modern hook lift trucks to sophisticated on-board ICTs are already a daily sight on African roads. But despite the positive signs of technological innovations in Africa, there is also evidence that adoption of some technologies in the industry is slow. For example, by 2008 only three countries (Namibia, Mozambique and South Africa) had installed weigh-in-motion technologies, while Kenya, Nigeria, Senegal, Tanzania, Angola and Botswana were still using portable scale surveys to estimate vehicle and axle weight statistics (Ackermann, Hechter & Louw, 2008). Similarly, the results of the *East Africa Logistics Performance Survey 2012* found that over 90 percent of shippers ranked ICT in the transport and logistics sector of that region as average to poor (Shippers Council of Eastern Africa, 2013:23). Not surprisingly, the results from the same survey showed that only 31 percent of shippers were able to track their goods using electronic cargo tracking systems. Thus, even though road freight transport technologies in the Sub-Saharan African market continue to advance, there appear to be barriers to effective adoption. These barriers are explored in the next section.

3.4.4 Factors Affecting the Adoption of Road Freight Transport Technological Innovations in Sub-Saharan Africa

Section 3.3 discussed internal organizational factors that affect the adoption of innovation in the road freight transport industry. The section focused on non-tangible internal resources (the focus of this research). This study is, however, mindful of the fact that tangible resources, particularly financial

resources, have an effect on the adoption of technological innovations in the industry (Christensen *et al.*, 2010). Most road freight transport operators in Africa, particularly small and medium enterprises (SMEs), do not have access to conventional bank loans to purchase new vehicles that are equipped with new technologies (UNCTAD, 2007). The majority of road freight transport operators rely on their cash flows or own savings to purchase both software and hardware equipment. In Southern Africa, for instance, only 7 percent of vehicles are financed with bank loans while the rest are either financed with company cash flows or personal savings (Teravaninthorn & Raballand, 2009:56). As a result, most transport operators in Sub-Saharan Africa buy second-hand vehicles, which often contain outdated technologies. While second-hand purchases are not uncommon in the industry, it can lead to obsolete technologies, as is the case in Côte d'Ivoire, where 15 percent of second-hand vehicles were more than 20 years old at the time of purchase (Nathan Associates, 2012).

While acknowledging the role of internal tangible and non-tangible factors in the adoption of technological innovations in the road freight transport industry, there are also several external factors that affect the adoption process.

3.4.4.1 The Role of Regulatory Institutions

There are several international, regional and local institutions that play a role in the adoption of technological innovation in Sub-Saharan Africa's road freight transport industry. At regulatory level, the adoption of road freight technologies is influenced by policies, rules and regulations which are developed and implemented by these institutions. From an international perspective, the adoption of technologies in Sub-Saharan Africa is influenced by institutions such as the International Road Federation, the International Road Transport Union, the International Transport Forum, United Nations agencies (i.e. United Nations Environment Programme and the World Health Organization), and other donor organizations. These institutions influence the adoption of technologies by funding initiatives that affirm or refute the use of certain transport technologies. Some of these initiatives, such as the IRF Vienna Manifesto on Intelligent Transport Systems, specifically target political decision-makers to acquaint them with different technologies (International Road Federation, 2012). Other initiatives, especially those run by governments, have directly introduced the adoption of technologies by donating technological equipment to African countries and by training personnel on how to operate and maintain the equipment (Zimbabwe Revenue Authority, 2013; GIZ CSP, 2014).

At regional level, sub-regional economic communities such as the East African Community (EAC), the Common Market for Eastern and Southern Africa (COMESA) and SADC have demonstrated the authority to influence the adoption of technological innovations in the industry. The EAC, for instance, has legislated the axle load limits for super single tyres in that region, and road transport firms operating in EAC member states are able to adopt new generation tyres with clarity (Curtis,

2014). In the COMESA and SADC regions, where the sub-regional economic communities do not have enacting power, influence on adoption of technological innovations is limited to policy recommendations to member states. This explains why load limits for super single tyres in SADC and COMESA member states are not legislated, leading to a delay in the adoption of this technology.

National-level institutions are involved in legislating and enforcing laws that impact the adoption of some technological innovations, especially those that have no direct or immediate economic benefits such as exhaust systems and liftable axles. Tanzania and Kenya, for instance, have banned vehicles containing the old liftable axle technology, because these can be lifted even while vehicles are overloaded, compelling road transport operators to switch to the new liftable axle technologies (Lwiza, Kilewo, Malisa & Kivuyo, 2013; Kenya Subsidiary Legislation, 2014). Similarly, individual countries, through their national road traffic, dictate the types of technologies that firms should adopt by specifying the types of systems and the fitting requirements for trucks.

3.4.4.2 Technological Infrastructure Support

Over the past 10 years, most technological innovations in the road freight transport industry have evolved, with few radically new technologies (McKinnon, 2009). Truck engines, for instance, are using less fuel, while their power has more than doubled over the past few years (Christensen *et al.*, 2010; Anon, 2012). But, while technology in the industry is improving, conditions for operators to switch from old to new technologies are not always favourable.

In Southern Africa, reports from the trucking industry have pointed out the quality of fuel as an obstacle to using new-generation engine trucks (*Inside Mining*, 2011). The varying quality of fuel in the sub-regions is a systemic challenge rooted in the fact that some refineries still use old technologies, thereby affecting the adoption process of clean/green driving technologies (ICF International, 2009; *Inside Mining*, 2011). On the positive side, the spread of information communication technologies and improved internet connectivity has provided favourable conditions for the adoption of intelligent transport services in some parts of the region.

3.4.4.3 Industry Pressure

Industry pressure in studies on innovation refers to the pressure from customers, suppliers, competitors and regulatory bodies to adopt innovation. Industry pressure plays a role in setting performance standards among firms and it can either be coercive or voluntary (Kuan & Chau, 2001). In Africa's road freight industry, coercive pressures - which Oliveira and Martins (2011:116) define as 'a set of formal or informal forces exerted on organizations by other organizations upon which the former organizations depend' - are common.

The implementation of the recent SADC-COMESA-EAC tripartite initiatives on vehicle load management, is an example brought about by industry pressure, in that administrative punitive measures were used to enforce conformity in the industry. The road transport management system in South Africa and Kenya's self-regulatory vehicle load control charter are also examples of formal industry pressures, where *certified* operators secure access to benefits that are not extended to *non-certified* operators (Nordengen, 2011; Curtis, 2014; Gibendi, 2014). In order to access the same benefits, firms that are not certified need to have specific performance standards in place, which may require them to adopt new technological innovations (Road Transport Management System, 2014; Kenya Subsidiary Legislation, 2014).

In the diffusion of innovation theory, voluntary informal industry pressure is best discussed by Rogers' (2003) 'relative advantage' and Moore and Benbasat's (1991) 'image' constructs of the epidemic model which however interesting, is beyond the scope of this research.

3.5 Summary of the Chapter

This chapter focused on issues affecting the development of innovation capability and the adoption of technological innovation in Africa's road freight transport industry. With regard to innovation capability, non-linear inputs of innovation (learning orientation, intra-organizational learning, attitudes towards risk, rewards systems, and strategy and leadership) were discussed in detail. The chapter found that learning remains a challenge, and that the industry is faced with a shortage of skilled personnel. Intra-organizational learning in firms is particularly constrained by the dispersed nature of core processes in the industry, which renders it difficult for management to provide adequate oversight.

Although taking risks in the road freight transport industry can be expensive and dangerous, controlled environments for experimentation are provided by suppliers of equipment and by some testing centres in the industry. The industry's overall rewards system, however, does not encourage creative thinking which often leads to experimenting with novel ideas. Compensation in the industry also remains poor, despite freight transport work being ranked among the jobs with the highest occupational health risks in Africa. The lack of adequate functional work resources, in terms of vehicles, human resources and other equipment, is a reflection of the industry's weakness in providing effective strategic innovative intent.

On the adoption side, the chapter found that suppliers of equipment have been introducing new technological innovations into the industry over the past few years. Available industry information shows that there is an uptake of technological innovation by road freight transport firms, although the diffusion pattern is slow due to both internal and external factors within the social system.

From the examples used in this chapter, it can be concluded that differences in innovation capacity of road freight transport industries exist between different sub-regions and different countries. Now that we have presented the context of the study and analysed the regional and sub-regional picture, the next chapter describes the methodology used in this study to explore the capacity of Namibia's road freight transport operators to competitively provide transport services in the economy, focusing on their innovation capability and their rate of technological innovation adoption.

CHAPTER FOUR: RESEARCH METHODOLOGY

4.1 Introduction

This study explored the innovation capacity of Namibia's road freight transport operators. Specifically, the study aimed to analyse Namibia's road freight transport operators' ability to develop inputs of innovation, and their ability to adopt technological innovations, which are necessary for providing competitive transport services. In Chapter 1, the theoretical perspectives which informed the methodology used in this study were presented, viz. the innovation capability theory and the diffusion of innovation theory.

Under the innovation capability theory, the non-linear innovation capability model is used because road freight transportation is a service industry, and competitiveness in service industries is achieved through process innovation, as opposed to product innovation (Damanpour & Wischnevsky, 2006). Recent studies on innovation (Martínez-Román *et al*., 2011; Yang, 2012; Saunila & Ukko, 2014; Saunila, Pekkola & Ukko, 2014) have demonstrated that non-linear inputs of innovation are better predictors of process innovation capacity than linear inputs because they measure the behavioural aspects of an organization, which is important for continuous improvement in service firms.

To analyse the adoption of technological innovation, the probit model of the diffusion of innovation theory was used because it accommodates exploration of the adoption of numerous innovations simultaneously (Diederen, Van Meijl, Wolters & Bijak, 2003). This also implies identification of determinants of innovation adoption.

Based on the theories discussed before, this chapter describes the methodology used to determine participants in the study, development of research instruments, data collection process, and ethical considerations. Figure 5.1 below shows a schematic diagram of the method used in the current study.

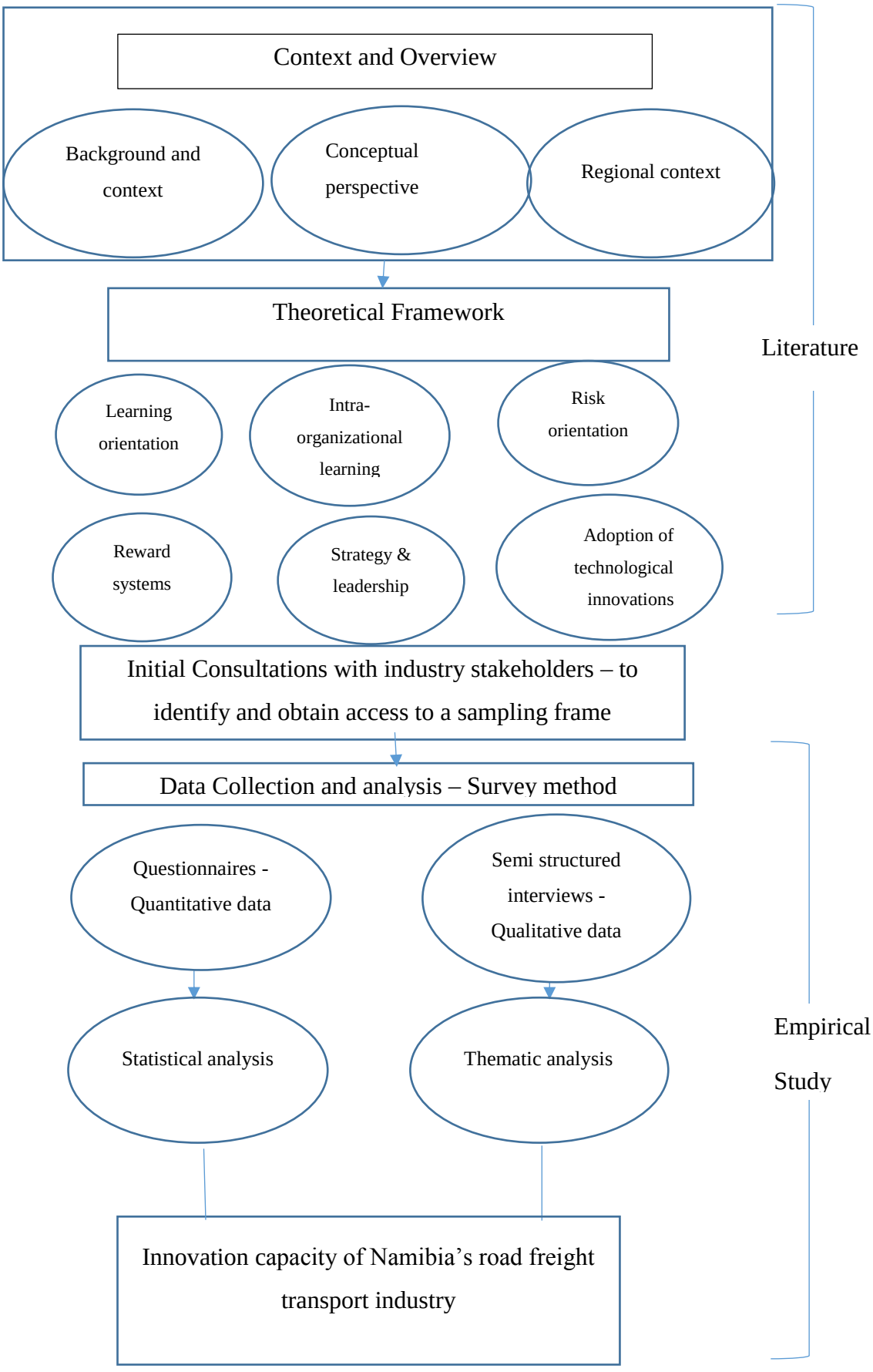

Figure 4.1 Overview of the research method used

4.2 Population of the Study

The population of this study comprises road freight transport operators in Namibia. The transport industry in Namibia does not have one central database containing all the operational road freight transport firms in the country, but there are institutions with either industry statistics or membership databases. For this reason, interviews with key role players in the industry to obtain details about the research population was necessary. These enquiries were conducted with the Statistics Division in the Ministry of Trade and Industry, which is responsible for enterprise statistics in Namibia; the Walvis Bay Corridor Group, which is a Public Private Partnership responsible for promoting the utilization of the country's corridor network by transport operators; the Polytechnic of Namibia's newly established Namibian-German Centre for Logistics, which provides education, training and research on logistics in Namibia and in the SADC region; the Namibia Logistics Association (NLA), which is an industry association that represents differently sized firms operating in road transport, freight forwarding, courier and customs clearance services; and the Namibia Transporters Association (NATA), which is also an industry association representing small and medium road transport firms in the country. From these enquiries, access was obtained to two databases which all industry role players agreed to contain the greatest number of road freight transport operators in the country: the NLA database and the NATA database. The population of this research is thus defined as road freight transport firms that were members of NLA and NATA at the end of March 2014.

4.3 Description of Participants

The Namibia Logistics Association database consists of 60 firms. There is a threefold-firm classification: the transport chamber, the freight expeditor chamber and the mixed chamber (transport and freight expeditors). This, according to Steenkamp (2014), is because most firms in the industry have a core business, but also fulfil other freight-related functions. After studying the database, four firms were excluded from the final participants list for the following reasons: one was a passenger service provider, the other an air freight courier service firm, and two were cargo owners that do not provide road freight transport services. On count, the final list from the NLA database stood at 56 firms: 27 transporters, 18 freight forwarders and 11 firms with mixed functions.

The database from the Namibia Transporters Association consisted of 11 small and micro road freight transport firms. All these firms met the criteria of being road freight transport operators and were included in the list. Hence, the study spanned 67 firms.

A total of 67 firms in a country's road freight transport industry could rightly be deemed inadequate, but compared to previous national studies, the number is satisfactory in the Namibian context. To illustrate, a 2007 study titled *Centralised Bargaining in Namibia's Road Transport Industry* reported

that there were 30 medium to large size transport companies in Namibia at the time (LaRRI, 2007:5). Similarly, the most recent *National Enterprise and Establishment Census for Namibia* by the Ministry of Trade and Industry (2009: 48) recorded 49 road freight transport establishments. Because of the relatively small population of the industry, no sample was drawn and all 67 firms were contacted to participate in the study.

4.4 Research Instrument and Measurement Quality

To answer the research questions: 1) What is the innovation capability of Namibia's road freight transport industry, 2) How does Namibia's road freight transport industry adopt innovations and, 3) How does the innovation capacity of Namibia's road freight transport industry affect its performance; this study used a mixed survey method for collecting both quantitative and qualitative data from industry operators. According to Maylor and Blackmon (2005:182), survey methods are useful ways of collecting 'facts, opinions, behaviours or attitudes' and can take the form of interviews, observations, or questionnaires. After a pilot study, this study – because of its exploratory nature – used a mixed-mode survey to collect data. In their book *Internet, Mail and Mixed-Mode Surveys*, which introduces four types of mixed-mode surveys, Dillman, Smyth and Christian (2009) state that survey studies are increasingly adopting the use of mixed-mode surveys to minimize errors that are inherent in single-mode surveys, viz. non-response errors, sampling errors and coverage errors. In spite of the advantages of mixed-mode surveys, Dillman and Messer (2010) have also acknowledged that the approach has measurement error limitations associated with respondents' varying reactions to questions posed under different modes and should be considered in model specifications.

This study used a questionnaire to collect data from the wider population, with follow-up semi structured interviews with some of the participants. The questionnaire design was informed by constructs extracted from the literature reviewed. Specifically, the current study used the non-linear constructs of innovation developed by Lawson and Samson (2001); Martensen *et al.* (2007); and Skarzynski and Gibson (2008) to measure innovation capability. These constructs were: commitment to learning, attitude towards risk, intra-organizational learning, reward system, and strategy and leadership. To measure the rate and determinants of adoption of innovation, the study used themes developed by Rogers (1962; 2003). Firm performance measures, i.e. sales, customer base growth, asset value and number of employees, were drawn from Community Innovation Survey

questionnaires[13], World Bank Enterprise Survey questionnaires and Namibia Business Investment Climate Survey (NamBIC) questionnaires.

In order to ensure that the instrument was relevant and applicable to the research, three approaches were used. Firstly, the study adopted appropriate measurement items from previous empirical studies that also employed constructs of non-linear inputs of innovation. To achieve this, 45 items (for measuring constructs of innovation capability) that are relevant to the current study and have a Cronbach's alpha value of 0.70 and above were identified from Calantone, Cavusgil and Zhao (2002); Martínez-Román *et al*. (2011); Yang (2012) and Saunila and Ukko (2014). In defining measures for the adoption of technological innovations in firms, the study used variables from the modified traditional diffusion model, as used in empirical research by Antonelli (1985); Van der Aa and Elfring (2002); Autant-Bernard (2010); Battisti and Stoneman (2010); and Lin and Chen (2012), namely, adoption patterns, firm characteristics and decision making process.

Secondly, to further develop the measurement items, questions were piloted with a panel of five members with background knowledge on innovation studies or transport and logistics. These included a faculty member at the Polytechnic of Namibia's Centre for Logistics, two relevant PhD candidates, the Operations Manager at NLA, and the Secretary General of NATA. The purpose of piloting the questions was, as Saris, Van der Velde and Gallhofer (2004) assert, to improve the formulation and the sequencing of the questions. The questions were then revised based on the inputs of the panel, and the construct measurement items were reduced to 34, with slight modifications so that common industry terminology could be used.

Lastly, a pilot study was conducted with five firms drawn from the study population. The aim of the pilot study was to determine the best mode of administering the questionnaire, and to find out if there are any difficulties in completing it. The questionnaire was sent by email with instructions for participation. Contact details for any queries were provided with the return email address. After a week, one response was received. A reminder was sent (by email) to the other four firms to complete and return the questionnaire. After the second week, one more questionnaire was received. Follow-up was then conducted telephonically at the beginning of week three. Two participants proposed to complete the survey by telephone, while one participant preferred not to participate, citing that there are too many surveys conducted and that these take much time with no benefits to participants.

[13] The Community Innovation Surveys are a series of surveys conducted at enterprise level to measure national innovation performance in EU countries (Eurostat, 2012).

Appointments to complete the questionnaires through telephonic interviews were immediately made, and both remaining questionnaires were completed in the third week.

Feedback from the pilot study showed that using a Likert-type scale for firm performance would increase response rate to this variable, as opposed to using real values. Some participants indicated that they could not use un-audited financial figures, while those with outsourced accounting functions preferred to leave the question blank than going through the process of obtaining actual figures from their accountants (incidentally, Likert-type scales were used for firm performance measures in all of the NamBIC Surveys).

Another important feedback from the pilot study was that participants said the qualitative questions in the questionnaire rendered it too lengthy to complete. Consequently, the research adopted two survey techniques: a mixed-mode questionnaire, followed by semi structured interviews.

4.4.1 Structure of the Research Questionnaire

The questionnaire consists of four sections used to capture general information, which could also be used to compile determinants for the adoption of innovation, absorption capacity, patterns in the adoption of innovation, and firm performance. The structure of the questionnaire is not based on themes or research questions; rather, the questions are sequenced according to logical flow. Thus some sections have questions that measure values for more than one research question.

Section A focused on demographic information, which were used to measure determinants of adoption of innovation (Questions 1-8). This section also contains questions related to firm performance measures, assessed on a Likert-type scale, ranging from strongly disagree to strongly agree (Questions 9-16). Questions on sources of new information under this section are also measured on a Likert-type scale, ranging from very unimportant to very important (Questions 17-28), followed by a ranking question (Question 29). Section B asked questions on the adoption of innovation. As indicated earlier, Namibia's road freight transport industry consists of firms with different primary functions, and the questions for Section B differ as follows. For the firms that are primarily transporters, Section B consists of questions that enquire about the adoption of:

- Lift axles or liftable axles: Lift axles are auxiliary technologies fitted on trucks. These axles are lowered to the ground to provide greater load-carrying capacity for heavier loads, or to comply with axle weight requirements, and raised when the truck is empty and/or carrying lighter loads that do not require greater carrying capacity (Green Truck Partnership, n.d.). Lift axles thus provide efficiency during times of empty running as well as during times of heavier loads, a situation that is associated with the one-directional freight traffic common in Namibia. As stated in the *Freight Best Practice* publication, "the facility to lift and retain a non-driven

axle clear of the ground when partially loaded can be economic in terms of both tyre life and fuel use" (UK Department of Transport, 2010:25).

- Satellite vehicle tracking systems: Satellite vehicle tracking systems are technologies that provide information on the location of vehicles. Vehicle tracking technologies use global positioning systems (GPS) and global system for mobile communication (GSM) (Ramani, Valarmathy, SuthanthiraVanitha, Selvaraju, Thiruppathi & Thangam, 2013). These systems are generally used to prevent theft and to retrieve stolen vehicles. The systems are easy to install and use.

- Fleet management system software: Fleet management systems is computer software that help users to collect, store, and process all information related to their fleet (Christensen *et al.*, 2010). Such a system differs from vehicle tracking systems in that, in addition to providing the location of the vehicle, it also performs a whole range of management functions such as fleet acquisition, fleet maintenance, fuel management, driver behaviour monitoring, and vehicle disposal (Ranaiefar, 2012).

For those firms that are primarily freight forwarders, the technological innovations assessed in Section B are:

- Radio-Frequency Identification (RFID): RFID is a technology used to identify and track cargo or inventory throughout the supply chain (Zhu, Mukhopadhyay & Kurata, 2012). Most researchers, such as Chang, Hung, Yen and Chen (2008) and Smart, Bunduchi and Gerst (2010), have generalized the use of RFID to the broader logistics function, while others, such as Brown and Russell (2007) have emphasized its use in the retail industry. Hoffman, Lusanga and Bhero (2013) focused on tracking items in containers to improve border crossing. The use of RFID among freight forwarders is not clearly defined, and the purpose of including RFID in this study is to explore its business case among freight forwarders in Namibia.

- Electronic Data Interchange (EDI): EDI is a technology used by firms to automatically share business information in a standard format, thus eliminating the exchange of data through physical documents (Hazen & Byrd, 2012). While EDI is common in many sectors today, the transport industry particularly depends on this technology because hauling goods requires more than just purchasing orders and invoices (Ganapathi & Nandi, 2014). Some of the documents shared between shippers and transporters through EDI include bills of lading, customs documents and acknowledgements of receipts (*ibid.*). EDI saves firms time and money which would otherwise be used in manually processing information and physically dispatching such documents (Ranaiefar, 2012).

- Automated System for Customs Data (ASYCUDA): ASYCUDA is an electronic data interchange technology for administering customs clearance processes (UNCTAD, 2011). Experience from countries using ASYCUDA has revealed that the system speeds up the clearance process and eliminates incidences of bribes, because all documents ("bills of lading, airway-bills, rail consignment notes, road transport documents and transit documents") are electronically processed and all due payments are made (United States International Trade Commission, 2012; UNCTAD, n.d.:1). This means that firms that are involved in clearing cargo no longer need to physically spend time at the ports of entry going from office to office. With ASYCUDA, firms can send and track all documents online, in addition to receiving alerts on the arrival and release of goods (Kigongo, 2014).

The technological innovations for this study are chosen based on Namibia's unique circumstances (i.e. long distances, and safety of cargo – especially when drivers cross to neighbouring countries where security threats are high); on consultations with the Polytechnic of Namibia's Centre for Logistics, who were in the process of conducting a study on the use of information communication systems in the wider logistics industry at the time; and on the outcomes of the pilot study.

To assess the rate of adoption of the above-stated innovations, dichotomous questions are used. In addition, adopter patterns are measured through a real value, namely the year of first use (Questions 30a – 30f).

Section C consists of questions on innovation capability (absorption capacity), assessing the non-linear inputs of innovation on a Likert-type scale ranging from strongly disagree to strongly agree (Questions 31- 52). The questions in Section D are open-ended, probing respondents about barriers to the adoption of technological innovation, and allowing them the opportunity to express themselves on any related issue in Other Comments (Questions 65a-c). The final question is only included for firms that are primarily in transport, and it asks if the respondent would be willing to participate in a follow-up semi structured interview. The reason for including this request only to the transport firms is to maintain the focus of the study on road freight transport innovations. The structure of the questionnaire is summarized in Table 4.1 below.

Table 4.1 Structure of the Questionnaire

	Research Question theme	**Variables/ Constructs**	**Item**
Section A	Adoption of innovations (Question 2)	Predictors of adoption of innovation / demographic information	2 - 8
	Firm performance (Question 3)	Sales	9 - 13
		Customer base	10-14
		Total assets value	11-15
		Number of employees	12-16
	Innovation capability (Question 1)	Sources of new information	17- 29
Section B	Adoption of innovations (Question 2)	Adoption rate	30a - c
		Adopter categories	30d - f
Section C	Innovation capability (Question 1)	Commitment to learning	31- 37
		Attitude towards risk	38 -44
		Reward system for innovation	45 - 51
		Strategy and organizational leadership	52 - 58
		Intra-organizational learning	59 - 64
Section D	Adoption of innovations (Question 2)	Qualitative - barriers to adoption of innovation	65a - c
		Willingness to participate in semi structured interviews	66

Source: Author

4.4.2 Semi Structured Interviews

The follow-up interview questions were semi structured, aimed at gaining detailed information on factors affecting the innovation process in firms. The questions differ slightly depending on whether the firm is an adopter or non-adopter of the assessed technological innovations. The development of these questions is particularly informed by the profitability consideration variable discussed by Stoneman (2002) and Battisti and Stoneman (2006), which is in line with the diffusion of innovation probit model.

The first question is asked to gain insight on the firm's operations. Questions 2 and 3 are aimed at understanding the decision process of acquiring and using technological innovations in the firm. Questions 4 to 6 enquire into one of the sources of innovative ideas that emerged from the initial survey under the category *Others*. This source is referred to by respondents as either *employees* or *own staff experience*. The reason for focusing on this category loops back to Chapter 3 where employees are referred to as tangible inputs of innovation, even though their ability to generate innovation is acknowledged as intangible. Question 7 probes reasons for non-adoption of innovation, while Question 8 enquires about labour relations associated with innovation success.

4.5 Data Collection

The study used the key informant approach, as discussed by Kumar, Stern and Anderson (1993), to collect data. This method is appropriate for exploratory studies seeking to collect data at organization level, and is achieved by identifying the most knowledgeable person in the firm (the person most familiar with the functional areas being studied) instead of working with multiple informants whose knowledge is confined to their respective functional areas and render high levels of non-responses in remaining areas (Calantone *et al.*, 2002; Yang, 2012).

Based on this approach, all remaining firms on the list were contacted telephonically to identify key informants. The contact numbers on the list were either of the owners or the directors of the firms. Discussions with the owners and directors then generated a list of email addresses and, in most cases, direct telephone numbers of key informants in the organizations. During this process, three (3) firms informed the researcher that they were not willing to participate in the study; one (1) firm had closed down; and one (1) was unreachable.

In the end, the questionnaires were emailed to key informants spanning 61 firms. During that week, calls were made to all firms to alert them that the questionnaire had been sent and to request them to complete it. Two weeks afterwards, follow-ups were conducted telephonically to inform firms that they could also choose to complete the questionnaires by telephone. Appointments were arranged with those who chose the telephone interview mode. The reason for not giving the respondents both modes of completing the questionnaire at once was informed by experiences from previous studies on survey coverage limitations. For example, Smyth, Dillman, Christian and O'Neill (2010) demonstrated that giving respondents options to different modes in a sequence yields higher rates of response than providing all mode options (at once). According to Dillman and Messer (2010), this is because the telephone interview is a more intensive mode than e-mail. The survey was open to respondents until two months and three weeks after the time of sending out the questionnaires.

From the responses, 14 firms agreed to participate in semi structured interviews, although only 9 were available for the actual interviews. The diffusion of innovation probit model does not require a representative sample of the industry, because the approach is based on the premise that decisions to adopt innovations are firm-specific, and that results are not generalizable to the population but rather to theory (Autant-Bernard, 2010; Battisti & Stoneman, 2010). Therefore, 9 firms are sufficient to understand some of the factors affecting the adoption of innovation.

The interview questions were laid out in a form of a questionnaire consisting of closed and open ended questions. The interviewer took notes during the interviews and before the end of each interview, these notes were read back to the interviewee. Elaborate field memos were produced

immediately thereafter, as suggested by Silverman (2006). The interviews each lasted between 45 minutes to an hour and 15 minutes.

4.6 Limitations of the Research Method

The method used in this study, like most methods comes with criticism. Firstly, data collected under a cross sectional survey study does not always allow for analysis of causal sequence between variables (Bryman & Bell, 2011). This means that in this study, the data collected will not determine the ongoing interaction feedback effects between innovation capabilities, adoption of technological innovation and performance. Instead the data is used for analysis of associations (relationships) between variables.

Secondly, data collected through survey studies may not provide in-depth details which is better obtained through observations. This is especially true in the case of observing behavioural non-linear inputs of innovation.

The last inherent limitation in the selected method is the use of key informant. Using key informants provides information from an individual's perspective which according to (Kumar *et al*., 1993: 1634), may 'suffer from individual memory failure' or 'inaccurate recalling of past events'.

4.7 Ethical Considerations

Before engaging with any participants in the study, permission was obtained from the Namibia Logistics Association and the Namibia Transporters Association. A confidentiality agreement was signed with the Namibia Logistics Association as per their requirement, while the Namibia Transporters Association only provided a letter of permission. Thereafter, access to the databases was granted.

In addition to industry access, the University of Stellenbosch's Research Ethics Committee and the Departmental Ethics Screening Committee granted the researcher permission to proceed with the study. Participants were informed that participation is voluntary and that they are free to omit questions they feel uncomfortable with. Participants were further assured that information would only be reported at aggregate level, and that no references would be linked to individual firms.

4.8 Summary of the Chapter

This chapter has presented an account of the method used in this study. The chapter started by emphasizing the theoretical perspectives informing the design of the study, namely the innovation capability and the diffusion of innovation theories. As an exploratory research aimed at assessing firms' innovation absorption capacities and their adoption of innovation, a mixed-mode survey

method was used. The research population comprised road freight transport firms that were members of the Namibia Logistics Association and the Namibia Transporters Association.

The research employed variables from previous empirical studies on non-linear innovation capability and probit innovation adoption models. Questionnaires were used to collect data from study participants, as well as follow-up semi structured interviews to obtain in-depth information on the uptake of technological innovations. The next chapter describes the data analysis process, followed by the presentation and discussion of the results.

CHAPTER FIVE: DATA ANALYSIS AND RESULTS

5.1 Introduction

The previous chapter discussed the methodology used to collect data on the innovation capability, adoption of technological innovation and firm performance among Namibia's road freight transport operators. This chapter presents the collected data. The chapter starts by presenting the responses received before describing how the data was prepared for analysis, as well as the types of analysis conducted. The results are subsequently presented.

5.2 Response Rate

As indicated in Chapter 4, data was collected in two separate stages. The first stage was the collection of quantitative data through questionnaires, while the second stage consisted of semi structured interviews with firms that were willing to participate.

In the first month of the first stage, seven self-administered responses were received from the firms, which represent 11.48 percent of the sample. In the second month, three more self-administered questionnaires were received. This brought the self-administered questionnaires to a total of 10, which represent 16.40 percent of the sample. Questionnaires were either received by e-mail or physically collected by the researcher.

As outlined earlier, a mixed mode method was used to collect data in the first stage, as suggested in Dillman *et al*. (2009) and Dillman and Messer (2010), to increase the response rate. This is because of the small size of the industry and a low response rate would restrict the study from drawing meaningful statistical inferences. Using the second mode, i.e. telephone interviews, an additional 34 responses were received. Previous studies on innovation at firm level have experienced a response rate of between 38 and 47 percent from using one mode of data collection (see for example Calantone *et al*., 2002 and Yang, 2012); with data from Finnish firms showing lower response rates (between 7.8 and 13 percent).

After the data collection process, the questionnaires were screened to ensure that only those with sufficient demographic data and a majority of completed questions were considered for analysis. The results are presented in Table 5.1 below.

Table 5.1 Response Rate

	Number of Firms	**Percentage (%)**
Total sample population	64	100
Self-administered questionnaires	10	15.62
Telephone-administered questionnaires	34	53.12
Total questionnaires received	44	68.75
Incomplete questionnaires	3	4.68
Usable questionnaires (response rate)	41	64.06

The second stage of data collection was the nine semi structured interviews, which were conducted over a period of 5 weeks.

5.3 Data Processing

The present investigation used the Statistical Package for the Social Sciences (SPSS 22.0) to enter data from the questionnaires and conduct both descriptive and inferential statistical analysis. SPSS was used because it provides analysis on large number of variables, and can test if any statistical assumptions are violated. Most questions in the instrument were pre-coded while in development. However, some questions (such as the respondent's position in the firm, and the location of company headquarters) were only coded after the responses were received. The data was coded as described below.

In Section A, company name is a string variable and is only for administrative purposes. Variable 2, the year of establishment, is a scale variable and is not coded. Variable 3, which is town or settlement, is given codes between 1 and 15 to represent Namibia's 14 administrative regions, while also accommodating firms that operate from more than one region. Variable 4, which was coded after the data was received, is coded from 1 to 3 as follows: 1 = Namibia, 2 = South Africa, and 3 = Europe. Variable 5 is the position of the respondent and is coded as follows: 1 = Owner/Managing Directors/CEO, 2 = Senior Manager, and 3 = Supervisory roles and technical positions. Variable 6 and 7 are scale variables and are not coded. Variable 8 is firm incorporation and is coded from 1 to 7 as follows: 1 = Sole Proprietorship, 2 = Partnership/Joint Venture, 3 = Closed Corporation, 4 = Private Company, 5 = Public Company, 6 = Branch of Foreign Company, and 7 = Other. Variables 9 to 16

are measured on a Likert-type scale and their codes range from 1 = strongly disagree to 5 = strongly agree. Variables 17 to 28 are also measured on a Likert-type scale, ranging from 1 = very unimportant to 5 = very important. Variable 29 is divided into three sub-variables ranking sources of new ideas from most important (Variable 29a), second most important (Variable 29b) and third most important (Variable 29c). These sub-variables are coded from 1 to 13 to reflect the sources of new information under Variables 17 to 24. Code 12 was developed after responses were received and it is for employees of the firm. Variable 30 also has sub-variables. The first three sub-variables (30a, 30b and 30c) are categorical measures and are coded as: 1 = yes and 2 = no. The second sub-variable is a scale measure for the year that a corresponding technological innovation was adopted. Variables 31 to 64 are all ordinal measures and are coded from 1 = strongly disagree to 5 = strongly agree. Variable 65 is a qualitative question asking for barriers to adoption, and is not entered in SPSS. Variable 66 is only for firms that are primarily in freight transport, and is coded as follows: 1 = yes, 2 = no, and 3 = not applicable. The not applicable label is for freight expeditor firms. For all missing data, a discrete code 99 was used.

After all the data was entered, variables 37, 43, 44, 51, 57, 58, 63 and 64 were reverse coded, as they were reverse scored in order to engage respondents (Bryman & Bell, 2011). Other variables that were recoded are the year of establishment and the number of permanent employees. These two variables were recoded from scale to categorical variables as follows:

Age of firm: The year of establishment of firms ranges from 2014 for the youngest firm to 1920 for the oldest firm. The following codes and categories were developed: 1 = 2011 to 2014 (less than or equal to three years); 2 = 2001 to 2010 (4-13 years); 3 = 1990 to 2000 (14-24 years) and 4 = 1989 to the oldest firm (25 years and older). The significance of having a category for 1989 and older is because Namibia achieved independence in 1990, and the data can be analysed to determine if there is a difference in innovation capacity between firms that were established before and after independence. There are two ten-year intervals in the categories. The first ten-year category (1990 to 2000) represents the first ten years after independence, and before Namibia's road transport sector reform. The second ten-year category (2001 to 2010) represents firms established in the first ten-year period after the road transport sector reform. This is then followed by the youngest firms in the remaining period (2011 to 2014).

Size of firm: There are no universal values for defining the size of a firm in Namibia. Several operational definitions are used for different purposes. For instance, financial institutions (commercial and development banks) use different numbers of employees and annual turnover to determine the size of the loans they lend to firms. Most studies in Namibia have used number of employees to categorize firm size. A study by Sherborne (2012:38) defined medium sized firms as

firms that employ between 10 and 100 people. Studies that have used international criteria to define firm sizes in Namibia, i.e. Walvis Bay Corridor Group (2013a:36), which used the equivalent of a 250 000 Euro turnover and an asset base of 800 000 Euro as their definition for SMEs, found that most of the firms meeting those criteria were considered large in Namibia. As a result, most studies develop their own operational definitions, which remain closely linked to the now outdated 1997 SME policy for Namibia, which is currently under review by the Ministry of Industrialization, Trade and SME Development (2015). For this study, firm size is defined using number of employees as follows: 1 = 1 to 5 employees (micro firm); 2 = 6 to 25 employees (small firm); 3 = 26 to 100 employees (medium firm); and 4 = 101 or more employees (large firm).

5.4 Internal Reliability Test

Internal reliability of data is the degree to which a measure produces consistent results. The purpose of carrying out a reliability test is to ensure that the items under each construct are measuring their respective constructs. For this study, measures of reliability were conducted at two levels. At the first level, an internal consistency reliability test of items 31 to 64 was carried out to determine how well they measure their respective constructs. Item 55 was exempted from this test because it is not part of any latent variables and is analysed separately. Coefficient alpha levels of > 0.70 were used to assess the reliability of the data, as outlined in Hair, Money, Samouel and Page (2007:244) and as evidenced in several studies on innovation at firm level. The items on all constructs in the study are positively correlated, with item 48 showing the lowest correlation at 0.18. All five constructs have composite coefficient alpha values ranging between 0.705996 and 0.855090, as illustrated in Table 5.2 below. The total innovation capability alpha coefficient is 0.833319.

Table 5.2 Internal Reliability

	Item total correlation (Range)	**Cronbach's alpha**
Learning	0.31 – 0.77	0.787744
Risk attitude	0.48 – 0.74	0.855090
Rewards	0.18 – 0.69	0.751254
Leadership and strategy	0.26 – 0.58	0.705996
Intra-organizational learning	0.30-0.73	0.796219
Total innovation capability		**0.833319**

The second level of ensuring reliability of the data was achieved by reading back the notes to interviewees and by expanding them into full field memos immediately after each interview.

5.5 Descriptive Data Analysis

5.5.1 Firm Demographic Data

Section A of the questionnaire captured the general demographic information of the firms that participated in the study. The types of demographic data captured included age of firm, size of firm, firm incorporation, and other measures such as whether the firm is a transporter or freight expeditor from the Namibia Logistics Association, or from the Namibia Transporters Association, and so forth. The results, illustrated in Table 5.3, show that the sample contains few firms (seven, or 17.1 percent) that are three years old or younger. The sample also contained the same number of firms (seven, or 17.1 percent) that were established immediately after independence. Approximately seventeen (41.5 percent) of the sample comprises of firms established in the first 10 years after the road sector reform, and ten (24.4 percent) before independence. The cumulative distribution of the sample is consistent with the Ministry of Works and Transport (2002a, b), which points out that most road freight transport service providers entered the industry from 1999 following the road transport sector reform. The two oldest firms were established in the 1920s, while the youngest firm was established in 2014. This negatively skewed age distribution, observed in the data, can be explained in part by the apartheid policy that regulated the road transport system before 1990. There was also limited reform in the industry during the first ten years of independence.

Table 5.3 Demographic Information of Participating Firms

	Frequency	Percentage
Firm Age		
2011-2013 (≤ 3 years	7	17.1
2001-2010 (4 to 13 years)	17	41.5
1990 -2000 (14 to 24 years)	7	17.1
1989 – 1920 (≥25 years)	10	24
Size of Firm		
Micro (1-5 employees)	8	19.5
Small (6-25 employees)	14	34.1
Medium (26 - 100 employees)	11	26.8
Large (101 or more employees)	8	19.5
Industry Category		
NLA Transporters	24	58.5
NLA Freight Expeditors	11	26.8
NATA Transporters	6	14.6
Position of Respondents		
Owners, Managing Directors, CEOs	18	43.9
Senior Managers	19	46.3
Supervisory and Technical positions	4	9.8
Firm incorporation		
Closed Corporation	19	46.3
Private Company (Pty) Ltd	22	53.7

The results also show that majority of the firms in the sample are either small (26.8 percent) or medium (34.1 percent), with micro and large size firms each accounting for 19.5 percent. This distribution is comparable to the World Bank study findings which, using the international definition[14], reported that Namibia's road freight transport industry consists of small enterprises, with a handful of medium sized firms (World Bank, 2012).

The majority of the firms (58.5 percent) in the sample are transporters who are members of the Namibia Logistics Association, followed by freight expeditors at 26.6 percent. The overall sample is fairly well distributed across the industry categories. It should be noted that while the Namibia

[14] Using employment figures, the World Bank defines micro enterprises as those firms that employ 1-10 people; small firms 11-49 people; medium 50-200, and large firms more than 200. However, the World Bank uses this indicator together with either the firm's value of assets or its annual turnover (Bank of Namibia, 2010).

Transporters Association was formed to represent the interests of smaller road freight transport firms in the industry, the data reveals that there are still micro and small firms that are members of NLA.

Firms in Namibia are registered under six common forms of incorporation as follows: sole proprietorship, partnership/joint venture, closed corporation, private company, public company, and branch of foreign company (Office of the Prime Minister, 2004). The sample of this study, as indicated in the results above, comprises (only) two forms of these firm incorporations, namely closed corporations (46.3 percent) and private companies (53.7 percent). The sample distribution of types of firm incorporation is not much different from the general business population in Namibia. Sherbourne (2012) asserts that closed corporations are common in Namibia because they are simpler and less expensive to establish, and they limit members from firm liabilities. When a firm outgrows its closed corporation status, the next least complicated form of incorporation is the private company; thus the two forms of incorporation (*ibid*).

The NLA and NATA lists that were used in this study have fairly executive representatives listed as contact people for their firms - most of them owners, co-owners, chief executive officers and managing directors. While some agreed to be key informants for this study, others designated senior officials to participate. As the results show in Table 5.3, out of the 41 participants, 18 (43.9 percent) of the respondents are either owners, managing directors or Chief Executive Officers (CEOs) while 19 (46.3 percent) are senior managers. Using senior positions as key informants at firm level has advantages in that these employees have a better view of the different functions across the firm. However, executive officials can also provide biased information because they are not always involved in the daily task execution.

5.5.2 Analysis of Interview Questions

As indicated in Section 6.2, the researcher conducted nine semi structured interviews for this research. The aim of the interviews was to gain detailed information on how the actions of firms influence the innovation process. The study used a thematic analysis method to synthesize the data by applying the Noticing, Collecting and Thinking 'NCT' model introduced by Seidel (1998) and further developed by Friese (2014).

The reason for using the thematic NCT model is twofold. Firstly, the number of firms that participated in the interviews is small, and quantifying their responses is likely to be unrepresentative of the population. Instead, this approach allows the study to provide meaning to the actions described. Secondly, the thematic NCT approach can be applied using both manual and computerized coding system, allowing for flexibility of analysis between large and small amounts of data.

Question 65 asked about barriers for adopting different technological innovations. All responses were collected and grouped under their respective technological innovations. Thereafter, responses were read for a number of times before they were coded. The first coding was done for each technological innovation and the second level of coding was done for all technological innovations to extract themes that were common across all technological innovations, while maintaining those unique to specific innovations.

For interview questions, responses for each individual firm were first read within their context before they were pre-coded. Thereafter, responses were grouped for each question and a second level of coding was undertaken. This enabled the researcher to observe themes and patterns that were emerging from the data. Below, in Figure 5.1, is a distinction between the thematic analysis method, which qualifies qualitative data, and the content analysis method, which quantifies qualitative data.

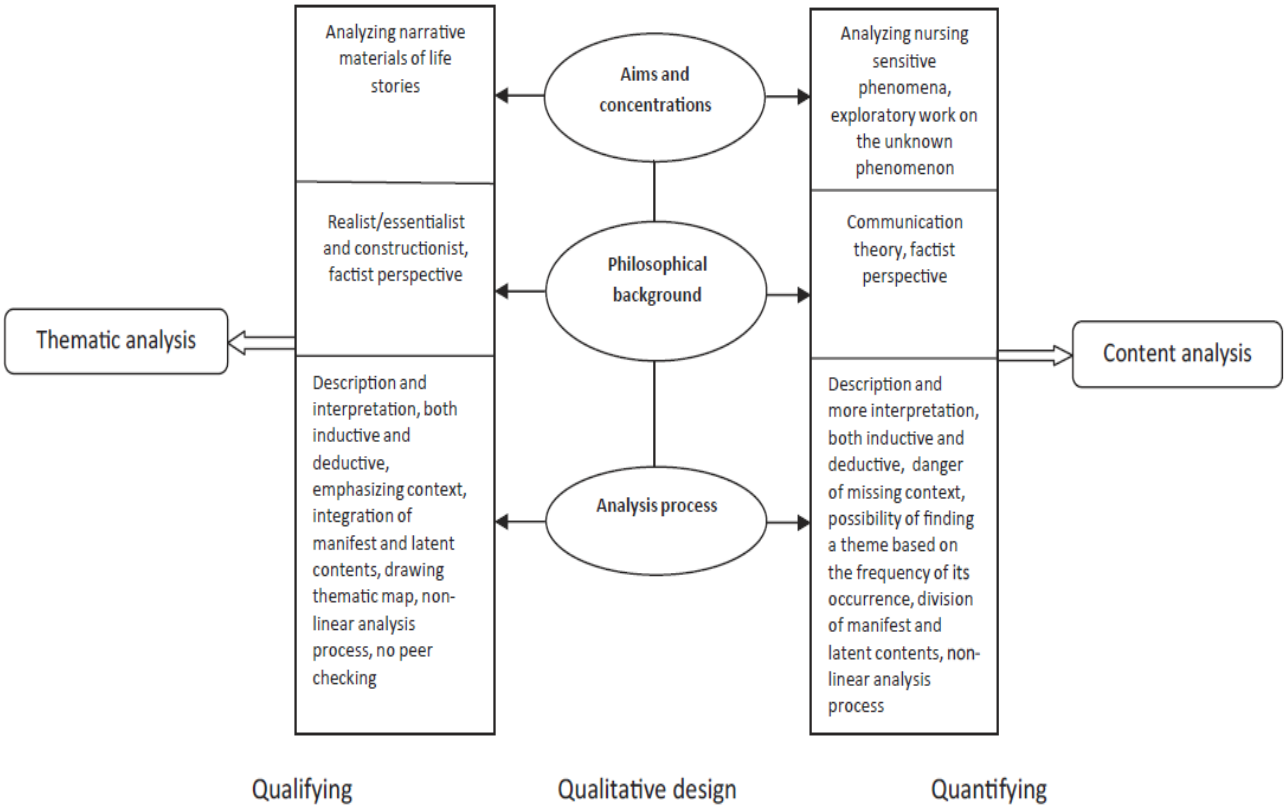

Figure 5.1 Characteristics of Thematic Analysis and Qualitative Content Analysis
Source: Vaismoradi, Turunen and Bondas (2013:399)

5.5.3 Descriptive Analysis of Firms Participating in Semi Structured Interviews

The interviewee firms are made up of two micro size firms, four small, two medium and one large. The large and medium firms have different types of trucks for carrying different types of goods, e.g. trucks that provide cold storage for temperature-sensitive goods, flat beds for transporting

construction material, and containers and tankers for transporting fuel and oil. Smaller and micro firms tend to specialize their service around a major off-taker client, e.g. brewery, hardware and construction material traders, livestock producers, and major retailers. Small and micro firms, which also include owner-operators tend to work with medium and large firms for loads during peak seasons. This description is consistent with Walvis Bay Corridor Group's (2013a) and Andruskiewicz, Murray, Sarber and Sharpe (2012).

5.5.4 Sources of New Ideas

To answer the first research question, namely *What is the innovation capability of Namibia's road freight transport industry?*, two types of information were collected: external sources of new ideas for road freight transport service providers, and organizational behaviours with regard to learning, rewards, attitude towards risk, intra-organizational learning, and leadership and strategy. The first set of information was analysed using mean scores to identify how important different external sources of new ideas in the industry are. As shown in Table 5.4, customers[15] are ranked as the highest source of new ideas at 4.90, followed by suppliers of technological innovations at 4.59, and competitors at 4.37.

Table 5.4 Sources of New Ideas

	Mean Scores
Customers/Clients	4.90
Suppliers of equipment, materials, components or software	4.59
Competitors/other transport and logistics firms in the industry	4.37
Financial Institutions	4.33
Government Ministries, Municipalities, Town Councils	3.98
Professional and Industry Associations (NLA, NATA, NCCO, etc.)	3.88
Family	3.78
Walvis Bay Corridor Group	3.56
Conferences	3.46
Universities/Polytechnic, and other higher education institutions	3.44
Consultants	3.10

[15] Customers or clients of road freight transport firms are owners of goods and include manufacturers, wholesalers, retailers and consumers.

This information is supplemented with a ranking question (Question 29), which is used to identify the three most important external sources of new ideas in the industry. The results confirm that customers are the most important source of new ideas, followed by suppliers of equipment in second position. The category *Others*, which is largely made up of employees, is ranked the third most important source of new ideas. All three of these sources are from the private sector. Institutions from the public sector and academia are ranked lower, with mean scores of 3.9 and below.

Even though this question sought to investigate external sources of new ideas, the introduction of an internal source under the category *Others*, which respondents referred to as *own experience*, *own staff* or *employees*, prompted the researcher to investigate this category deeper. The detailed results of this source of innovation are discussed in Section 6.6.4.3.

5.6 Inferential Analysis

5.6.1 Measuring Innovation Capability

In this study, organizational behavioural information on innovation capability, also known as inputs of innovation, are measured using multiple techniques. Firstly, the study computed and analysed the sum of scores of constructs of innovation capability, i.e. commitment to learning, attitude towards risk, reward systems, intra-organizational learning, and strategy and leadership. This was done using the answers from Questions 31 to 64, which was provided on a Likert-type scale[16]. The sums of scores are expressed as percentages.

Secondly, to establish the differences in the level of innovation capabilities between different age groups, size and legal status, the study computed mean scores for the constructs and carried out Analysis of Variances (ANOVA) and a t-tests. Chi-square tests were also used to investigate associations between selected variables suggested in the reviewed literature.

5.6.1.1 Level of Innovation Capability in Firms

As described above, the level of innovation capability in firms is measured using the sum of scores, expressed as percentages. Overall, the results show that most respondents have high levels of innovation capability. None of the firms that participated in the study scored below 50 percent on any construct. Over half of the firms scored on average between 71 and 90 percent on all constructs. The constructs that have the most firms scoring below 70 percent are rewards for innovation (9 out of 41)

[16] The answers to Question 55 were excluded in all analysis at construct level.

and risk attitude (7 out of 41). A considerable number of firms scored over 90 percent on some constructs, e.g. commitment to learning (14 out of 41) and risk attitude (10 out of 41).

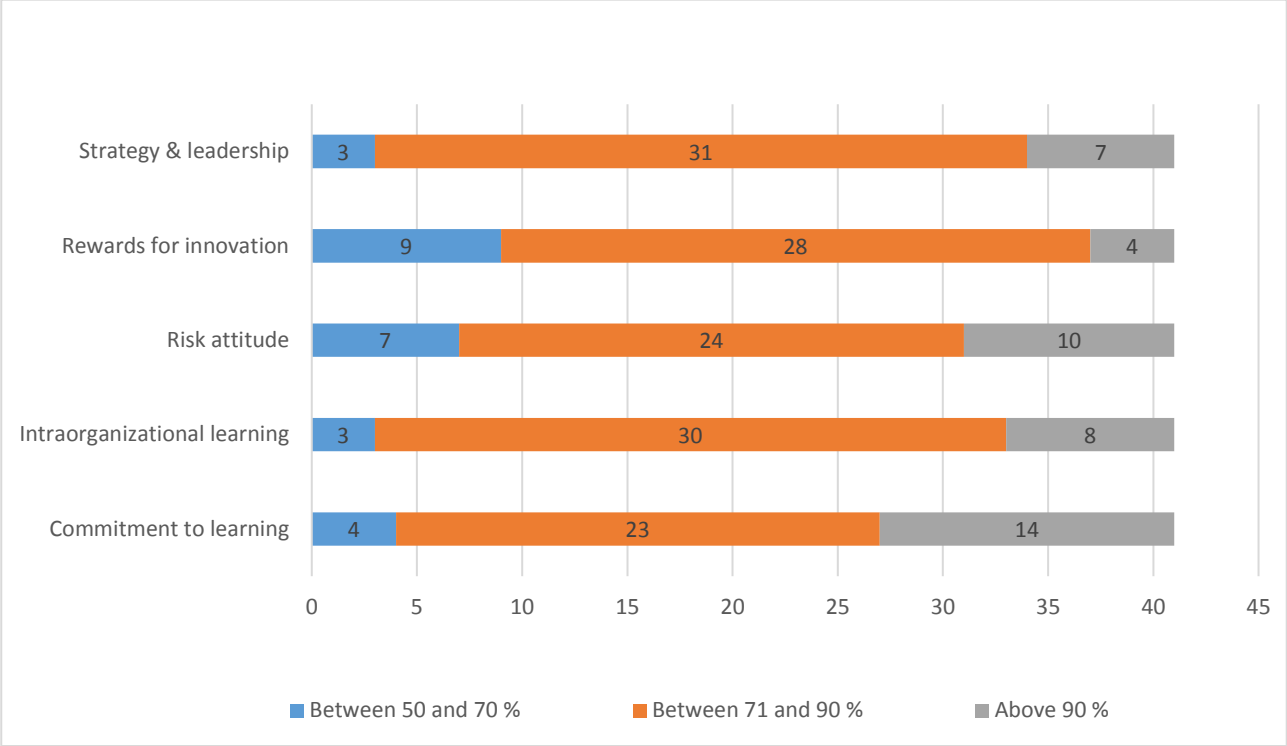

Figure 5.2 Level of Innovation Capability (%)

While the level of innovation capability appears to be high across the industry, an ANOVA test was performed to determine if this level differs between firms of different sizes and ages, while a t-test was used for firm incorporations. The ANOVA results show that although the between-group level of innovation capability is not significantly different among firms of different size categories (p=062>0.05) and age categories (p=0.174>0.05), when compared to each group through the LSD post hoc analysis, significant differences are observed between micro and medium size firms at p=0.031<0.05, and between micro and large firms at p=0.048<0.05 (see Table 5.5).

Table 5.5 Level of Innovation Capability and Size of Firm – Multiple Comparisons

LSD

(I) Size of the firm	(J) Size of the firm	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Micro	Small	-.09666	.16114	.552	-.4232	.2298
	Medium	-.37982*	.16894	.031	-.7221	-.0375
	Large	-.37121*	.18179	.048	-.7396	-.0029
Small	Micro	.09666	.16114	.552	-.2298	.4232
	Medium	-.28316	.14649	.061	-.5800	.0137
	Large	-.27455	.16114	.097	-.6011	.0520
Medium	Micro	.37982*	.16894	.031	.0375	.7221
	Small	.28316	.14649	.061	-.0137	.5800
	Large	.00861	.16894	.960	-.3337	.3509
Large	Micro	.37121*	.18179	.048	.0029	.7396
	Small	.27455	.16114	.097	-.0520	.6011
	Medium	-.00861	.16894	.960	-.3509	.3337

*. The mean difference is significant at the 0.05 level.

A similar multiple comparison between groups of different ages, shown in Table 5.6, also indicates a significantly high level of innovation capability ($p=0.045<0.05$) between firms that are 25 years or older and firms between the ages of 4 and 13.

Table 5.6 Level of Innovation Capability and Age of Firm – Multiple Comparisons

LSD

(I) Firm Age	(J) Firm Age	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Less than or equal 3	Between 4 and 13	-.01970	.16851	.908	-.3611	.3217
	Between 14 and 24	-.17749	.20057	.382	-.5839	.2289
	More than or equal 25	-.33074	.18492	.082	-.7054	.0439
Between 4 and 13	Less than or equal 3	.01970	.16851	.908	-.3217	.3611
	Between 14 and 24	-.15779	.16851	.355	-.4992	.1836
	More than or equal 25	-.31104*	.14954	.045	-.6140	-.0080
Between 14 and 24	Less than or equal 3	.17749	.20057	.382	-.2289	.5839
	Between 4 and 13	.15779	.16851	.355	-.1836	.4992
	More than or equal 25	-.15325	.18492	.413	-.5279	.2214
More than or equal 25	Less than or equal 3	.33074	.18492	.082	-.0439	.7054
	Between 4 and 13	.31104*	.14954	.045	.0080	.6140
	Between 14 and 24	.15325	.18492	.413	-.2214	.5279

*. The mean difference is significant at the 0.05 level.

Another observation made is on firm incorporations, where the results show that private companies have a statistically significant higher level of innovation capability than closed corporations at $t_{39}=-2.736, p=0.009<0.01$ (see Table A.3.1 under Annex 3).

Having established the integrative level of innovation capability in the road freight transport industry, the next sections explores if the level of different constructs of innovation capability, i.e. learning, intra-organizational learning, risk attitude, rewards and strategy and leadership differ among firms.

5.6.1.2 Level of Learning

In determining the differences in the level of commitment to learning, mean scores for Questions 31 to Question 37 were computed and analysed. The results reveal a high mean value for medium size firms at 4.4935, followed by large firms at 4.3750. Micro enterprises have the lowest mean value at 4.000, while small enterprises scored a mean value of 4.0918. The observation in the mean values is confirmed with Levine's test of homogeneity, which shows that there are differences in the level of commitment to learning between different sizes of firms at p=0.840>0.05. Using the one-way analysis of variance, the differences between groups show no significance at p=0.08>0.05. However, when compared to each group, the results of the LSD post hoc analysis (Table 5.7) reveal significant differences in the levels of commitment to learning between the medium sized firms and the micro sized firms at p=0.033<0.05, and between the medium sized firms and the small size firms at p=0.044<0.05. This indicates that medium sized firms learn significantly better than micro and small enterprises. The results also indicate that there is no significant difference in the level of learning between the different remaining firms, and between large firms and micro or small sized firms.

Table 5.7 Commitment to Learning and Size of Firm

LSD

(I) Size of the firm	(J) Size of the firm	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Micro	Small	-.09184	.21225	.668	-.5219	.3382
	Medium	-.49351*	.22253	.033	-.9444	-.0426
	Large	-.37500	.23945	.126	-.8602	.1102
Small	Micro	.09184	.21225	.668	-.3382	.5219
	Medium	-.40167*	.19296	.044	-.7926	-.0107
	Large	-.28316	.21225	.190	-.7132	.1469
Medium	Micro	.49351*	.22253	.033	.0426	.9444
	Small	.40167*	.19296	.044	.0107	.7926
	Large	.11851	.22253	.598	-.3324	.5694
Large	Micro	.37500	.23945	.126	-.1102	.8602
	Small	.28316	.21225	.190	-.1469	.7132
	Medium	-.11851	.22253	.598	-.5694	.3324

*. The mean difference is significant at the 0.05 level.

When examined among firms of different age categories (as shown in Table 5.8 below), the differences between the mean values of enterprises that are 25 years or older (4.4429) and those that

are between 14 – and 24 years old (4. 3673) appear smaller compared to the other two age groups. The firms that are less than 3 years old have the least mean value at 4.0612, while the 4 to 13 years old firms have a mean value of 4.1345. As demonstrated using Levine's test of homogeneity, the level of learning in the industry differs between firm age groups at p=0.558>=0.05. However, both the ANOVA results (p=0.302>=0.05) and the LSD post hoc test show that none of the differences observed among different age groups is significant. These results suggest that commitment to learning in Namibia's road freight transport industry is not determined by the age of the firm.

Table 5.8 Commitment to Learning and Age of Firm

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Less than or equal 3	7	4.0612	.54621	.20645	3.5561	4.5664	3.14	4.86
Between 4 and 13	17	4.1345	.49608	.12032	3.8794	4.3895	3.43	5.00
Between 14 and 24	7	4.3673	.28401	.10735	4.1047	4.6300	4.00	4.86
More than or equal 25	10	4.4429	.57321	.18127	4.0328	4.8529	3.14	5.00
Total	41	4.2369	.50266	.07850	4.0783	4.3956	3.14	5.00

With regard to the legal status of the firm, descriptive statistics show a lower mean value for closed corporations at 4.0301, compared to the mean value of private companies, which is 4.4156 (as shown in Table 5.9 below).

Table 5.9 Commitment to Learning and Legal Status of the Firm

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Closed Corporation	19	4.0301	.49161	.11278	3.7931	4.2670	3.14	5.00
Private Company (Pty) Ltd	22	4.4156	.44940	.09581	4.2163	4.6148	3.14	5.00
Total	41	4.2369	.50266	.07850	4.0783	4.3956	3.14	5.00

This difference in the variance of the means is further acknowledged by Levine's test of homogeneity at p=0.768>0.05. The t-test results presented in Table A3.2 under Annex 3 show that the difference observed in the means is significant at t_{39}=-2.623, p=0.012< 0.05. This indicates that there is a significantly higher level of commitment to learning among private companies compared to closed corporations in Namibia's road freight transport industry.

One of the arguments put forth in the reviewed literature is that larger firms are more likely to learn through advances in science and technology than SMEs because the former have access to affordable capital, which they can use for R&D (Institute for Public Policy Research, 2009; Sherbourne, 2012; Xu *et al*, 2012; Saunila & Ukko, 2014). Question 55 was aimed at determining if R&D allocation in Namibia's road freight transport industry is a function of resource availability or a management decision function. In this case, the availability of resources is measured using firm size. To examine this association, a chi-square test (χ^2) was conducted.

In total, 28 firms (68.3 percent) have no budgets dedicated to R&D, while the remaining 13 firms (31.7 percent) do have budgets dedicated to R&D. Of the latter, five (38.5 percent) are large size, four (30.8 percent) are medium size and the remaining 30.1 percent are small and micro size firms (see Figure 5.3 below)

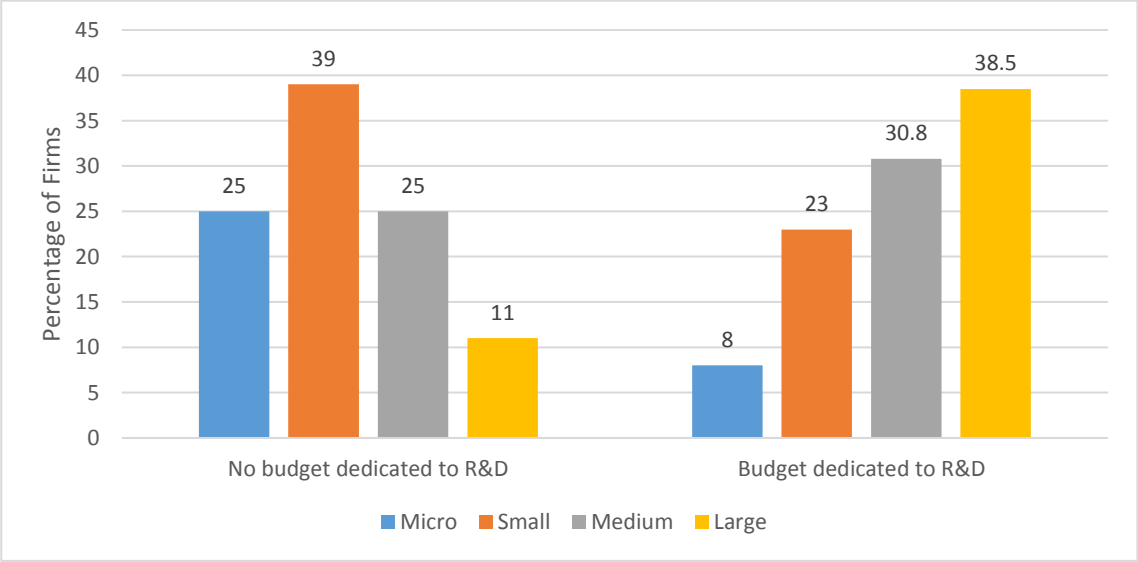

Figure 5.3 Learning through R&D and Size of the Firm

Even though it appears that there are more large firms that have budgets that are dedicated to R&D than medium, small and micro sized firms, the results are not statistically significant at χ^2=5.639, *df*=3, *P*=0.131> 0.05. This shows no evidence of association between the amount of resources available to the firm and its commitment to learn through R&D in Namibia's road freight transport industry.

5.6.1.3 Level of Intra-organizational learning

Having established the level of commitment to learn by Namibia's road freight transport firms, a one-way analysis of variance was conducted to determine if there is a difference in how knowledge in firms is shared among the employees of different firms. The analysis is carried out using the mean score values of Questions 59 to 64 with the following independent variables: size of firm, age of firm and legal status.

Table 5.10 Intra-organizational Learning and Size of Firm

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Micro	8	4.0625	.47923	.16943	3.6619	4.4631	3.33	4.83
Small	14	4.2143	.56398	.15073	3.8887	4.5399	2.67	5.00
Medium	11	4.2879	.21201	.06392	4.1454	4.4303	4.00	4.50
Large	8	4.2500	.70147	.24801	3.6636	4.8364	2.67	4.83
Total	41	4.2114	.49725	.07766	4.0544	4.3683	2.67	5.00

From the descriptive results in Table 5.10, there is a small difference in the means between small (4.214), medium (4.287), and large (4.250) firms. However, the difference in mean values between all firms and micro size firms is bigger at 4.062. This difference in the means is confirmed by Levine's test of homogeneity at p=0.316>0.05, but is not statistically significant, with the ANOVA results indicating p=0.807>0.05. The LSD post hoc test also found no statistically significant differences between the means of all firm sizes.

As indicated in Table 5.11, a similar trend is observed in the variance of the means for the level of knowledge sharing among employees in firms of different age categories, where Levine's test of homogeneity is p=0.749>0.05. The between-groups ANOVA test results show that the observed difference is not statistically significant at p=0.995>0.05. Similarly, the LSD post hoc results show no significant difference in the means of firms of different age categories.

Table 5.11 Intra-organizational Learning and Age of Firm

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Less than or equal 3	7	4.2381	.50787	.19196	3.7684	4.7078	3.33	4.83
Between 4 and 13	17	4.2255	.53014	.12858	3.9529	4.4981	2.67	5.00
Between 14 and 24	7	4.1905	.32530	.12295	3.8896	4.4913	3.83	4.83
More than or equal 25	10	4.1833	.59551	.18832	3.7573	4.6093	2.67	4.83
Total	41	4.2114	.49725	.07766	4.0544	4.3683	2.67	5.00

Furthermore, although a difference is observed in the mean values of intra-organizational learning between closed corporations and private companies at p=0.169>0.05 (see Table 5.12), this difference is also not statistically significant at t_{39}=-0.847, p=0.402>0.05 (see Table A.3.3 under Annex 3).

Table 5.12 Intra-organizational Learning and Legal Status of Firm

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Closed Corporation	19	4.1404	.55905	.12826	3.8709	4.4098	2.67	5.00
Private Company (Pty) Ltd	22	4.2727	.44109	.09404	4.0772	4.4683	2.67	4.83
Total	41	4.2114	.49725	.07766	4.0544	4.3683	2.67	5.00

This means that there is no evidence indicating that a difference exists in the level at which knowledge is shared among employees of differently sized, aged and incorporated firms in Namibia's road freight transport industry.

5.6.1.4 Level of Risk Attitude

In determining if there is a difference in risk appetite among firms, the mean score values of Questions 39 to 44 were computed and analysed. The results (presented in Table 5.13 below) show a smaller difference between the mean values of micro firms (3.750) and small firms (3.959), compared to medium firms (4.311) and large firms (4.250). The Levine test shows these differences at p=0.091>0.05. Following on the ANOVA test, which indicates a statistically insignificant difference in the groups combined at p=0.084>0.05, the LSD post hoc test indicates that there is a significant difference between the level of risk attitude of micro firms and that of medium firms at p=0.024<0.05.

Table 5.13 Level of Risk Attitude and Size of Firm

LSD

(I) Size of the firm	(J) Size of the firm	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Micro	Small	-.20918	.22745	.364	-.6700	.2517
	Medium	-.56169*	.23846	.024	-1.0449	-.0785
	Large	-.50000	.25660	.059	-1.0199	.0199
Small	Micro	.20918	.22745	.364	-.2517	.6700
	Medium	-.35250	.20677	.097	-.7715	.0665
	Large	-.29082	.22745	.209	-.7517	.1700
Medium	Micro	.56169*	.23846	.024	.0785	1.0449
	Small	.35250	.20677	.097	-.0665	.7715
	Large	.06169	.23846	.797	-.4215	.5449
Large	Micro	.50000	.25660	.059	-.0199	1.0199
	Small	.29082	.22745	.209	-.1700	.7517
	Medium	-.06169	.23846	.797	-.5449	.4215

*. The mean difference is significant at the 0.05 level.

The results from the analysis of variance of the means for risk appetite between firms in different age categories (see Table 5.14 below) also reveal a similar trend, with the Levine's test displaying a statistically insignificant value of p=0.311>0.05, and a between-groups ANOVA value of p=0.164>0.05. However, the LSD post hoc test to examine the difference in the means between all groups against each other shows significance between firms that are 25 years and older and firms that are between 4 and 13 years old at p=0.045<0.05. This implies that firms that were established before independence have a significantly higher appetite for risk compared to firms established in the first 10 years after the road transport sector reform.

Table 5.14 Level of Risk Attitude and Age of Firm

LSD

(I) Firm Age	(J) Firm Age	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Less than or equal 3	Between 4 and 13	-.02641	.23527	.911	-.5031	.4503
	Between 14 and 24	-.28571	.28003	.314	-.8531	.2817
	More than or equal 25	-.45918	.25817	.084	-.9823	.0639
Between 4 and 13	Less than or equal 3	.02641	.23527	.911	-.4503	.5031
	Between 14 and 24	-.25930	.23527	.278	-.7360	.2174
	More than or equal 25	-.43277*	.20878	.045	-.8558	-.0097
Between 14 and 24	Less than or equal 3	.28571	.28003	.314	-.2817	.8531
	Between 4 and 13	.25930	.23527	.278	-.2174	.7360
	More than or equal 25	-.17347	.25817	.506	-.6966	.3496
More than or equal 25	Less than or equal 3	.45918	.25817	.084	-.0639	.9823
	Between 4 and 13	.43277*	.20878	.045	.0097	.8558
	Between 14 and 24	.17347	.25817	.506	-.3496	.6966

*. The mean difference is significant at the 0.05 level.

Moving on to the difference in the means of attitude towards risk between closed corporations and private companies, the data, as indicated by the Levine test, shows statistically significant variance at p=0.023<0.05. This means that the assumption of homogeneity is violated. In his book, *Discovering Statistics Using IBM SPSS Statistics*, Field (2013) recommended the use of Welch or Brown-Forsythe when the test of homogeneity is violated for ANOVA, and the adjusted values for equal variances are not assumed for the t-test. The t-tests (shown in Table A3.4 under Annex 3) have found a statistically significant difference in the attitude of closed corporations towards risk and that of private companies at t_{39}=-3.377, p=0.003<0.01.

What the results demonstrate is that there is evidence to assume Namibia's road freight transport industry private companies have a significantly positive attitude towards risk compared to closed corporations, and would be expected to be more involved in experimentation.

5.6.1.5 Level of Rewards for Innovation

Recalling the level of innovation capability among Namibian firms from Section 5.1.1.1, overall, the reward for innovation is one of two constructs, with most firms (9 out of 41) scoring a value of less than 70 percent, and the lowest number of firms (4 out of 41) scoring more than 90 percent among all innovation capability constructs. To find out how rewards differ among different firms, the means for Questions 41 to 51 were computed and analysed.

Starting with the results from the Levine test of homogeneity, a difference in the means of firms of different sizes is observed at p=0.461>0.05. The between-groups ANOVA results, however, indicate that the observed differences in the means are not significant at p=0.148>0.05. Nonetheless, the LSD post hoc test has revealed a significant difference in rewards between large and small firms at p=0.049<0.05, as shown in Table 5.15 below.

Table 5.15 Level of Rewards and Size of Firm

LSD

(I) Size of the firm	(J) Size of the firm	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Micro	Small	.02296	.22146	.918	-.4258	.4717
	Medium	-.28409	.23218	.229	-.7545	.1863
	Large	-.42857	.24984	.095	-.9348	.0776
Small	Micro	-.02296	.22146	.918	-.4717	.4258
	Medium	-.30705	.20132	.136	-.7150	.1009
	Large	-.45153*	.22146	.049	-.9002	-.0028
Medium	Micro	.28409	.23218	.229	-.1863	.7545
	Small	.30705	.20132	.136	-.1009	.7150
	Large	-.14448	.23218	.538	-.6149	.3260
Large	Micro	.42857	.24984	.095	-.0776	.9348
	Small	.45153*	.22146	.049	.0028	.9002
	Medium	.14448	.23218	.538	-.3260	.6149

*. The mean difference is significant at the 0.05 level.

A difference in the variances of the means for rewards systems among firms of different ages was also observed through Levine's test at p=0.934>0.05. The ANOVA test for the combined groups indicates that the observed variance is not significant at p=0.062>0.05. When compared to individual groups, however, the LSD post hoc results show a significant difference in rewards between firms established in the first 10 years after the road transport reform (firms of 4-13 years old) and those established before independence (25 years and older) at p= 0.009<0.01(see Table 516 below).

Table 5.16 Level of Rewards and Age of Firm

LSD

(I) Firm Age	(J) Firm Age	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Less than or equal 3	Between 4 and 13	.08884	.21854	.687	-.3540	.5316
	Between 14 and 24	-.06122	.26012	.815	-.5883	.4658
	More than or equal 25	-.44898	.23982	.069	-.9349	.0369
Between 4 and 13	Less than or equal 3	-.08884	.21854	.687	-.5316	.3540
	Between 14 and 24	-.15006	.21854	.497	-.5929	.2927
	More than or equal 25	-.53782*	.19394	.009	-.9308	-.1449
Between 14 and 24	Less than or equal 3	.06122	.26012	.815	-.4658	.5883
	Between 4 and 13	.15006	.21854	.497	-.2927	.5929
	More than or equal 25	-.38776	.23982	.114	-.8737	.0982
More than or equal 25	Less than or equal 3	.44898	.23982	.069	-.0369	.9349
	Between 4 and 13	.53782*	.19394	.009	.1449	.9308
	Between 14 and 24	.38776	.23982	.114	-.0982	.8737

*. The mean difference is significant at the 0.05 level.

Furthermore, at p=0.562>0.05, the Levine test indicates a statistically insignificant difference in the means between closed corporations and private companies. The difference in the variance of the means, according to the t-test, is also not statistically significant at t_{39}=-1.622, p=0.113>0.05. The results show that no significant differences exist in the reward systems of both closed corporations and private companies (Table 5.17 and Table A3.5 under Annex 3).

Table 5.17 Level of Rewards and Legal Status of Firm

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Closed Corporation	19	3.6391	.56618	.12989	3.3662	3.9120	2.71	5.00
Private Company (Pty) Ltd	22	3.8961	.44783	.09548	3.6975	4.0947	2.86	4.71
Total	41	3.7770	.51612	.08060	3.6141	3.9399	2.71	5.00

Overall, the results show that, in Namibia, larger firms have significantly better reward systems that stimulate innovation than small firms. Other than that, reward systems are not significantly different between any other firm size categories. The results also show that older firms have significantly better

reward systems for innovation than firms established within the first 10 years following the road transport sector reform. The data did not find evidence to show that there is a difference in the rewards systems for innovation among differently incorporated firms in Namibia.

5.6.1.6 Level of Strategy and Leadership

Strategy and leadership is one of the constructs with the lowest number of firms (3 out of 41) scoring below 70 percent on the measurement scale, as illustrated in Figure 5.1 (Section 5.1.1.1). The majority of the firms (31 out of 41) scored between 71 and 90 percent on this construct. According to the mean values computed from Questions 52 to 58, strategy and leadership abilities differ between firms of different sizes, as indicated by Levine's test at p=0.781>0.05. Yet the ANOVA test results has not found a significant difference in the variance of the means between groups at p=0.134>0.05. Even when compared to each group, the LSD post hoc test results found no statistically significant difference (see Table 5.18 below).

Table 5.18 Strategy and Leadership with Size of Firm

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Micro	8	4.0625	.45371	.16041	3.6832	4.4418	3.17	4.50
Small	14	4.1190	.32310	.08635	3.9325	4.3056	3.50	4.67
Medium	11	4.3636	.31463	.09486	4.1523	4.5750	3.83	5.00
Large	8	4.3958	.42667	.15085	4.0391	4.7525	3.50	4.83
Total	41	4.2276	.38325	.05985	4.1067	4.3486	3.17	5.00

Similar to the results comparing strategy and leadership in differently sized firms above, a Levine test to compare strategy and leadership with age (as shown in Table 5.19 below) also reveals a difference in the mean values at p=0.708>0.05; with ANOVA results showing that this difference is not significant between groups at p=0.181>0.05. When compared to each group through the LSD post hoc test, the results still show no significant difference.

Table 5.19 Strategy and Leadership with Age of Firm

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Less than or equal 3	7	4.0476	.23002	.08694	3.8349	4.2604	3.83	4.50
Between 4 and 13	17	4.1569	.42275	.10253	3.9395	4.3742	3.17	5.00
Between 14 and 24	7	4.3095	.32530	.12295	4.0087	4.6104	3.67	4.67
More than or equal 25	10	4.4167	.38690	.12235	4.1399	4.6934	3.50	4.83
Total	41	4.2276	.38325	.05985	4.1067	4.3486	3.17	5.00

In determining the difference in strategy and leadership between closed corporations and private companies, the results show a difference in the means at p=0.454>0.05. However, this difference between groups is not significant, with t-test results of t_{39}=-1.814, p=0.077>0.05 (see Table A3.6 under Annex 3).

Overall, the results on strategy and leadership show that there is no significant difference in the design of strategies and leadership styles among firms in Namibia's road freight transport industry.

Summing up, the answer to the first research question of this study, i.e. *What is the level of innovation capability of Namibia's road freight transport industry?;* is as follows: There is a high level of innovation capability in Namibia's road freight transport industry. On average, the majority of the firms (35.8 out of 41) scored more than 70 percent on all constructs of innovation capability. These findings are compatible with the expectations of firms in competitive road freight transport countries. Namibia does not have freight sharing schemes and queuing systems to protect firms against competition. As such, firms have to continuously improve their services to compete for more loads.

The results also show that, cumulatively, the level of innovation capability is not significantly different between small, medium and large firms. The difference is only between micro firms and medium and large firms. The results also show that the levels of innovation capability between firms established before independence (25 years and older) and firms established in the first 10 years after independence (14 to 24 years old) or those established in the past three years do not differ significantly. The level of innovation capability only differs significantly between firms established before independence (25 years and older) and those established during the first 10 years after the country's road transport sector reform (4-13 years old). The results further show that private firms have a statistically significant higher level of innovation capability than closed corporations.

On individual constructs, the results show that medium firms in Namibia's road freight transport industry learn significantly better than micro firms (p=0.033<0.05) and small firms (p=0044<0.05).

The results further show that private companies learn significantly better than closed corporations (p=0.012<0.05). Yet the level at which firms share knowledge internally is not significantly different in the industry. Medium sized firms have a significantly higher level of risk tolerance than micro firms (p=0.024<0.05), while firms that were established before independence also have a significantly higher level of risk acceptance (p=0.045<0.05) than firms established in the first 10 years after the road transport sector reform. The results further suggest that private companies have a significantly higher level of risk appetite than closed corporations (p=0.003<0.05). The rewards system for innovation is significantly higher for larger firms than for small firms (p=0.049<0.05), while firms established before independence also present a higher level of rewards (p=0.009<0.01) than firms established between 2001 and 2010. No significant difference was found between the levels of strategy and leadership among different road freight transport firms in Namibia.

5.6.2 Measuring Adoption of Innovation

This section presents the results of the second research question for this study, i.e. *How does Namibia's road freight transport industry adopt innovations?* To answer this question, data was drawn from two instruments, namely the survey questionnaire and the semi structured interview questions. From the questionnaire, data from Question 30 was used to determine the level of adoption of innovations among road freight transport firms in Namibia. This data was further analysed to establish organizational structural determinants of adoption of innovation through Spearman's correlations and Chi square tests. Question 30 provided respondents with three technological innovations and asked them to tick those innovations that their firms are using. Firms that are primarily in trucking were provided with the following three innovations: lift axles, satellite vehicle tracking system and fleet management system software. Firms whose primary function is freight expedition, i.e. freight forwarders and clearing agents, had to tick from the list of the following innovations: Radio Frequency Identification (RFID), Electronic Data Interchange (EDI) and Automated System for Customs Data (ASYCUDA).

5.6.2.1 Number of Technological Innovations Adopted by Firms

As presented in Figure 5.4 below, out of the 41 firms that responded, the majority of the firms, 18 (43.9 percent) have adopted two technological innovations out of the three that were presented to them, followed by those that have only adopted one technological innovation 11(26.8. percent). Only 2 out of 41 firms (4.9 percent) are without any of the technological innovations, while 10 (24.4 percent) of the firms have adopted all three innovations.

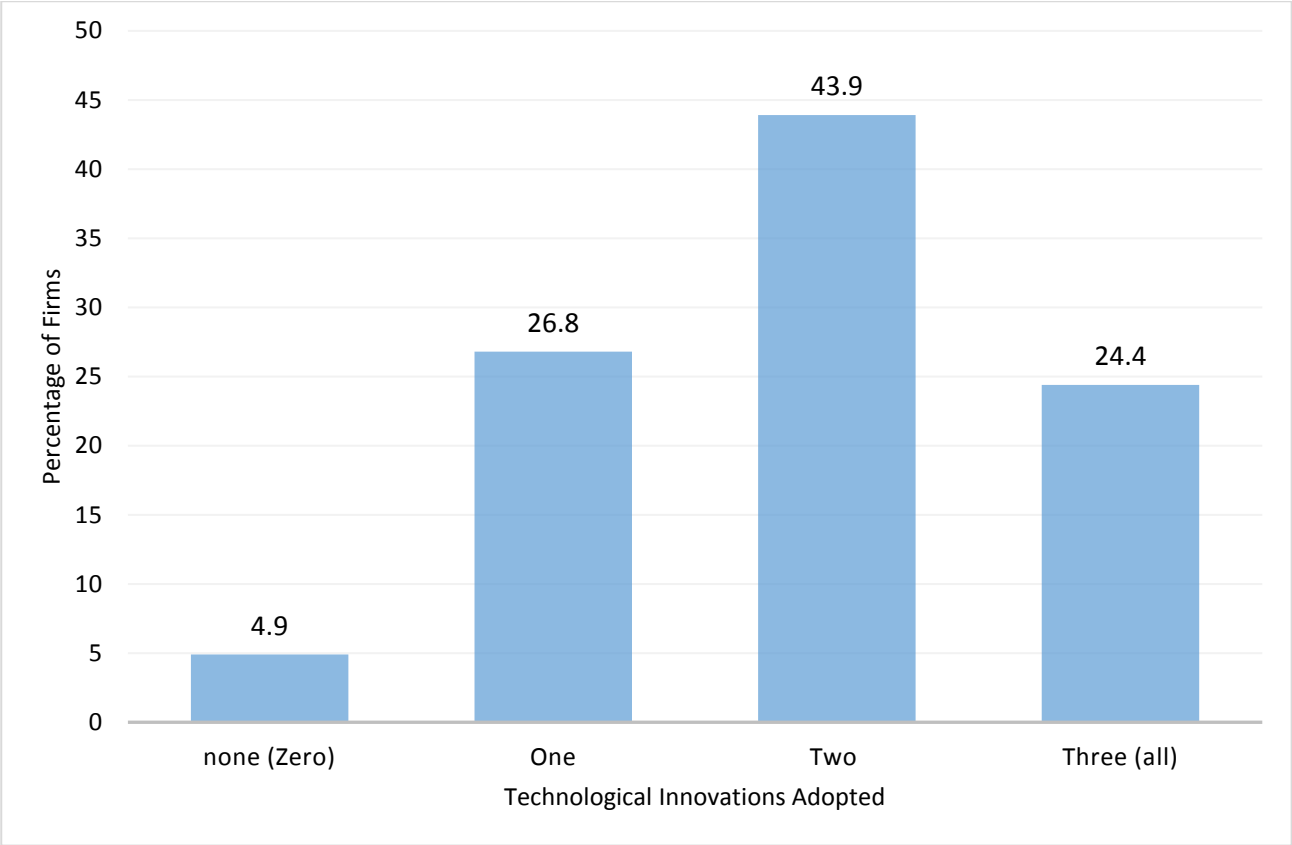

Figure 5.4 Levels of Adoption of Technological Innovations

As illustrated in Figure 5.5 below, the two firms without any of the three technological innovations are divided equally among the industry categories. Of those firms that adopted two innovations, 5 (27.2 percent) are freight expeditors, while 13 (72.2 percent) are transporters. Of the 11 firms that adopted one technological innovation, 4 (36.4 percent) are freight expeditors, while seven (63.6 percent) are transporters. The majority of the firms with all three technological innovations are transporters 9 (90 percent), while 1 (10 percent) was a freight expeditor.

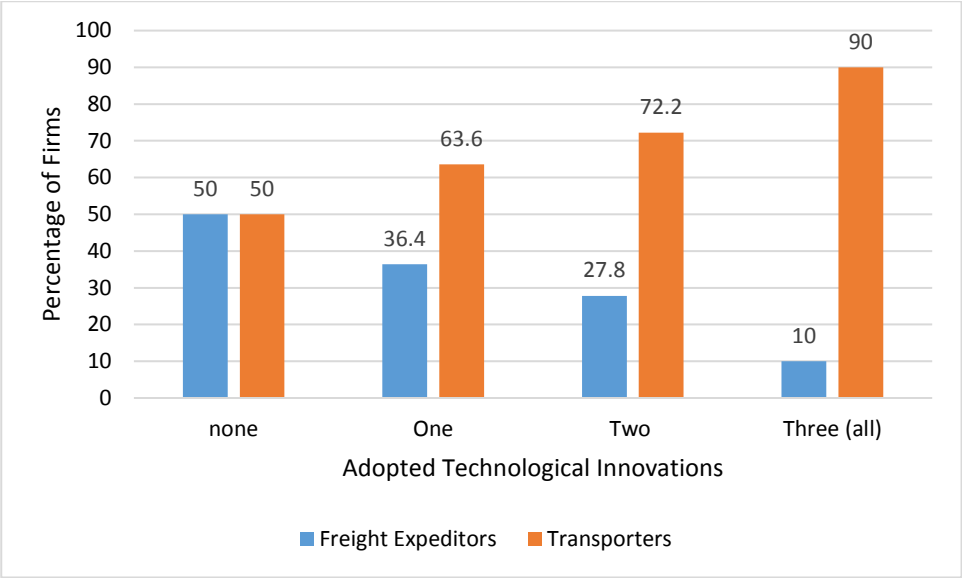

Figure 5.5 Adoption of Technological Innovations per Industry Category

Even though it may appear as if firms that are primarily transporters adopt more technological innovations than freight expeditors, results from a chi-square test show that the difference observed is insignificant: χ^2 =2.722, *df*=3, *P*=0.436>0.05. Therefore, there is no difference in the adoption patterns of technological innovations among firms of different chambers or industry categories in Namibia's road freight transport industry. In other words, freight expeditor firms and transporter firms do not innovate significantly different.

5.6.2.2 Adoption Patterns and Firm Demographic Characteristics

To examine the adoption patterns among firms, the same demographic characteristics used in Section 6.6.1; i.e., size, age and legal status, are applied, as described below.

5.6.2.2.1 Size and Adoption of Technological Innovation

The adoption patterns in Figure 5.6 below show that majority of the micro size firms (50 percent) have adopted one technological innovation, followed by those that have adopted all three technological innovations (25 percent). By contrast, over half of the small size firms (57.1 percent) have adopted two innovations, followed by those that have adopted only one innovation (21.4 percent). Of the two non-adopting firms, one is of micro size and one is of small size. There is no medium size firm that has not adopted at least one innovation, with those that have adopted two innovations (45.5 percent) being in the majority. Half of the large firms (50 percent) have adopted two innovations, while the other half adopted all three innovations.

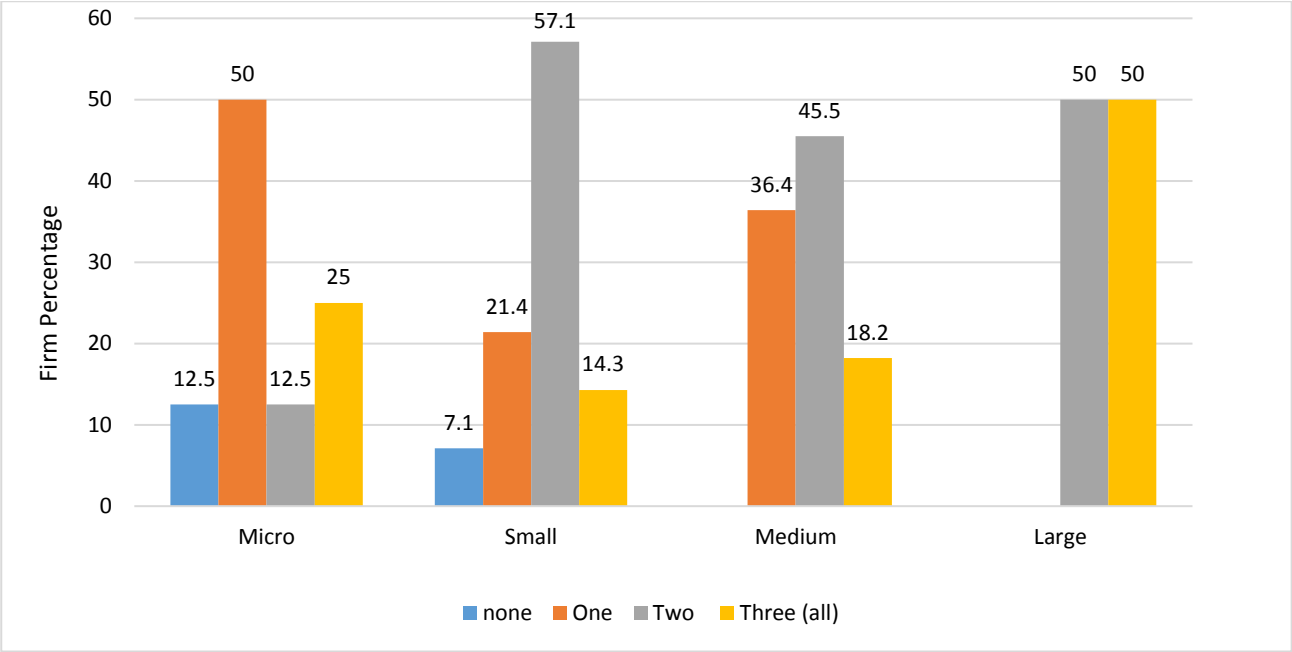

Figure 5.6 Adoption of Technological Innovations and Size of Firm

To test if there is indeed a relationship between the adoption of technological innovation patterns and the size of the firm, a chi-square test was conducted. The results indicate that this observation is not significant at $\chi^2 = 14.328$, $df=9$, $P=0.111>0.05$. This suggests that the adoption of technological innovations in Namibia's road freight transport industry is independent of size.

5.6.2.2.2 Age and Adoption

The analysis to examine the adoption of technological innovation patterns among firms of different age groups, illustrated in Figure 5.7 below, shows a similar trend to that observed with size of firm described above. Of the two non-adopting firms, one each belongs to the age categories ≤ 3 years old and 4-13 years old. The adoption pattern in firms that are ≤ 3 years old is the same across all innovations at 28.6 percent. Close to half of the 4-13 years old firms (47.1 percent) have adopted one technological innovation, followed by those that have adopted two innovations (35.3 percent). Over 70 percent of 14-24 years old firms have adopted two innovations. The remaining firms in this age category have adopted one innovation (14.3 percent) and three innovations (14.3 percent) respectively. Firms that are 25 years and older are all adopters of more than one technological innovation. Half of the firms in this age category (50 percent) have adopted two innovations, and the other half have adopted three innovations.

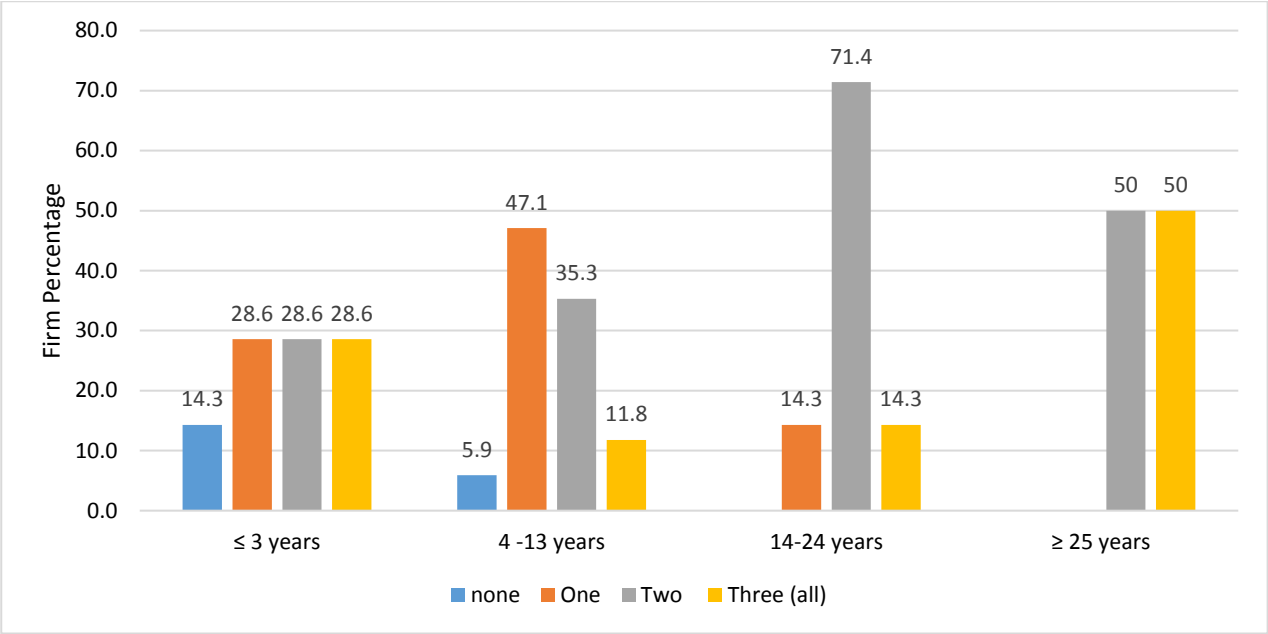

Figure 5.7 Adoption of Technological Innovations and Age of Firm

A chi-square test of independence to examine the relationship between adoption of technological innovation patterns and age of firm indicates that even though older firms appear to adopt more innovations than younger firms, there is no evidence that age has an effect on the adoption patterns at χ^2 =16.161,*df*=9, *P*=0.064>0.05. This result, once more, suggests that the adoption of technological innovations among firms in Namibia's road freight transport industry is independent of age.

5.6.2.2.3 Legal Status and Adoption

The results in Figure 5.8 below demonstrate the adoption patterns of technological innovations between closed corporations and private companies. All non-adopting firms (10 percent) are closed corporations. The same number of closed corporations (10 percent) have adopted all three technological innovations, while 36.8 percent have adopted two innovations. The remaining firms (42.1 percent) have adopted only one.

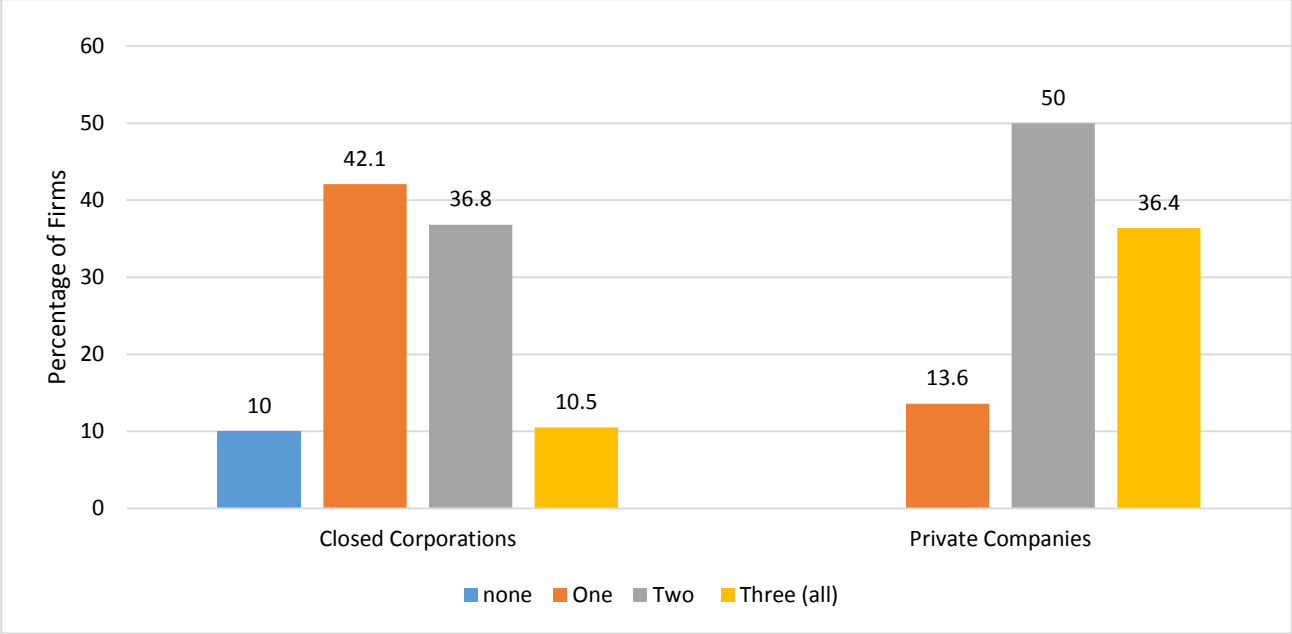

Figure 5.8 Adoption of Technological Innovations and Legal Status of Firm

The private companies are all adopters. The majority (50 percent) have adopted two innovations, followed by firms that have adopted all three innovations (36.4 percent). Only 13.6 of the private companies have adopted one innovation. To examine the relationship between the adoption of technological innovation patterns and the firms' legal status, a chi-square test of independence was performed.

As indicated in Table A3.7 and Table A3.8 under Annex 3, the results show evidence that a relationship between legal status and adoption pattern of technological innovation exists. These results are significant at χ^2=9.662, *df*=3, *p*=0.022<0.05. This effect, according to the results, is medium to high (Cramer's V 0.458) and these results are significant at *p*=0.035<0.05.

5.6.2.3 Innovation Capability and Adoption of Technological Innovation

Innovation in the service industry is defined by Damanpour and Wischnevsky (2006:275) as 'a product, service, or technology assimilated by the organization and used by its members for the first time'. These innovations are realized through inputs of innovation, i.e. innovation capabilities. In order to examine the effects of innovation capability constructs on the adoption of technological innovation in Namibia's road freight transport industry, a series of Spearman rank order correlations were performed. This was done using data from Question 30 and computed mean scores for the integrated innovation capability and for individual constructs of innovation capability.

Starting with individual constructs of innovation capability, the results of a two-tailed significance test (see Table 6.20) show that there is a positive but small and insignificant relationship between the

adoption of technological innovation and: learning at $r_s(41)=0.196$, $p=0.218>0.05$; intra-organizational learning at $r_s(41)=0.106$, $p=0.509>0.05$; and attitude towards risk at $r_s(41)=0.255$, $p=0.107>0.05$. From the same Spearman correlations test, results indicate a moderately significant relationship between the adoption of technological innovation and reward systems $r_s(41)=0.393$, $p=0.011<0.05$; and between adoption and strategy and leadership $r_s(41)=0.350$, $p=0.025<0.05$.

Table 5.20 Spearman's rho Correlations: Innovation Capability constructs and Adoption of Technological Innovation

		Technical innovations Adoptions
Technical Innovations Adoption	Correlation Coefficient	1.000
	Sig. (2-tailed)	.
	N	41
Learning	Correlation Coefficient	.196
	Sig. (2-tailed)	.218
	N	41
Intra-organizational Learning	Correlation Coefficient	.106
	Sig. (2-tailed)	.509
	N	41
Risk	Correlation Coefficient	.255
	Sig. (2-tailed)	.107
	N	41
Rewards	Correlation Coefficient	.393*
	Sig. (2-tailed)	.011
	N	41
Strategy and Leadership	Correlation Coefficient	.350*
	Sig. (2-tailed)	.025
	N	41

Table 5.21 below shows results from a similar test to examine the integrative effect of innovation capability on the adoption of technological innovation in Namibia's road freight transport industry using the composite mean score for innovation capability. The results show a moderately positive relationship between the level of innovation capability of a firm and its adoption of innovation pattern at $r_s(41)=0.317$, $p=0.044<0.05$.

Table 5.21 Spearman's rho Correlations: Innovation Capability and Adoption of Technological Innovation

		Technical innovations Adoption	Innovation Capability
Technical innovations Adoption	Correlation Coefficient	1.000	.317*
	Sig. (2-tailed)	.	.044
	N	41	41
Innovation Capability	Correlation Coefficient	.317*	1.000
	Sig. (2-tailed)	.044	.
	N	41	41

*. Correlation is significant at the 0.05 level (2-tailed).

5.6.2.4 Barriers on Adoption of Technological Innovations

To identify factors affecting adoption of technological innovations in this industry, an open-ended question (Question 65) was included at the end of the questionnaire. Respondents simply mentioned the barriers or described them. Using manual coding techniques, the barriers identified were grouped into three thematic categories. An example of grouped statements used to generate themes is attached as Annex 2.

The first category comprises statements that relate to limited support by the state. These statements point to the absence of targeted programs in the road freight transport industry similar to those offered to other industries such as manufacturing and agriculture. Some respondents made reference to the fact that there are no support services to subsidise their loans and/or facilitate access to capital, as is the case with the equipment aid fund[17] for the manufacturing industry, or the affirmative action loans extended to the agricultural sector through the Namibia Agricultural Bank.

The second category consists of statements that relate to additional initial capital required to support the full implementation of technological innovations, e.g. sending employees for training, or buying new equipment (such as computers) that are compatible with new systems. These statements cover all technological innovations.

The third and last category is the unreliable communication network and electricity provision in the country. Statements in this category are specific to the adoption of ASYCUDA, fleet management systems, and EDI. Respondents pointed out that while these systems are meant to make their work more effective, it can cause major delays when either the internet or electricity is down. Among these

[17] The equipment aid fund is an SME support scheme under the Ministry of Industrialization, Trade and SME Development which provides firms with production equipment, especially those involved in value addition activities.

statements, reference was also made with regard to inadequate outside capacity to utilize systems such as the ASYCUDA, especially by customs officials.

In summary, patterns of adoption of technological innovations in Namibia's road freight transport industry are independent of the size and age of a firm. There is, however, evidence from the data that adoption patterns of technological innovations are positively associated with a firm's legal status, which means that private firms tend to adopt more technological innovations than closed corporations.

Furthermore, the results show that the adoption of innovation is positively associated with integrative innovation capability, with rewards systems, and with strategy and leadership. The results point to three barriers affecting the adoption of technological innovations, viz. support by the state, access to resources (financial and non-financial) and unreliable internet and electricity connections.

5.6.3 Innovation Capability, Adoption of Technological Innovation and Firm Performance

The third research question for this study is *How does the innovation capacity of Namibia's road freight transport industry affect its performance?* Innovation capacity, as discussed in Chapter 1, is a function of innovation capability and adoption of innovation. To answer the third research question, the study ran a series of Spearman rank order correlations to test the relationship between innovation capability and adoption of technological innovation with firm performance data obtained from Questions 9 to 12. Firm performance, as discussed in Chapters 1 and 3, is measured through a number of indicators: revenue (sales), customer base, asset base and number of employees.

5.6.3.1 Level of Firm Performance

Before examining the effects of innovation capability and adoption of technological innovations on firm performance, data from Questions 9 to 12 is analysed to determine the level of performance in the industry. The questions asked the respondents to indicate if their performance had gone up in the past three years based on the four performance measures (sales, customer base, assets and number of employees). Responses were provided on a Likert-type scale ranging from strongly disagree to strongly agree. In total, 40 out of 41 firms provided answers to Questions 9-12. One firm was still new at the time of the survey (established in 2014) and had no previous performance records for comparison. The results are shown in Figure 5.9 below.

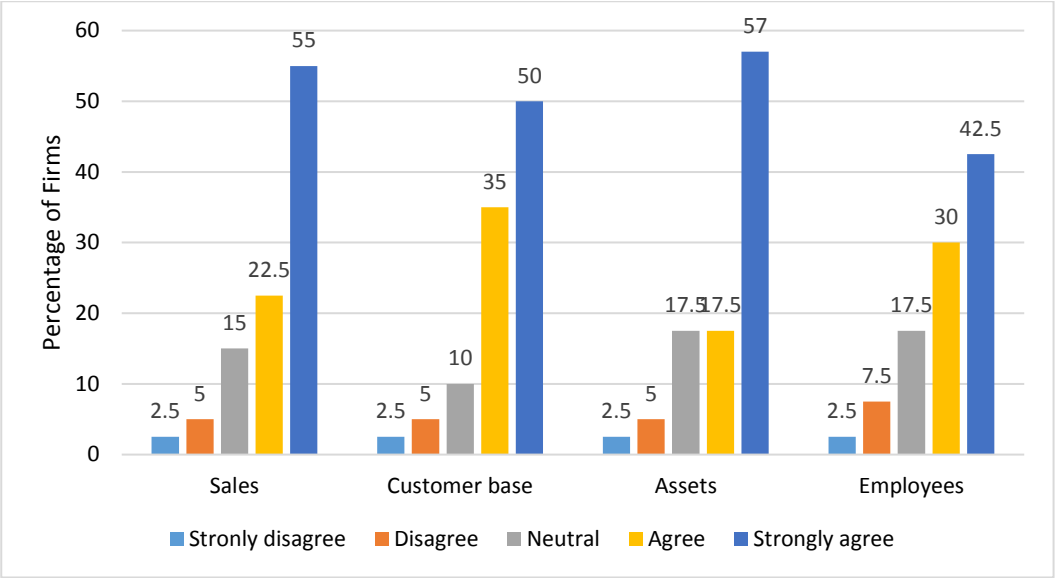

Figure 5.9 Level of Firm Performance

Overall, the results show that firms in Namibia's road freight transport industry have experienced high performance levels over the past three years. The majority of the firms (over 75 percent) either agree or strongly agree that their sales, customer base, assets and number of employees have increased over the past three years. The remaining firms, about 25 percent, either strongly disagree, disagree or were neutral about the increase in their performance over the same period.

5.6.3.2 Level of Performance and Firm Demographic Characteristics

To examine how the level of firm performance in Namibia's road freight transport industry is spread among firms of different sizes, ages and legal status, mean scores for Questions 9 to 12 were computed and a series of ANOVA tests conducted. Medium sized firms, according to the results (see Table 5.22 below), recorded the highest increase in performance over the past three years at 4.5909, followed by large firms at 4.3125. The results also show that micro firms have performed better than small firms. The differences in the means are confirmed by the Levine test at p=0.238>0.05. Yet these differences are not significant, as revealed by the between-groups ANOVA test results (p=0.256>0.05) and the LSD post hoc test results.

Table 5.22 Performance and Size of Firm

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Micro	7	3.9643	1.07460	.40616	2.9704	4.9581	2.00	5.00
Small	14	3.8750	.84210	.22506	3.3888	4.3612	2.00	5.00
Medium	11	4.5909	.40732	.12281	4.3173	4.8645	4.00	5.00
Large	8	4.3125	1.36768	.48355	3.1691	5.4559	1.00	5.00
Total	40	4.1750	.94088	.14877	3.8741	4.4759	1.00	5.00

Similar results are observed in the level of performance among different age categories (as shown in Table 5.23), where older firms (over 25 years old) perform better than all other age categories at 4.3000, followed by firms of 4-13 years old at 4.2353. The difference in the level of performance between age group categories is revealed by the Levine test of homogeneity at p= 0.779>0.05, although results from the between-group ANOVA test (p=0.803>0.05) and the LSD post hoc found no significance in the variance of means.

Table 5.23 Performance and Age of Firm

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Less than or equal 3	6	3.8333	1.15830	.47288	2.6178	5.0489	2.00	5.00
Between 4 and 13	17	4.2353	.81236	.19703	3.8176	4.6530	2.00	5.00
Between 14 and 24	7	4.1429	.73396	.27741	3.4641	4.8217	3.25	5.00
More than or equal 25	10	4.3000	1.20646	.38152	3.4369	5.1631	1.00	5.00
Total	40	4.1750	.94088	.14877	3.8741	4.4759	1.00	5.00

Not surprisingly, the trend in Table 5.24 indicates that the level of performance of private companies (4.3864) is higher than that of closed corporations (3. 9169). Although this difference is acknowledged by the Levine test at p=0.262>0.05, the t-test results show that the observed difference is insignificant at t=-1.602, p=0.117>0.05 (Table A3.9 under Annex 3).

Table 5.24 Performance and Legal Status of Firm

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Closed Corporation	18	3.9167	.95486	.22506	3.4418	4.3915	2.00	5.00
Private Company (Pty) Ltd	22	4.3864	.89552	.19092	3.9893	4.7834	1.00	5.00
Total	40	4.1750	.94088	.14877	3.8741	4.4759	1.00	5.00

The conclusion that can be drawn from the results above is that the level of performance among Namibia's road freight transport firms is independent of the size, age and legal status of a firm. Having established the level of performance among Namibia's road freight transport firms, the next section discusses how this performance is related to innovation capability and to adoption patterns of technological innovation.

5.6.3.3 Innovation Capability and Firm Performance

To examine the relationship between innovation capability and firm performance, Spearman's correlations were run on the integrative innovation capability variable against firm performance indicators, and on the individual constructs of innovation capability against firm performance indicators. The correlation results show that there is a positive but weak association between integrative innovation capability and total firm performance $r_s(40)=0.191$, $p>0.05$ (see Table 5.25 below).

Table 5.25 Spearman's rho Correlations: Integrative Innovation Capability and Total Firm Performance

			Innovation Capability	Firm Performance
Spearman's rho	Innovation Capability	Correlation Coefficient	1.000	.191
		Sig. (2-tailed)	.	.237
		N	41	40
	Firm Performance	Correlation Coefficient	.191	1.000
		Sig. (2-tailed)	.237	.
		N	40	40

Results on individual firm performance measures (as shown in Table 5.26 below) also confirm their insignificant relationship with innovation capability: sales $r_s(40)=0.188$, $p=0.246>0.05$; customer base $r_s(40)=0.173$, $p=0.286>0.05$; value of assets $r_s(40)=0.256$, $p=0.111>0.05$; and number of employees $r_s(40)=0.117$, $p=0.472>0.05$.

Table 5.26 Spearman's rho Correlations: Innovation Capability and Firm Performance

		Innovation Capability
Innovation Capability	Correlation Coefficient	1.000
	Sig. (2-tailed)	.
	N	41
Increased Sales	Correlation Coefficient	.188
	Sig. (2-tailed)	.246
	N	40
Customer base	Correlation Coefficient	.173
	Sig. (2-tailed)	.286
	N	40
Value of total assets	Correlation Coefficient	.256
	Sig. (2-tailed)	.111
	N	40
Number of employees	Correlation Coefficient	.117
	Sig. (2-tailed)	.472
	N	40

However, when the relationships between individual constructs of innovation capability were examined against firm performance measures (see Table 5.27 below), intra-organizational learning showed a statistically significant moderate to strong association with sales $r_s(40)=0.340$, $p=0.032<0.05$ and with customer base $r_s(40)=0.472$, $p=0.002<0.01$.

Table 5.27 Spearman's rho Correlation: Intra-organizational Learning and Firm Performance

		Intra-organizational Learning
Intra-organizational Learning	Correlation Coefficient	1.000
	Sig. (2-tailed)	.
	N	41
Increased Sales	Correlation Coefficient	.340*
	Sig. (2-tailed)	.032
	N	40
Customer base	Correlation Coefficient	.472**
	Sig. (2-tailed)	.002
	N	40
Value of total assets	Correlation Coefficient	.302
	Sig. (2-tailed)	.058
	N	40
Number of employees	Correlation Coefficient	.286
	Sig. (2-tailed)	.074
	N	40

Strategy and leadership also indicated a significant moderate association with customer base $r_s(40)=0.313$, $p=0.049<0.05$, as indicated in Table 5.28 below.

Table 5.28 Spearman's rho Correlation: Strategy and Leadership with Firm Performance

		Strategy and Leadership
Strategy and Leadership	Correlation Coefficient	1.000
	Sig. (2-tailed)	.
	N	41
Increased Sales	Correlation Coefficient	.266
	Sig. (2-tailed)	.097
	N	40
Customer base	Correlation Coefficient	.313*
	Sig. (2-tailed)	.049
	N	40
Value of total	Correlation Coefficient	.306
	Sig. (2-tailed)	.055
	N	40
Number of employees	Correlation Coefficient	.224
	Sig. (2-tailed)	.165
	N	40

The overall association between integrative innovation capability and firm performance measures, as well as between the individual constructs of innovation capability and firm performance measures is graphically summarized in Figure 6.10 below, while the reminder of the correlation tables, viz. commitment to learning against firm performance measures, risk attitude against firm performance measures, and reward systems against performance measures are included in Tables A3.10, Table A3.11 and Table A3.12 under Annex 3.

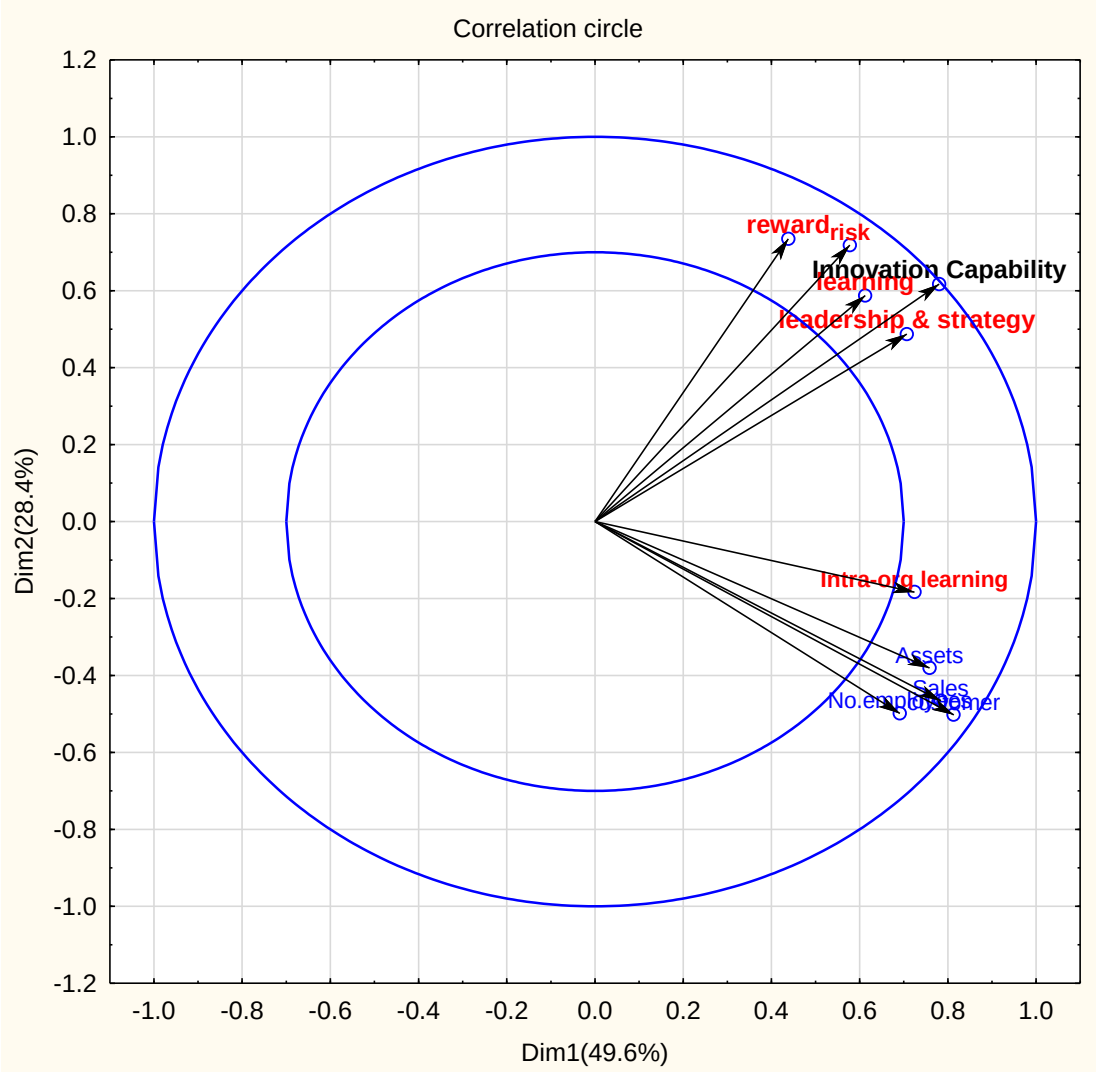

Figure 5.10 Innovation Capability and Firm Performance: Correlation Circle

What the results show is that innovation capability is positively associated with firm performance, even though that relationship is weak. The results also show that among the constructs of innovation capability in this study, intra-organizational learning has the strongest correlation to firm performance, followed by leadership and strategy.

5.6.3.4 Adoption of Technological Innovation and Firm Performance

To examine the relationship between firms' technological innovation adoption patterns and their performance, a similar Spearman rank order test was conducted on the 'total innovation' variable against firm performance variables (Questions 9 to 12). The results, as shown in Table 5.29 below, found a positive moderate significant correlation between total firm performance and a firm's adoption pattern of technological innovations $r_s(40)=0.349$, $p=0.027<0.05$.

Table 5.29 Spearman's rho: Adoption of Innovation and Firm Performance

			Number of technical innovations	Firm performance
Spearman's rho	Number of technical innovations	Correlation Coefficient	1.000	.349*
		Sig. (2-tailed)	.	.027
		N	41	40
	Firm performance	Correlation Coefficient	.349*	1.000
		Sig. (2-tailed)	.027	.
		N	40	40

*. Correlation is significant at the 0.05 level (2-tailed).

The analysis of individual firm performance measures also show moderate significant correlations between the adoption of technological innovation and sales ($r_s(40)=0.379$, $p=0.016<0.05$), and between the adoption of technological innovation and customer base ($r_s(40)=0.325$, $p=0.041<0.05$), as can be seen in Table 5.30 below.

The results found no significant correlation between the adoption of technological innovation and value of assets ($r_s(40)=0.294$, $p=0.066>0.05$) and number of employees ($r_s(40)=0.231$, $p=0.152>0.05$.

Table 5.30 Spearman's rho: Adoption of Innovation and Individual Firm Performance Measures

		Adoption of technical innovations
Adoption of technical innovations	Correlation Coefficient	1.000
	Sig. (2-tailed)	.
	N	41
Sales	Correlation Coefficient	.379*
	Sig. (2-tailed)	.016
	N	40
Customer base	Correlation Coefficient	.325*
	Sig. (2-tailed)	.041
	N	40
Value of total assets	Correlation Coefficient	.294
	Sig. (2-tailed)	.066
	N	40
Number of employees	Correlation Coefficient	.231
	Sig. (2-tailed)	.152
	N	40

The findings above indicate that overall, the adoption of the studied technological innovations in Namibia's road freight transport industry is positively related to firm performance. The results also show that a statistical significant moderate to strong correlation only exists between adoption of innovation and sales, and between adoption of innovation and customer base.

5.6.4 Description of Innovation Practices

5.6.4.1 Decisions to Innovate: Planned or Imposed?

A firm's decision to innovate can be classified under one of three approaches. The first approach is when a firm decides to adopt an innovation because it is a requirement by a client (e.g. retailers, producers and consumers of goods) or by authorities (government, industry bodies). With this approach, adoption of that specific innovation is conditional for allocation of loads and or for compliance with rules and regulations. The second approach is when an innovation is introduced to a firm as a secondary item through a primary innovation, i.e. a computer (a primary innovation) coming with a new software (secondary innovation). The third approach is when a firm itself identifies the need to adopt a certain innovation.

In this study, the first two approaches are referred to as imposed innovations, while the third approach is a planned innovation. Innovations that are adopted in response to client requirements or through primary innovations often end up turning into industry norms. This is the case with vehicle tracking systems, where clients want to be enabled to track their goods while in transit. Another example of an imposed innovation is the fleet management systems that now come as standard features for some new trucks. In the trucking industry, a truck is a primary innovation, and if that truck comes with certain innovations, then those innovations are in a way imposed on firms.

In the interviews, decisions to adopt imposed innovations are abstractly described. For instance, interviewees described the decision to adopt 'client-imposed' innovations as being the same as decisions to do business with a particular client while 'supplier imposed' decisions are describes as upgrading ones' fleet or ones' system. The decision to adopt client- or supplier-imposed innovations involves senior management because, as one interviewee puts it, 'these [decisions] have more to do with our financial ability to acquire the innovation and little to do with our ability to search and use innovations'. One of the micro firms indicated that they rely on their financial advisor in decisions to adopt imposed innovations, while small, medium and large firms indicated that they rely on the extensive involvement of senior management and final approval by the board of directors. In short, the process of adopting imposed innovations is primarily informed by the firm's budget, and decisions are made from operational perspectives, based on the availability of funds.

Planned innovations, on the other hand, require firms to have innovation capability, which allows them to search for transformational "new to the firm" or "new to the market" innovations. The process of adopting planned innovations is more complex, and involves back-and-forth consultations. The process of adopting new innovations is not to be confused with the procurement process, which is governed by price limits that can be approved at certain management levels. Consequences of

adopting innovations are more extensively considered during planned innovation processes rather than in imposed innovation processes. For imposed innovation decision processes, the goals are short term, e.g. to retain a contract with a major client or to be awarded a new tender. In planned innovation decision processes, however, the goal is medium to long term, e.g. to enter a new market, or to increase a fleet's carrying capacity.

Because of their strategic nature, decision processes to adopt planned innovations in small, medium and large firms are lengthy (a year or more). In planned innovation decision processes, management is responsible for identifying the need to innovate, evaluate innovation options and present their commercial viability to the board for decisions. One of the micro size firms that participated in semi structured interviews is a family-owned business whose decision processes for planned innovations are equally as extensively consultative. Even in the absence of a management team and a board of directors, firms still consult widely by engaging people and organizations that have knowledge and experience with the innovation. In other words, the reasons for adoption (planned or imposed) influence the decision process of a firm to adopt an innovation. This should be acknowledged, rather than merely assigning adopter categories to firms.

Adopter categories are classifications used throughout the literature on innovation based on the earliness of a firm or individual to adopt an innovation. The most widely used adopter categories are Rogers' 1983 categories, which are based on a normal distribution logic where innovators are those members that innovate earliest at time (t), followed by early adopters, then early majority, late majority and lastly, laggards (Rogers, 2003). Since then, scholars have used similar but broader categories. For instance, in her study *The Introduction of New Technology in a Mature Industry,* Jafta (2003) classified firms as leading, moderate, adapters or laggards based on the attributes of the technologies they had adopted.

Using arguments based on earliness of adoption of technological innovations to classify firms into adopter categories provides a necessary but limited framework for understanding innovation in firms. In industries such as road freight transport, these arguments need to be extended to include the influence of other actors in the social system (clients and suppliers) on the adoption of innovations.

5.6.4.2 Employees and Adoption of Innovation

The adoption of innovation process, according to Rogers (2003), has five phases. The first phase is the knowledge stage, where firms identify innovations and start learning more about them. The second phase is the persuasion stage, where firms start evaluating the innovation, which leads to the third phase: the decision of either adopting the innovation or rejecting it and defer the decision to innovate. Once the decision is made to adopt an innovation, the firm starts with the implementation

phase by readying the organization to receive the new technology or process. Thereafter, the organization either starts with the actual use of the innovation, or discontinues the process.

The study results reveal that the role of employees in innovation processes is determined by the phase of the innovation process and the rank or position of employees. In the first three phases of the innovation process, the involvement of employees in management positions is more prominent compared to that of non-management employees. The role of non-management employees in the first three phases is passive, and mainly limited to receiving information on management's plans to acquire new technological innovations, as well as the advantages of such innovations to the firm.

Starting with the third phase of the innovation process, however, non-management employees become actively involved. Non-management employees at this stage are participating in the process by attending training programs and tutorials on how to use the innovation. The role of management employees at this stage includes identifying skills gaps for operationalizing the innovation, identifying appropriate training courses or workshops, and hiring new capacity where required.

The difference in the roles of various employees in the innovation process among firms is stark at the implementation stage. There are some firms that emphasize the importance of non-management employees' feedback at this stage. The non-management employees of these firms are encouraged to evaluate the innovation as they participate in implementation activities, and this feedback is used to decide if the organization will proceed with the acquisition process. In other firms, feedback from non-management employees is used to seek more implementation support, rather than to evaluate decisions to adopt the innovation. In fact, for some firms, non-management employees are only involved in the innovation process after the innovation is already acquired.

Another pattern related to the role of employees in the innovation process is observed through the types of incentives used to encourage innovation in firms. There are firms that attach individual incentives to the innovation process for individuals who perform well with the innovation. An example of this is a firm that provides incentives to truck drivers whose trucks have liftable axles on the basis of their fuel and tyre consumption. Firms that do not attach individual incentives to the innovation process provide them at organizational level by declaring bonuses when the organization performs well (as a whole), and usually at the end of the financial or calendar year.

Participation of employees in the innovation process is linked to the success of innovations. Jafta (2003:183) has described how leading innovative firms have 'worker participation schemes and enjoy excellent relations with their employees'. Our findings reveal a different picture where employee relations are constrained. Preventing industrial actions was flagged as a serious concern for

management, as employees are constantly expressing their dissatisfaction either through strikes (a common occurrence in the industry) or resignations.

5.7 Summary of the Chapter

This chapter presented the findings on Namibia's road freight transport industry's innovation capacity. Overall, the findings show that firms in the industry have high levels of innovation capability. The findings also found a high level of adoption of technological innovations in the road freight transport industry. The study did not find a significant relationship between innovation capability and total firm performance. However, two individual constructs of innovation capability, namely intra-organizational learning and leadership and strategy, showed positive significant relationships with sales and customer base. The level of adoption of innovation is also moderately related to firm performance. Specifically, adoption of innovation is significantly related to an increase in sales and increase in customer base.

In clarifying the state of innovation in the industry, two issues emerged. The first is that adoption of innovation in itself does not imply innovativeness of firms, because some innovations are imposed on firms. Secondly, even though firms are creating innovation capability and adopting innovations, employees are not adequately involved in the process, and their willingness to contribute to the success of innovations is not explored.

The next section focuses on how firms in Namibia's road freight transport industry are trapped in the race to enable employees to implement innovations, instead of drawing on the willingness of employees to innovate. The section will also explore possible explanations for why high innovation capability and high levels of adoption of technological innovations do not strongly translate in high firm performance in the industry.

CHAPTER SIX: THE INNOVATION REGIME OF NAMIBIA'S ROAD FREIGHT TRANSPORT INDUSTRY

6.1 Introduction

In Chapter 5, the results from individual firms were presented to determine the level of innovation capacity in Namibia's road freight transport industry, and its effect on firm performance. The chapter concluded that firms in the industry demonstrate high levels of innovation capability, and that the majority are adopting technological innovations, with varying effects on performance.

In their study titled *Transport Prices and Costs in Africa*, Teravaninthorn and Raballand (2009: 104) conclude that road freight transport services in Southern Africa 'are the most advanced [on the continent] in terms of efficiency, competitive prices and service quality'. Road freight transport efficiency and competitiveness, according to Visser, Van Binsbergen and Nemoto (1999), are a function of market regulation and the innovation capability of firms. Given that Namibia's road freight transport industry is not affected by freight sharing schemes which distorts markets, competitive advantage in Namibian firms is anchored in their ability to develop innovation competencies.

This assertion is confirmed by the results of the current study and the literature reviewed on innovation in firms. The high level of innovation capacity observed is however not strongly related to performance as suggested by Lawson and Samson (2001); Matersen *et al.* (2007); and Skarzynski and Gobson (2008). In this Chapter, the reviewed literature[18] is used to project current results on Namibia's wider innovation development trajectory to understand why firms of different sizes, ages and incorporations in the industry do not innovate significantly differently and why developing innovation capacity does not strongly associate with high firm performance. Results of two studies on innovation capability in the transport and logistics industry (one from Australia and another from Hong Kong) are also used to compare and situate the results of the current study broadly. But before moving to discussions on innovation, first, characteristics of Namibia's road freight transport industry is presented.

[18] The review of the literature used to discuss results in this Chapter is inclusive of dynamic capability and the diffusion of innovation theories as well as empirical results of previous studies.

6.2 Characteristics of Road Freight Transport Firms in Namibia

The composition of the sample in this study (which shows fewer firms established before independence and in the first 10 years after independence compared to those established after 2000) reflects Namibia's road freight transport industry evolution. As asserted by the Ministry of Works Transport and Communication (2000a), enterprise formation and sophistication started in 1999 following the introduction of the road transport services liberalization program[19]. During that period, industry operators went from not paying adequate road user charges (operating in a protected environment) to embracing changes such as compliance with overload measures (Ministry of Works Transport and Communication, 2000a; Pinard, 2010:59). Statistics from the Roads Authority (2014:48) show that 97.9 percent of the 119 600 inspected commercial vehicles in 2014 were in compliance with traffic regulations in respect to weight, vehicle safety and load dimensions

The World Bank (2012) has described road transport operators in Namibia as primarily micro and small enterprises, with few medium-sized firms. This is because generally, new firms start off small and most firms in Namibia were established in recent years. This account supports the composition of the current sample as presented in Table 5.3 and establishes grounds for providing possible explanations for the high level of innovation capacity observed among participants of this study. The next section discusses the learning orientation of road freight transport operators and interactions with policy framework in Namibia's system of innovation.

6.3 Namibia's National System of Innovation and the Road Freight Transport Industry

In his work on national innovation system as an analytical framework, Lundvall (2007) concedes that innovation is a contextual phenomenon framed by economic, academic and political stakeholders' interactions at different levels. From the firm perspective, these interactions, as advanced through innovation theory, need to go beyond employee level and extend to inter-firms and inter-sectors (Rogers, 2003). Results from the current study shows that there is high intra-firm and inter-firm interactions but low inter-sector interactions for innovation in Namibia's road freight transport industry. Specifically, the interaction between road freight transport service providers with academia and state institutions as sources of novelty is limited. How then, if at all, does industry practice in

[19] In 1999 Namibia started implementing the road transport services liberalization program 'promote effective and equal competition between road transport operators within Namibia and between Namibian and foreign road transport operators in the cross-border road transport market' (Ministry of Works Transport and Communication, 2000a:8)

Namibia's road freight transport industry inform knowledge production, learning and policy in terms of innovation, given the distance between the two?

Before discussing implications for the interface in Namibia's road freight transport industry, it is important to acknowledge that the national system of innovation is inherently constrained by biases as submitted by Lundvall (2007), namely, biases arising from the view that innovation is associated with high technology industries and biases related to the fact that innovation is more identified with science based activities as opposed to gradual improvements that stem from learning by doing. In Namibia, the road freight transport industry does not only suffer from the two biases but also from the by-products of these biases; namely, low skills and low rewards. The effects of low skills and low rewards are discussed in Section 6.7 while those that relate to road infrastructure - which is also a component of the national system of innovation – are discussed under Annex 4, section A4. 2. The focus of this section is to discuss the context for low skills and the conspicuous absence of relevant policies and regulations for promoting innovation among road freight transport firms in Namibia. The section also explores linkages between industry practices with academia and policy development in the country.

6.3.1 Acquiring Knowledge for Innovation and Skills Development

Since the work of Teece and Pisano (1994), scholars of innovation have acknowledged the need for continuous development in the building of innovation capability by firms. In fact, the process of developing innovation capability is referred to throughout the literature reviewed as a continuous transformation of knowledge into new ways of producing goods and services (Lawson & Samson, 2001). Data from the current study suggests that there is continuous development of innovation capability in Namibia's road freight transport industry, starting with knowledge acquisition.

Gavetti, 1995 (cited in Jafta, 2003:16) describes the following types of learning processes: learning by doing (incremental improvements); learning by using existing technological innovations; learning by searching (through own research); learning from advances in science and technology (such as cooperation with universities and attending conferences); learning from industrial spillovers and imitation (by copying what others are doing); and learning from interacting with external sources of new ideas. The firms in Namibia's road freight transport industry combine these different forms of learning for different reasons. On the one hand, firms are learning to improve their service offerings due to competition in the region; hence the high level of cooperation with suppliers of innovation, customers, and competitors as sources of new ideas. On the other hand, these firms are also engaging with learning institutions not as sources of new ideas (innovation capability), but as sources of

functional capabilities. This is because transport and logistics is among the sectors that experienced a critical skills shortage after the country's independence (National Planning Commission, 2012).

Learning in Namibia, both formal and informal, received urgent attention only after the 2009 Business Investment Climate survey (NamBIC), which emphasized skills shortage as a major concern for businesses in the country (National Planning Commission, 2012; Links, 2010). In particular, the survey highlighted a mismatch between the skills needed by the private sector and those produced by the education system (Institute for Public Policy Research, 2009). Fewer appropriate training courses and the poor image associated with the transport and logistics industry have over time constrained learning among road freight transport firms (Minister of Labour and Social Welfare, 2006; Namibia Training Authority, 2014). For instance, until 2010, there was a lack of formal transport and logistics training courses in the country, which led to only a small pool of qualified technical and professionally skilled personnel (National Planning Commission, 2012b; Tjivikua, 2013). Today, a number of higher learning institutions such as the Polytechnic of Namibia, the Business School of Excellence and the Centre for Professional Studies are offering accredited courses in transport and logistics.

Even though it is still too early to evaluate the effectiveness of these transport and logistics learning programs in Namibia, especially given the Namibia Training Authority's (2014) observation on students with good grades not finding/securing career options in this industry attractive, learning is increasing. Improvement in learning is also reflected at industry level, where institutions such as the Namibia Logistics Association, the Namibia Transporters Association, the Walvis Bay Corridor Group and the Institute for Capacity Development are providing firms with industry-specific capacity development programs and networking opportunities (Deutscher Entwicklungsdienst, 2007; Walvis Bay Corridor Group, 2013b; Namibia Logistics Association, 2014).

While the results of the current study show that Namibia's road freight transport firms are acquiring functional capabilities (which are necessary for innovation), there is limited cooperation with universities as sources of new ideas. Learning through science and technology is linked to spending on R&D, widely acknowledged in the literature on innovation as linear inputs of innovation (Saunila & Ukko, 2014). What the literature often overlooks is that decisions to engage in R&D activities are non-linear inputs of innovation. These decisions are not necessarily reflected in the quantum of resources that a firm spends on innovation, but instead in its commitment towards learning through R&D. As the current results show, Namibia's road freight transport firms are learning less through R&D, not because they are constrained by access to funding, but because of their level of commitment towards advances in science and technology. Nevertheless, this should be viewed in the historical context of limited platforms in the country where research institutions can prototype ideas for commercialization (Southern Africa Innovation Support Program, 2012; 2014).

6.3.2 Regulation and Coordination of Innovation Activities in Namibia's Road Freight Transport Industry

Regulations in Namibia's road freight transport industry have tended to gravitate more towards infrastructure preservation and less on the promotion of innovation activities among industry operators. For instance, the country has regulations related to axle load requirements and punitive fines associated with these offences but, current adoption practices of liftable axles by road freight transport operators are not used to promote its diffusion. In other parts of Africa, such as in East Africa, the diffusion of liftable axles is promoted not only through harmonisation of axle load requirements but also through issuance of specifications for required technological innovations (Curtis, 2014).

Given the absence of policy that promote the diffusion of any technological innovations examined in this study, it can be argued that with regards to the diffusion of technological innovations, the interface between policies in Namibia's road freight transport industry with practice in firms is - as confirmed by the results of the current study - limited.

The inadequate interaction (for novelty) between road freight transport firms with the public sector reflect what Kahn and Menéndez (2014:47) describe as the 'disconnect' in Namibia's system of innovation, consisting of government, industry, and research institutions. This status is also acknowledged by the National Commission on Research Science and Technology (2014a:7), which describes Namibia's innovation system as:

> Conspicuously fragmented and scattered, with R&D institutions scattered in different ministries and departments and in semi-autonomous institutions that have own legal mandates but sometimes lack internal policies to guide their activities. These institutions execute their functions in isolation. Their mandates and research programs/activities lack harmony and the coordination among them requires harmonisation. This stems from the way that S&T [science and technology] has traditionally been coordinated by individual MOAs [ministries/offices/agencies]. While the institutions have strong vertical linkages, they have weak or non-existent horizontal linkages to ensure standardized and timely delivery of research information, knowledge, science and technology to the enterprise sector and to innovators.

Namibia's system of innovation, similar to most developing countries, is hobbled by different government institutions with their respective rigid structures and control systems that do not nurture and promote innovation (Thompson, 1965; Damanpour, 1991).

In summary, Namibia's road freight transport firms are providing conditions for their employees to acquire functional knowledge, especially from universities. For acquiring innovation knowledge however, the sources are mainly limited to customers and suppliers. The next section will extend the discussion to identify factors influencing the adoption process. Specifically, the section will present an account of how firms in the industry organize and utilize acquired knowledge as a source of innovation value.

6.4 Incubating Innovation Capabilities in Namibia's Road Freight Transport Firms

Despite continuous acquisition of innovation capability in Namibia's road freight transport industry, there is evidence from earlier studies (see Andruskiewicz *et al*., 2012; Walvis Bay Corridor Group, 2013a) that this knowledge is not retained in most firms, especially in micro, small and medium enterprises. According to the Namibia Training Authority (2014), staff turnover in the road transport industry is high for all job categories, i.e. transport managers, truck drivers, supply chain and dispatch managers, loaders, crane and fork lift operators and fleet controllers. Specifically, a high number of skilled and unskilled employees are leaving the road freight transport industry for the mining sector[20] and transport parastatals[21], which pay higher salaries. A study by Andruskiewicz *et al.* (2012) found that some parastatals such as Transnamib and the Roads Authority were also experiencing a shortage of skilled labour.

The history of workplace rewards in Namibia is rooted in the contract labour system used to provide cheap labour during the apartheid era (Ministry of labour and Social Welfare, 2012; Jauch, Edwards, Cupido & Resource, 2009). Many have argued that even though the apartheid system has been abolished, the legacy of the contract labour system has remained in some sectors of Namibia after independence (Ncube, 2013). This was further affirmed by the Minister of Labour and Social Welfare (2012:3) in his address at the 8th National Congress of the Namibia Transport and Allied Workers Union (NATAU), where he stated that 'some Namibian employers still exploit and discriminate [sic] their employees, treating them as commodities that can be used and discarded at will, rather than as

[20] Namibia continues to experience a boom in the mining sector. As of 2014, the country had 19 operating mines, employing about 17 770 people (Malango, 2015:11).

[21] Namibia has nine parastatals in the transport and logistics sector, namely Transnamib, which provides both rail and road transport services (passenger and freight); the Namibia Ports Authority, which manages sea port services in the country; the Roads Authority, which is responsible for maintaining the roads network; the Road Contractors Company, which is responsible for managing and undertaking construction works for the country's roads network; the Road Fund Administration, which manages the country's road user charging system; the Motor Vehicle Accident Fund, for preventing and managing crash accident cases on the road; the National Road Safety Council to promote road safety; Air Namibia, the national airline; and the Namibia Airports Company, which is responsible for providing and managing airport infrastructure (Developing Namibia's Transport Sector, 2014:1-15).

key contributors to the success of the business'. High unemployment, especially among the 'less skilled' labour force which is 'desperate for jobs' renders employees vulnerable to exploitation (Klerck, 2008; Jauch, 2010).

Namibia's Labour Act (No.11 of 2007) regulates the working conditions of employees in the country, amongst other things. The act does not stipulate a national universal minimum wage and, as such, only a few industries have regulated minimum wages: domestic workers, security personnel, the construction industry's labourers and the agricultural sector's farm workers (Office of the Prime Minister, 2007). The transport sector is one of the industries with a large number of less skilled employees, but it does not have a legislated minimum wage (Namibia Logistics Association, 2016). A 2007 study to explore options and challenges to centralized bargaining found that the majority of firms were satisfied with individual bargaining, while some employees feared that large employers, which are providing better working conditions, could lower their packages (LaRRI, 2007). The current driver development program (an industry initiative to address the shortage of skilled truck drivers) has proposed the introduction of a minimum wage for truck drivers, starting at 1500 Namibia Dollars per month for truck driver interns; a scale that confirms the fear of employees whose employers are paying above the proposed minimum wage (Namibia Logistics Association, n.d.:6). It is therefore not surprising that there is high level of discriminatory labour practices and unfair rewards, which, according to several sources (LaRRI, 2007; Tjihenuna, 2013; Walvis Bay Corridor Group, 2013), are the main cause of industrial actions, strikes and resignations in Namibia's transport and logistics sector.

When employees leave a firm, the innovation process is interrupted and its value compromised. This is because innovation in the road freight transport industry is based on continuous improvements, which require personal interaction between individuals within the firm, and among the units in a firm. Evidence from a case study of truck drivers, by Rodriguez, Targa and Belzer (2006: 205, 208), demonstrates that increasing employees' salaries lowers the probability of separation, thereby increasing retention rates. Similarly, involving employees throughout the innovation process creates a sense of belonging and encourages them to fully utilize technological innovations. As the findings of this study reveal, non-management employees seldom participate in ideation processes of innovation. Instead, employees use their newly acquired skills to find other jobs rather than contributing to the organization's bottom line.

The inadequate involvement of employees in the innovation process is not unique to Namibia's road freight transport industry. While criticizing management scholars for integrating innovation discussions with 'planning processes' and assigning them to 'research and development departments', Gubbins (2003:95) has at the same time endorsed this practice in his work *Managing Transport*

Operations by submitting that 'it is the research and development department's task to investigate and advice on new methods of operating goods and people. Equally, it is the function of management to try new procedures, new working methods and verify that their section is up to date and efficient'. Industrial psychologists (see Huhtala & Parzefall, 2007:299) have warned against the compartmentalization of innovation by referring to innovation in firms as 'not a requirement for a few select individuals but something which is expected of most employees in their everyday work'. When employees are neither adequately included in the innovation process nor empowered to participate, an environment for experimentation becomes redundant to them. In other words, excluding employees from innovation phases frequently cripples firm performance, as the enabling environment (by design and default) is restricted and confined solely to management.

Now that some factors affecting the innovation process in Namibia's road freight transport industry have been discussed, the next section will focus on demographic effects on innovation capacity and performance. This discussion on firms' inability to exploit employees' knowledge to innovate will be revisited under reflections on the application of innovation principles in Namibia's road freight transport industry.

6.5 Innovation Capacity, Size, Age and Firm Incorporation

Empirical studies on innovation at firm level (Rogers, 2004; Zhou, Gao, Yang & Zhou, 2005; Sarkar, 2009) have continued to present results which indicate that firms of varying ages and sizes innovate differently. Specifically, Huergo and Jaumandreu (2004a, b) found that larger and older firms innovate significantly different than younger SMEs. Some explanations provided for smaller and younger firms innovating significantly less than larger firms is that they do not have access to the skills and resources required to build up innovation capacity. However, the results from Namibia's road freight transport industry do not support these findings. Evidently, even though innovation capability for larger firms is higher than for all other firms, the difference is not statistically significant from that of medium and small firms. The significant difference is mostly observed between medium and micro sized firms. On individual constructs, the only significant differences were observed in reward systems between large and micro firms and large and small firms.

A possible explanation for the current results is that growth experienced in Namibia's road freight transport industry over the past decade has created opportunities along the transport and logistics value chain (World Bank, 2012; African Development Bank, 2014). The move to address these new capacity requirements is reflected in the finding that majority of large and medium size firms are establishing complementary functions (which are not part of their core businesses). Unmet capacity in the road transport value chain is observed in the three chamber membership classifications of the

Namibia Logistics Association. As summarized by Walvis Bay Corridor Group (2013a:40), 'majority of SME's [in Namibia's road freight transport industry] started to exist as a result of [their owners] working as employees in similar jobs in larger companies and saw the opportunity to open their own businesses. Some are a continuation of family businesses'. This indicates that because employees of larger firms are branching out to start their own firms in the industry, there is a circulation of managerial skills from larger firms to micro, small and medium enterprises; hence, the slight difference in the capacity to innovate among differently sized firms.

Results from previous studies have singled out inadequate access to resources and the absence of well-established industry networks as unique challenges stunting smaller enterprises' ability to innovate (Rogers, 2004; Sarkar, 2009). Connaughton and Madsen (2009) specifically cite lack of access to appropriate management skills as a reason for low levels of innovation in SMEs, a situation which is not critical in Namibia's road freight transport industry. The results observed among Namibia's road freight transport firms are better described using Zhou *et al.*'s (2005) thesis, which insists that even though SMEs do not have access to the type of resources for acquiring innovations that large enterprises have, the flexibility in their organizational structures facilitates the implementation of innovation better than the often bureaucratic structures of large firms.

With respect to firm age, the results from the current study also show that older firms have higher levels of innovation capacity than younger firms, although only the firms established before independence innovate significantly better than firms established in the first 10 years after the road transport sector reform. According to the World Bank (2014), for a firm, the number of years in operation is associated with experience and accumulated resources or lack thereof. Again, the current results do not support previous empirical studies on process innovation, which found that new firms tend to have significantly higher levels of innovation activities than seasoned firms (Huergo & Jaumandreu, 2004a, b; Balasubramanian & Lee, 2008). The findings of previous studies also contradict the discourse on firm size and innovation, because new (young) firms generally start off small, and according to the literature reviewed, small firms lack the resources to invest in innovation. For Namibia's road freight transport firms, even though they may be young and lack track records to raise conventional debt capital for innovation, the experience of the owners/managers provides them with opportunities to attract alternative funding, which is optimal for growth.

While findings on the relationship between size and age of firms with innovation are explained by country-specific dynamics in the industry, it is unclear why there is a significant difference in innovation capacity only between firms established ten years after the road transport reform and those established before independence. Although further investigation is needed to understand these results, some possible explanations can be drawn from organizational evolution theory, which states that

firms go through periods of convergence[22] to strategically reorient and recreate themselves based on the circumstances around them (Sørensen & Stuart, 2000; Burke, Lake & Paine, 2008). For instance, Koberg, Uhlenbruck and Sarason (1996) and Amara, Landry, Becheikh and Ouimet (2008) argue that it is common for firms to have little or no innovation activities during the start-up stage, as they are still exploring market potential. However, as firms evolve to full commercialization and the growth stage, there is increased acquisition of new systems and technologies, which translates into increased levels of adoption of innovation (Koberg *et al*., 1996). It could thus be that firms established in the first 10 years after the road transport reforms are experiencing significantly lower innovation capacity because of factors associated with the life cycle of their equipment rather than their age.

In relation to firm incorporation, the current results show that only two types of firms exist in Namibia's road freight transport industry: private companies and closed corporations. These results confirm findings by Walvis Bay Corridor Group (2013a) which indicate that small and medium enterprises in Namibia's road freight transport industry are either private companies or closed corporations. A firm's incorporation constitutes its genotype, which sets its operational parameters in terms of: 1) legal status; 2) responsibility of liabilities; 3) control and management; 4) acquisition of start-up capital; 5) change in ownership and continuity; and 6) requirements for the establishment and termination of the firm (Aardt, Aardt, Bezuidenhout & Mumba, 2011).

The analysis of firm types in the literature on innovation is limited to ownership, which is only one attribute of firm type. For example, using data from the South African innovation survey of 2001, Oerlemans and Pretorius (2006) found that firms with foreign ownership tend to innovate more than firms that are exclusively domestic-owned. This is because foreign ownership presents firms with access to a wider network of information, skills and resources, which are associated with increased innovation (Srholec, 2009; Dachs & Peters, 2014; Choi, Lee & Williams, 2011). The use of ownership type to explain innovation results provides important lessons for both policy makers and firm managers; however, the approach does not consider other embedded incorporation factors that can influence a firm's adoption of innovation pattern. For example, firms that have limited liabilities, regardless of whether they are domestic or foreign, might behave differently from those with unlimited liabilities.

Results from the current study could not determine if there is a difference in innovation capacity between firms with limited liabilities and those without. This is because both private companies and

[22] Convergence in firms is a process of redefining and aligning a firm's strategy to avoid complacency (Lind, 2005)

closed corporations have limited liabilities. The results were, however, able to show that private companies have significantly higher levels of innovation capacity than closed corporations. This observation can be explained by the high growth potential of the industry, coupled with the optimal entrepreneurial profiles of the firm managers and/or owners. These characteristics suggest that most firms, regardless of size, or age may have undergone transformation in terms of investments, possibly causing their legal status to change from closed corporations to private companies. The change of legal status from sole proprietorship or closed corporation to private company in Namibia is a standard requirement for firms to access alternative sources of expansionary capital, such as private equity or venture capital (Sherborne, 2012). Thus, access to growth capital is therefore a possible contribution to the significant difference in the levels of innovation capacity between private companies and closed corporations.

6.6 Firms as Rational Beings: Growth Prospects and Innovation

This study used the probit approach model to understand factors for the non-adoption of technological innovations from the perspective of individual firms, and not based on the perceived characteristics of innovations as described by Rogers (2003); viz. relative advantage, compatibility, complexity, trialability, and observability. Some endogenous factors affecting the adoption of innovation in Namibia's road freight transport firms are discussed throughout this study within the realm of innovation capabilities, while some exogenous factors have been collated and discussed as barriers to innovation in Section 6.6.2.4, namely lack of industry-specific support from the state, additional capital required to fully implement innovation, and the unreliable communication and electricity networks in the country. In this section, additional factors influencing the adoption of technological innovations are discussed.

Stoneman (2002) points out that firms act as rational beings by adopting technological innovations only if there are gross benefits to be realized. He further maintains that for process innovation (as in the case of the road freight transport industry), firms adopt technological innovations to reduce their cost of production in the long run, thereby increasing their gross profits. These decisions are influenced by, among other things, market conditions, organizational factors, and previous investments (interviews confirmed these perspectives). For instance, some firms indicated that they plan to adopt fleet management systems because they foresee the industry continuing to grow over the next decade. Specific reference was made to expansion activities at the port of Walvis Bay and

the expected growth from the country's industrial activities. The newly constructed dry ports[23] for Botswana, Zambia and Zimbabwe were also cited as positive prospects for growth in the industry. Another new growth prospect is the increase of cargo volumes from Brazil into the SADC region through the Walvis Bay Port (Maswabi, 2015).

While the adoption of some technological innovations is expected to increase, others may experience a decline. Some firms indicated that even though the use of liftable axles may still continue in some markets such as South Africa, it may decline for others such as Zambia, where return cargo for export is increasing. These views affirm remarks by the World Bank (2012:11) that even though the Walvis Bay corridor route is not as competitive as the Durban and Dar es Salaam routes, it provides a "commercially viable alternative for high-value and time-sensitive cargo", like copper from Zambia and the Democratic Republic of the Congo, to international markets.

Another factor observed through the current study is that some firms are developing their own in-house technological innovation systems. For example, one of the firms in the industry has developed its own fleet management system in Microsoft Excel (which does not provide all the functions found in off-the-shelf fleet management software) despite owning a fleet management software as well. The manual system is used alongside the vehicle tracking system and cellular phones to track goods. In-house technological innovations are particularly used as backup for when communication and electricity networks are down. Power supply challenges in Namibia, as in many SADC countries is a concern for businesses across all sectors. In 2015, the country experience a maximum demand of 596.842 megawatts against the supply of 429.5 megawatts (Nampower, 2015:3, 33). According to Namibia's national development framework, energy production capacity should increase to more than 750 megawatts by 2017, although in 2015, targets for the National power utility were still at 480 megawatts (National Planning Commission, 2013:xvi; Nampower, 2015:3). Communication networks hindrances on the other hand, relate to internet being either too slow or down. As with the power supply, slow internet connection is also a concern for businesses across all sectors. In 2014, Namibia was among countries with the slowest broadband speed in the world (International Telecommunication Union, 2015:5).

[23] As landlocked countries, Botswana, Zambia and Zimbabwe established dry ports outside of the Walvis Bay Port to offer their businesses access to markets in the EU, the Americas, and North and West Africa. The ports provide 'transport and logistics services to and from the port, cartage services, container handling, stacking, storage, a break bulk terminal, general purpose warehouse, empty container park and value-added services, such as customs clearance' (Walvis Bay Corridor Group, 2015:6)

What the results reveal is that road freight transport firms are making innovation decisions based on many factors which are beyond firm control and beyond perceived characteristics of innovations. It is at this juncture where the epidemic diffusion model, which argues that the diffusion of innovations is based on information that is available on the benefits of an innovation, falls short. Information about other factors such as market developments and social system support is equally important in forecasting gross benefits and in driving innovation decisions.

Noting the moderate relationship that innovation capability has with adoption of technological innovations and with firm performance, it can be assumed that the growth experienced in transit and transhipment traffic, local economic transformation activities and increases in regional economic activities may also be partly responsible for high industry performance.

6.7 Researcher's Reflection on the Application of Innovation Principles from the Literature Reviewed in the Road Freight Transport Industry

The literature reviewed on innovation in the transport industry hones in on two issues. Firstly, the literature dwells on the acquisition of different technological innovations, and secondly, there is much emphasis on enabling employees to use technological innovations. This approach underestimates the role of employees in the innovation process and casts innovation as a predominantly managerial process.

Scholars of organizational psychology describe innovation in firms as the outcome of a creative process which requires the ability and willingness of employees. This implies that in addition to providing skills to operate technological innovations, road freight transport firms need to consider employees' well-being so that they are willing to reconfigure their tasks during routinization of acquired technologies to further improve processes; after all, innovation is a continuous process. To achieve this, firms need to embrace the two facets of employee well-being described by Van der Doef and Maes (2010) as psychological well-being and job-related well-being. Although some studies have only focused on a single facet, such as Rasulzada and Dackert (2009:196), who concluded that 'organizational creativity and innovation are related to psychological wellbeing', others, such as Ramamoorthy *et al*. (2005), have found a similar relationship between both psychological and job-related well-being and innovative behaviours. Van der Doef and Maes (2010:110) submit that both facets can be improved by 'enhancing job control and social support'.

Work in the road freight transport industry is physically and psychologically demanding. For instance, according to the World Bank (2009b), truck drivers spend long periods at border crossings waiting for their goods to be cleared; they endure harassment by traffic and immigration officers; they face hijackers and thieves on the road; they deal with xenophobic attacks; and many other inherent job

challenges. Additionally, truck drivers, especially in Namibia, have to remain on the road for prolonged periods, spending extended time away from their families because they cannot afford to 'take breaks' (Tjihenuna, 2013). An HIV impact assessment study of 20 firms in the transport sector in Namibia in 2006 found that the majority of employees (including long-distance truck drivers) earned less than 1000.00 Namibia Dollars, which is roughly equivalent to United States Dollars 100.00 (PricewaterhouseCoopers, 2007:10). A similar, but more inclusive[24] recent study of 483 employees from six road freight transport firms in the country observed that about 24 percent of the employees received less than 1700 Namibia Dollars (Kiderlen, Conteh, Roll, Seeling & Weinmann, 2015:349). In the same year, a study of 146 truck drivers in Namibia reported high (53.42 percent) job dissatisfaction, with reasons ranging from low wages/salaries (35 percent) and poor working conditions (27 percent) to delays at border crossings (26.5 percent) and time spent away from home (10.7 percent) (Majoni, 2014:25). The same study also found that close to 20 percent of truck drivers sleep in their trucks without adequate blankets and warm clothing because they cannot afford to pay for decent accommodation along the road. These statistics point to poor working conditions in the industry which for truck drivers, according to Saltzman and Belzer (2007) and Benstowe (2008) are causes of exhaustion, organ distress, fatigue, sleep deprivation and other health-related problems such as pneumonia, HIV/AIDS and sexually transmitted diseases.

Even though these challenges have been cited by numerous studies in the country (Martin, 2004; Keulder & Lebeau, 2006; PricewaterhouseCoopers, 2007; Elvegård, 2011; Majoni, 2014), there is as yet no assessment that qualifies their effects on employees' morale, which determines their willingness to participate in creativity and innovation, and the subsequent effects of this on the organization. This study has among others presented the association between reward systems with adoption of innovation and firm performance. An outcome of a recent road safety campaign targeting 320 truck drivers from eight companies in Namibia was a plea from drivers urging the Motor Vehicle Accident Fund to engage truck owners and truck companies to address the issue of fatigue in the industry (Lutombi, 2015).

It is easy for the management of road freight transport firms to underestimate the potential contribution of employees to the innovation process because of the latter's low levels of education (Keulder & Lebeau, 2006). In addition, given the tight schedules that employees must meet, there is insufficient time to meaningfully engage with their employers or their jobs. This means that even though employees are being provided with the functional skills to carry out their jobs through training,

[24] Respondents of this study included truck drivers, labourers, administrators and management.

their job demands do not allow them to go beyond mainstream tasks, thus compromising the quality of innovation in the industry.

6.8 Universality of Innovation Capacity in the Transport and Logistics Industry: Results from Australia and Hong Kong

The high level of innovation capability observed in the current study is essential but not unique to Namibia. What is however atypical from the current study is the insignificant relationship observed between innovation capability and firm performance. To demonstrate this, the current findings are compared to two extant studies in the transport and logistics industry. In drawing comparisons between the findings, this section does not attempt to provide contextual lessons for Namibia[25], but only to highlight economic value of developing innovation capability in the industry.

The section begins by discussing the most recent study on innovation capability of the courier industry in Australia followed by the study of logistics service providers in Hong Kong. Thereafter, the importance of improving innovation capability in the transport and logistics industry using perspectives from the two studies is presented.

6.8.1 Innovation Capability, Operational Capacity and Firm Performance

The study by Wang (2016) is an empirical investigation of the relationship between innovation capability, operational capability and performance of courier firms in Australia. The study is based on a premise that innovation capability has an effect on both operational capability and firm performance. Operational capabilities are referred to by Lawson and Samson (2001) as mainstream functional knowledge for providing services/products. For a firm to be competitive, innovation capability is required to improve daily operational capabilities to generate superior products or methods of production (*ibid*.).

Spanning a total of 167 individuals from 98 courier firms, the study found high levels of innovation capability and operational capabilities among participating firms. The study also reported a 'significant positive relationship between innovation capability, operations capability, and logistics performance' (Wang, 2016: 13). These results are consistent with the findings of the current study in that road freight transport firms in Namibia have also recorded high level of innovation capabilities.

[25] Given limited research on innovation capability in the transport and logistics industry, there are no available similar contextual studies from low skilled, less regulated developing small economies.

However, the results also differ from the current study which found a positive, but insignificant relationship between integrative innovation capability with firm performance.

6.8.2 Innovation Capability and Relationship Management

The second study is also an empirical research of 251 logistics service providers (LSPs) in Hong Kong in which Panayides (2006) examines the effects of relationship orientation on firm innovation capability and implications on firm performance. The study uses trust, bonding, communication, shared values and empathy to determine relational affinity between logistics service providers and their clients. These constructs were then used to measure their effects on the ability of LSPs to innovate and on the performance improvement of firms.

The study results demonstrates that LSPs who have closer and profound relationships with their customers are: i) more likely to engage in innovative behaviours, ii) the first to market with new processes of delivering services, iii) able to provide higher quality service and iv) more likely to perform significantly higher. This finding is important because it highlights the fact that interaction with stakeholders, especially customers, delivers new insights on how to improve services; prompting the LSP to continuously improve their process in response to customer needs.

In comparison, results from the current study show that, cooperation with customers is highest among road freight transport operators in Namibia. Customers are the main source of new information as illustrated in Table 6.4, with a mean score of 4.90 out of 5 points. This result was further affirmed through the ranking of the most important external sources of new ideas where customers were ranked number *one*.

What the results from Panayides (2006) show is that there is more to a closer mutual relationship between transport service providers and customers than merely providing new information. The relational proximity has economic value which is derived from the timeliness and accuracy of new information. This is reflected in the innovation performance of those firms that have closer relationship with their customers and in the high ranking of this affiliation as a source of new ideas. It can thus be concluded that cooperation with customers significantly improves the transport and logistics firm's innovation capability, resulting in high reliable physical movement of goods and continuously improving process for service delivery.

6.8.3 Perspectives for Optimising the Value of Innovation Capability

The two studies discussed above show the importance of innovation capability to the transport and logistics industry. Both studies have demonstrated positive significant relationships between innovation capability and firm performance. In the case of Namibia however, where road freight

transport firms also demonstrate high levels of innovation capability; there is (as previously mentioned) a positive but insignificant relationship between the integrative effect of innovation capability and firm performance. This analysis has identified two perspectives for optimising the value of innovation capability in the transport and logistics industry.

The first perspective emerges from Panayides (2006) and it is embedded in LSPs' management of customer relationships, a concept borrowed from the Marketing discipline. Customer relationship management is a systematic approach governing all forms of interactions with a client to create formal long term relationships (Soliman, 2011). By extending this practice to the transport and logistics industry, the study focus on *soft* sets of principles such as shared values, honest communication and caring about client's feelings. This is different from the traditional transactional approach where the focus is on technical compatibility. In this case, the cooperation goes beyond the traditional type and humanises the relationship. With established mutually beneficial relationships, firms gain access to timely more accurate information which can be used to improve service delivery processes, thereby leveraging the value of innovation capability on firm performance.

The second perspective is from Wang (2016) where empirical evidence draws a parallel relationship between innovation management and strategic management in the industry. This is demonstrated by the positive significant relationship between innovation capability, operational capability and their effect on firm performance. The argument is especially important to extend to contexts where innovation is largely considered a management function. What the results reveal is that, if there is a breakdown between the generation of novelty (innovation capability) and the implementation thereof (operational capability), the organization is stifled. The study therefore enforces the importance of maintaining a link between developing innovation capability and infusing that novelty in transport and logistics mainstream operations.

Taken together, the results of the two studies show that innovation capability in itself is important to the transport and logistics industry; however, the capability needs to be directed towards improving efficient service delivery. In other words, firms in the industry need to be aware of the dangers of accumulating innovation capability which does not result in economic value.

6.9 Summary of the Chapter

This chapter used the literature reviewed to provide context to the results of the current study. The chapter began by presenting the historical perspectives that frame the current state of knowledge acquisition in Namibia's road freight transport industry. The discussion concluded that transport is one of the sectors in Namibia that since independence experienced critical skills shortage. As a result,

the high level of knowledge acquisition observed in the industry is for both functional and innovation capabilities.

The chapter then proceeded to establish grounds for the mismatch between the level of innovation capacity in the industry and its contribution to firm performance. Specifically, the discussion examined issues of high employee turnover in the industry, and the negative effect of this on process innovation, which requires retained knowledge for continuous improvement. The practice of enabling employees to implement (but not to create innovation) was also examined in the reflection on the application of innovation principles at firm level. In addressing the inconsistencies observed in the current results on innovation capacity among firms of different size, age and incorporation with the results of previous studies, the discussion used industry-specific dynamics of firm establishment and management profiles in Namibia. Two cases, one from Australia and another from Hong Kong were analysed to compare their results with that of the current study.

The next section summarizes and concludes the study with reference to its objectives and proffer various recommendations for policy and road freight transport firms. The section also furnishes suggestions for future research, along with the limitations experienced in conducting the research.

CHAPTER SEVEN: SUMMARY, CONTRIBUTIONS, IMPLICATIONS AND RECOMMENDATIONS

7.1 Introduction

Innovation has become the quintessential source of economic growth around the world. At firm level, innovation is the vehicle for value creation, and road freight transport operators are no exception. Trucks with state-of-the-art auxiliary technologies are but a part of innovation in the road freight transport industry. As an interactive social process transcending mere inventions, this study turned to the widely acknowledged but less understood inputs of innovation, especially their application in industries where majority of key employees have low levels of education. Specifically, the study focused on innovation capability and the adoption of technological innovations to explore industry operators' abilities to provide reliable, cost-efficient transport services. The near-symbiotic relationship between innovation capability and the adoption of technological innovation has long been theoretically hypothesized but empirically ignored in innovation studies across Sub-Saharan Africa.

For innovation capability, a non-linear model consisting of intangible inputs of innovation was deployed to determine if managerial practices are promoting or inhibiting innovative industry behaviour. To understand the adoption of technological innovations, the study used the probit model of Everett Rogers' diffusion of innovation theory to measure the uptake of innovations and identify factors influencing the adoption process among road freight transport operators.

This research is one of the few pioneer studies of firm-level innovation in Namibia. The study is the first to explore the innovation capacity of road freight transport firms in the country. Previous firm-level innovation studies used case study qualitative approaches to focus either on the diffusion of information communication technologies, or on competence-building in fewer, selected firms. Resultantly, there is no comprehensive industry-level innovation capacity study in any sector of the economy.

In this Chapter, the main points from Chapters 1 to 6 are woven together to narrate the process used to answer the three research questions for this study. Implications of the current results for theory, policy, firm managerial practices and methodology are also presented, followed by final thoughts and limitations encountered during the study. Finally, directions for future research are provisionally proposed.

7.2 Theoretical Summary of the Research

Grasping the reality of Namibia's road freight transport operators must necessarily be anchored in 100 years of colonial history mired with apartheid, harsh geographic habitats and local dynamics of trade. Overcoming long distances between small pockets of economic activities, diminishing markets (for instance the Angolan market), empty running of trucks caused by one-directional freight traffic, new carrying capacity requirements due to economic transformation programs being initiated by government and fierce regional competition are routine obstacles that road freight transport operators confront. Added to this are high land transport costs - among the highest in the region. Unsurprisingly, freight transport prices significantly contribute to constraining the growth of productive sectors across the economy.

Close to 60 percent of the total imports and 30 percent of the total exports in Namibia are transported by road. Road transport also provides indispensable intermodal connections for goods shipped by sea, rail and air to their final destinations. Namibia's transport infrastructure development investment program adapted after independence is evidenced through the country's international standards roads, the highest in Africa. Infrastructure development is admittedly indispensable to the provision of road freight transport services, but roads alone are not enough. Transport operators are equally as important to the provision of transport services. In isolation, infrastructure development can reduce transport costs, but it will not translate into efficient transport services. In lieu of this, the country's recent economic transformation activities and growing transit traffic along the Walvis Bay corridor have peaked interest in road freight transport services. While a competitive road freight transport industry is acknowledged throughout the national development framework, there is limited knowledge on transport operators' capacity to deliver efficient transport services. Thus, this study proposed an inquiry into the road freight industry's innovation capacity by identifying the following research questions:

i) What is the innovation capability of Namibia's road freight transport industry?

ii) How does Namibia's road freight transport industry adopt innovations?

iii) How does the innovation capacity of Namibia's road freight transport industry affect its performance?

The contextualization of this study delved into the troubled colonial relationship between road freight transport and national economic development, which prevailed until after independence. On independence, the first democratically elected government started connecting local production centers to markets and providing international trading gateways to neighboring countries. Namibia's road transport development agenda has since been premised on infrastructure development, so much

so that besides acknowledging the importance of efficient transport services, there is limited documented information regarding the capacity of industry operators.

Although much is expected from Namibia's road transport industry, less is known about its ability to continue moving goods in, out and around the economy efficiently. This study attempted to bridge this gap by gathering data from road freight transport operators in the country to answer the main research question: *What is Namibia's road freight transport industry's innovation capacity*?

To situate the current study in the literature, a review of road freight transport and innovation capacity was conducted, with a focus on Sub-Saharan Africa. The findings, as presented in Chapter 2, revealed tectonic shifts over the past three decades, which have transformed road freight transport services into a primary logistics function linking supply chains across the world. In most countries on the continent, road freight transport is sometimes the only means of bringing goods from and to communities, linking them to local, regional and international markets. Noting that freight transport prices in Africa account for up to 20 percent of product costs, the emergence of longer transport distances (as a result of global sourcing) coupled with shorter product life cycles (especially for consumer goods) underscores the importance of reliable road freight transport services. For road freight transport operators, providing 'reliability of time' and product safety competes with modern efficiency demands of road safety, loading regulations and environmental safety (noise and air pollution).

The balance between economic, environmental and social objectives in Sub Saharan Africa's road freight transport industry is regulated through different rules of origin with third country rules and cabotage systems. In Central and West Africa, freight sharing schemes and queuing systems are also practiced. While these rules provide an important regulatory role for trade, they breed complacency among transport firms, induce border crossing delays and create differing load requirements. To overcome these exogenous challenges, firms, especially those in market driven transport services, have been developing organizational abilities for innovation to keep their prices competitive.

As discussed in Chapter 3, the most common managerial practices for developing and maintaining innovation capabilities in service industries are learning, intra-organizational knowledge sharing, risk appetite, rewards, and strategy and leadership. Africa's road freight transport industry, however, is visibly inhibited by a shortage of critical skills caused by an aging labour force, occupational health issues and low entry by young people, who are less interested in transport careers. Rewards in the industry are low and employment in the sector carries extremely high occupational health risks.

With regard to adoption of technological innovations, West and Central Africa's road freight transport industries are characterized by an oversupply of old poorly maintained trucks - the majority lack fuel

efficiency capabilities. Some countries in these sub regions have entirely obsolete fleets but still operate. East and Southern Africa's adoption of modern technologies is comparatively higher with their average truck ages ranging between five and seven years compared to the more than twelve years for West and Central Africa. Thus, overall, the diffusion of modern technologies across the continent's road freight transport industry is slow because, in some instances, existing and new technologies are incompatible.

7.3 Summary of the Research Findings

Overall, what the results reveal is that road freight transport operators in Namibia have high levels of innovation capacity. None of the participating firms scored below 50 percent on any of the constructs of innovation capability. The majority of the firms (over 60 percent) scored between 70 and 90 percent on commitments towards learning, intra organizational learning and strategy and leadership. However, scores on rewards for innovation and risk-taking acumen are conspicuously low, with 22 and 17 percent of participating firms recording 70 percent and below respectively.

The uptake of technological innovations among firms is high with 43.9 percent of firms having adopted two out of three technological innovations and 24.4 percent having adopted all three innovations. The study further shows that innovation capacity is fairly evenly distributed among firms of different sizes and ages. However, private companies have shown significantly higher levels of innovation capacity than closed corporation, indicating that the legal status of a firm does affect its innovative behavior.

Specifically, what the results tell us about the differences in innovation capability in Namibia's road freight transport industry is that firm size does not have a significant effect on the ability of employees to share knowledge and learn internally; nor does it affect the leadership style and the strategies a firm pursues - but medium sized firms do search for external knowledge more than micro and small firms do. Medium sized firms also exhibit a higher appetite for risk than micro sized firms. This proves that medium sized road freight transport firms in Namibia are better able to generate and absorb innovations than small and micro firms. The study further revealed a resource gap associated with firm size by highlighting that rewards in larger firms are significantly higher than in smaller firms.

From the results, it became clear that the number of years a firm has been in operation does not appear to have a linear significant effect on its ability to acquire external knowledge, learn internally and provide leadership and strategic directions for innovation. A firm's structural characteristics (size and age) do not have a significant effect on the adoption of technological innovations among industry operators either, although the adoption of technological innovations is significantly higher among

private firms than in closed corporations (similar with innovation capability). The study also showed that how a firm performs is not determined by its structural characteristics (size, age and legal status) as no significant relationships were observed.

Honing in on the relationship between a firm's innovation capability and its adoption of innovation pattern, the study confirmed a moderately positive relationship. This confirms the symbiotic relationship between Namibia's road freight transport operators' absorption capacity and their uptake of technological innovations. The relationship between integrative innovation capability and firm performance also shows a positive but weak association; again, reinforcing the argument that innovation capability is only a fraction of the innovation process. For individual constructs of innovation capability, positive moderate to strongly significant associations were recorded between intra-organizational learning and sales and intra-organizational learning and customer base; and between strategy and leadership and customer base. This shows that intra-organizational learning is a construct highly associated with firm performance.

In examining the relationship between adoption of technological innovations and total firm performance, the results recount a similar narrative. A moderately significant positive association was observed. This relationship was also reflected in individual performance measures, where firms that adopt more innovations were most likely to have higher sales figures and a growing customer base.

Overall, there is evidence to conclude that Namibia's road freight transport operators possess the capacity to provide efficient transport services to the economy but there is a need to improve rewards systems and attitudes towards risk in the industry. This is especially important because, despite high levels of intra-organizational learning - a construct strongly associated with high firm performance - it appears that innovation capabilities are not translating into efficient transport services, hence the high transport prices in the country. The results therefore draw the attention of industry operators to move beyond simply enabling employees to participate in the innovation process, to allow them to initiate, implement and evaluate innovative ideas.

7.4 Contributions and Implications

This is the first industry level innovation capacity study in Namibia. In addition to the new research perspective used, the study also empirically contributes to the knowledge of innovation capacity of road freight transport firms in a low skilled less regulated industry (compounded by a dearth of information). The contributions by this study are discussed below.

7.4.1 Methodological contribution

Previous quantitative innovation studies at firm level examined relationships between individual constructs of innovation capability with firm performance or between multi constructs of innovation capability with firm performance or between adoptions of technological innovations with firm performance. This study combined the above stated approaches to examine the relationship between innovation capability (using multiple constructs), adoption of technological innovation and firm performance. The approach is grounded on the premise that success of technological innovations in any organization is determined by its absorption capacity which is developed through innovation capabilities, see Figure 7.1 below.

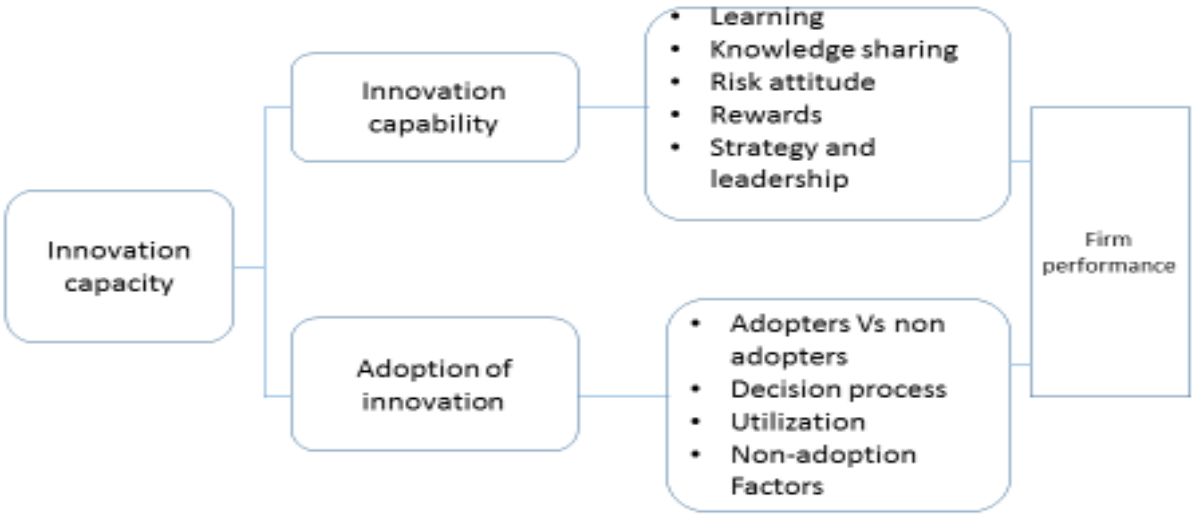

Figure 7.1 Innovation Capacity Assessment Approach

Using this approach has provided evidence that firm level innovation capacity can be assessed more comprehensively. Employing two research instruments eased the collection of both quantitative and qualitative data. The advantage of using follow up semi structured interviews is that it improves the understanding of innovation decision processes for adopting innovations in firms and it led to a shorter, friendlier questionnaire.

As compared to the two studies discussed in the results chapter (one from Australia and the other from Hong Kong), this approach provides a more improved and detailed analysis of the industry.

7.4.2 Empirical Contribution

7.4.2.1 Beyond Innovation Capability and Adoption of Technological Innovations

In terms of content, this study has gone beyond the assessment of innovation capacity and has empirically investigated a phenomenon often ignored in studies on innovation. The current study extends knowledge on road freight transport firms along the innovation spectrum by transcending the traditional science and technology approach through focused integration human factors and by seeking to examine this integrative effects on utilization of adopted technological innovations to create value in firms. In other words, the study introduces an improved innovation results spectrum to the field, comprising a firm's generation capabilities (human factor), absorption abilities (technology factor), actual utilization (socio integrative effect) and firm performance (bottom line). Within the context of the current results, it emerged that while adoption of technological innovation was high in firms, utilization was low. The underutilization of adopted technological innovations in the industry is caused by two main factors.

Firstly, from the users' perspectives of the studied technological innovations, there appears to be limited appreciation of the relative advantage of using some of the new technologies adopted. This is observed in instances where older technological innovations are still frequently used, while the newer technological innovations are either idle or underutilized.

The second factor is associated with employee's limited participation in the innovation process which leads to innovation initiatives being seen as management projects. This means that, even when employees are capable of fully utilizing the technological innovations, their association with such innovation is limited.

7.4.2.2 Inefficiency in Namibia's Road Freight Transport Innovation Ecosystem

Earlier studies on innovation capability in the transport and logistics industry have all reported positive significant relationships between integrative innovation capability and firm performance. The current results on the other hand found a positive but insignificant effects of integrative innovation capability and firm performance. These results reveal a weak innovation ecosystem where institutions accumulate innovation capability without exploiting that capability for economic value.

While results from the current study spotlights Namibia's road freight transport industry's inability to commercialize novelty, they also flag a systemic inertia of the country where the focus of innovation remains on research and development for science and technology. Inadvertently, the current results also show weak collaborations between universities/research institutions and public institutions with private sector, rendering R&D for science and technology less effective for commercialization in the industry.

7.4.2.3 Eroded Innovation Capabilities

In their study titled *Developing Innovation Capability in Organisations: A Dynamic Capabilities Approach*, Lawson and Samson (2001:380) provide an account of how 'efficiency, quality, customer responsiveness and speed' ceased being sources of competitive advantage for firms in the 1980s and 1990s, and became minimum mainstream operating requirements. While innovation has since remained a source of competitiveness, the results from the current study empirically highlight that some constructs of innovation capability (continuous learning, taking risks, rewards systems, and providing leadership and strategic direction) appear to have become mainstream competencies in the road freight transport industry. This is not surprising, as these capabilities are what drive growth in firms today. With rapid technological advances easing access to new information, the idiosyncratic abilities of some competencies might be eroding. The results do not, however, dispute the importance of these capabilities in firms. On the contrary, the positive association between these capabilities and innovation affirms their critical supportive function in the innovation process.

Earlier studies on innovation have not established the distinctiveness of intra-organizational learning (as a highly competitive factor) from other innovation capabilities. The current results therefore empirically affirm theoretical predictions which assert that novelty in process innovation is generated through interactions and continuous feedback among employees. Put differently, this study explicitly supports intra-organizational learning as the most competitive factor for Namibia's road freight transport firms.

7.4.2.4 Large Older Firms do not Innovate Significantly Better than Younger SMEs

Another empirical contribution of this study relates to the relationship between innovation capacity and firm size, age and incorporation. Results from past empirical studies on innovation maintain that firms of different sizes and ages innovate differently. The general conclusion among these studies is that larger and older firms, because of their ample resources and social capital networks (acquired over time), have significantly higher innovation capacity than younger small and medium enterprises. This perspective has not been empirically tested in the road freight transport industry. In the context of Namibia's industry, the difference is only significant on rewards where larger firms provide significantly better incentives than small and micro sized firms. No other input of innovation capability included in this study showed a significant difference between large firms and firms of other sizes. Instead, significant differences are observed between medium and micro size firms for most inputs of innovation capabilities. Similarly, age had no linear effect on either innovation capability or the uptake of technological innovations, as suggested by previous studies.

For Namibia's road freight industry, there are other factors underpinning innovative behaviors among differently sized firms which differ from previous studies. Most notably, in Namibia's road freight

transport industry; small and medium firms are established by skilled entrepreneurs from within the industry whose innovative behaviors mimic those of managers in large firms. Often, it is argued that SMEs in developing countries do not have access to finance, especially for conventional debt finance. However, in Namibia's road freight transport industry, the experience of SMEs owners/managers makes them attractive to equity finance which is more optimal for innovation and growth. The fact that private firms in Namibia's road freight transport industry innovate significantly higher than closed corporation also supports the possible use of alternative financing, a point not raised in earlier studies that only focused on ownership type.

Another emerging perspective established through this study is drawn from organizational life cycle so as to widen the argument on the interaction between age of a firm and innovative behavior. Quite often, firms in different life cycle might behave similarly (in terms of adopting innovation) not because of their age (solely) but because of the age of their technologies or other strategic changes. This could be older firms replacing their aging equipment or adding new production lines/functions who depict innovation behaviors associated with younger firms going into operation. It could also be middle aged firms stabilizing operations and mimicking innovative behaviors of younger firms that are still exploring markets or prototyping.

7.4.2.5 Effects of Social Systems on Adopter Categories

This study revisited adopter categories to determine their applicability to Namibia's road freight transport operators. While adopter category classifications are widely used in previous studies to understand adopter's characteristics, their context in the current study is limited in that they do not include social system attributes. Worded differently, they are unable to adhere to client conditionalities and regulatory requirements. In Namibia's road freight transport industry, vehicle tracking systems are a basic safety condition required by most clients of goods while fleet management systems are not. In such cases, most firms, regardless of their characteristics will adopt vehicle tracking systems earlier and faster than the fleet management systems. Therefore, in their current frame, adopter classifications in Namibia's road freight industry will only be applicable to those technological innovations that are solely adopted for operational efficiency while further qualifications will be needed for those technological innovations that are conditional in the industry.

7.4.3 Policy Implications

Industrialization programs for transforming the Namibian economy are planned against aspirations of efficient transport and logistics services. In acknowledging the dearth of documented information of this industry, this study affords policy makers empirical evidence on innovation capacity for differently sized, aged and incorporated road freight transport firms.

7.4.3.1 Finalize and Strengthen the Capacity for Implementing the National Research and Innovation Policy

The first point for policy consideration relates to the finalization and strengthening of implementation capacity for the national research and innovation policy. As discussed in Chapter 1, Namibia's system of innovation is fragmented with weak coordination mechanisms. Currently, innovation activities in the country are coordinated by different Ministries through different policies. For instance, the Ministry of Industrialization, Trade and SME Development promotes innovation through industrial policy, and intellectual property regulations (through the newly established Business and Intellectual Property Authority) while the Ministry of Higher Education (through the National Commission for Research Science and Technology) is responsible for promoting and implementing the National Policy on Research Science and Technology (under the Research Science and Technology Act of 2004).

The current implementation mechanism under the National Commission for Research Science and Technology is new and requires strengthening with respect to human resources to streamline complexities for implementing the innovation policy. The National Commission for Research Science and Technology will particularly require capacity to bridge the gap observed in the system of innovation between government (regulators), universities (research institutions) and the industry. There is a danger for the National Commission for Research Science and Technology to duplicate and even compete with other actors in the system of innovation given its dual function of regulating while actively participating in creating innovation.

The finalization and implementation of the research and innovation policy in Namibia is critical to support the enactment of laws that promote innovation. Consultations for developing a draft policy started before 2014 but there is only a first draft in place (discussed in 2016). The Ministry of Higher Education therefore needs to set a plan of action for the second round of consultations on the second draft, before finalizing the policy and publishing it.

7.4.3.2 Establish an Aggressive National Risk Capital Fund for the Road Freight Transport Industry

As revealed in the study, most small and medium enterprises in the road freight transport industry are established by former employees of bigger companies with high innovation orientation. While this study focused on behavioral inputs of innovation, funding was raised as a barrier to adoption of technological innovations. It is widely acknowledged that innovation is risky and requires patient capital. With the country's venture capital industry being in its infancy stage, government, particularly the Ministry of Finance, should invest in a public venture capital fund to target high risk projects with developmental objectives. The efficiency of the road freight transport industry is crucial

to Namibia's economic transformation goals but, as indicated earlier, incentives for this industry are limited.

Establishing a national risk capital fund is a priority area under Namibia's Financial Sector Strategy, and within the innovation domain, this could augment the small grant under the National Commission for Research Science and Technology. Although the country is currently experiencing liquidity challenges with the budget, investing in enterprise formation and enterprise growth will deepen and broaden government revenue.

Given the country's financial regulatory environment, there are at least two approaches for establishing a state funded risk capital fund to promote innovation in Namibia's road freight transport industry. The first option would be for government to establish a purely state sponsored fund while the second option would entail government inviting the private sector to invest and manage the fund-which would include individuals, companies, pension funds and development institutions. This study recommends the second option because it offers government an opportunity not only to *spend* in social development but also to *invest* and receive returns on its investment. Private sector participation will also allow government to access fund management expertise. The first option is discouraged because the fund is likely to be viewed as a government grant with all the attributed problems of recovery and repayment.

This means that in order to establish such a fund, government (through the Ministry of Finance) would need to consider Regulation 29 of the Pension Fund Act which governs the establishment of investment vehicles in Namibia.

7.4.3.3 Integrate Road Freight Transport Services in Road Transport Development Planning and Budgeting

The importance of road transport services in Namibia is acknowledged throughout the development framework but it does not receive attention in terms of planning. Specifically, strategies for developing the road freight transport industry (as outlined in the Fourth National Development Plan) are persistently fixated on infrastructure development with disregard or passive mention of transport service provision. Evidently, the provision of infrastructure development is placed under the Ministry of Works and Transport (and through that to the relevant State Owned Enterprises) while the provision of road freight transport services loosely falls under meso-level organizations, namely, the Walvis Bay Corridor Group, Namibia Logistics Association and Namibia Transporters Association.

To effectively integrate the provision of road transport services in the development framework, the National Planning Commission which is responsible for coordinating government programs through National Development Plans needs to purposively engage road transport operators in the planning

process alongside road infrastructure providers and promoters. A similar approach used to develop strategies for supporting tourist operators, farmers, manufacturers (which are also priority development sectors) should be applied.

7.4.3.4 Regulate Working Conditions

The third point for policy consideration relates to the need to regulate working conditions. Exploitation in Namibia's road freight transport industry continues to prevail despite the country's Labour Act. This is not the first study to reveal the poor working conditions in the industry, but it is the first study that attempts to highlight the relationship between reward systems and their manifestation in the willingness of employees to share knowledge and participate in innovative activities. The relationship between employees' well-being, creativity and innovation was confirmed with primary evidence in this study. Thus, introducing protective compensatory measures and enforcing occupational health standards that extend beyond road accidents can potentially encourage innovation and growth. This should be supported with industry-specific incentives, which are currently lacking.

To date, government through the Ministry of Labour and Social welfare has introduced minimum wage policies for domestic workers, security personnel, the construction industry's labourers and the agricultural sector's farm workers. In the road freight transport industry however, there is a minimum compensatory initiative by the Namibia Logistics Association, namely, the Driver Development Program. The Driver Development Program has two drawbacks. Firstly, the program does not include non-truck driver employees and secondly, compliance is voluntary. For this reason, the Ministry of Labour and Social Welfare may develop an industry-wide policy (with strong participation of the industry representatives) to protect employees in the transport and logistics industry. Existing mechanisms for developing and monitoring the implementation of the policy should be used.

7.4.3.5 Render Inclusive Development Support

The last point that relates to policy is the level of innovation capacity observed among differently sized firms, which is not significantly different between larger firms with small and medium enterprises. In the past, support from development partners through government has often benefited small and medium enterprises, including micro sized firms. What the current results suggest is that policy makers need to move away from providing blanket development initiatives for small and medium enterprises that often include micro enterprises. According to this study, micro enterprises have significantly lower capacities than medium enterprises, and their support programs need to be informed by these differences. The results also call on policy makers to not exclude large road freight transport enterprises from capacity development support programs, because their innovative

behavioral traits are not significantly different from those of small and medium enterprises. Thus, if government wants to improve the provision of road transport services in the economy, development support programs for road freight transport firms should be inclusive.

The implementation of this point is complex because freight transport development programs are typically supported by donors. However, most often than not, these programmes are implemented in partnership with the Walvis Bay Corridor Group. As a Public Private Partnership with regulatory authority in the industry, the Walvis Bay Corridor Group needs to sensitize partners of this dynamic during programme design stage.

7.4.4 Managerial Implications

7.4.4.1 Intra-Organizational Learning Drives Innovation

There are three contributions from this study for managerial practices in Namibia's road freight transport industry. The first contribution is for managers to note that while studies have reported high levels of innovation capability in the industry, not all constructs offer competitive value. Specifically, these results present an argument for road freight transport managers to maintain high levels of intra-organizational learning, and to use them as knowledge management tools for two reasons. Firstly, there is high employee turnover in the industry, and firms need to retain knowledge before it is lost. Secondly, through intra-organizational learning firms are able to combine newly acquired knowledge from different employees or units, internalize this, and develop it further into rich new knowledge, which is a requirement for process improvement.

7.4.4.2 Incentivize Employees to Engage in Creative Activities

The second contribution relates to the need for managers to improve their reward systems in order to incentivize employees to engage in creative activities. Innovation is an outcome of an often risky creative process that requires ability and willingness. The blind spot that lies between the ability and the willingness of employees to innovate, according to organization psychology theories, is their well-being. When employees feel safe and trust the firm to look after their interests, they search for better ways to improve the firm. This is because creativity is a discretionary behaviour, where employees seek improvement not because they have to but because they want to. What this means for managers is that they need to take a look at their current practices and create working environments that will bridge the innovation gap in their firms. For most firms, this will mean going back to basics by ensuring that employees (especially truck drivers) are afforded enough rest; entitled paid annual leave days are utilized, equipment (trucks and other equipment) is operational and well maintained; and monetary compensation is reflective of employees' contribution (and includes public holidays and overtime).

7.4.4.3 Involve Employees Meaningfully in the Adoption of Innovation Process

The third contribution is that the adoption of technological innovations without the substantial participation of employees in the process does not necessarily improve a firm's competitiveness. Currently, adoption of technological innovations in Namibia's road freight transport industry follows what Burgess, Shaw and de Mattos (2005:101) refer to as 'political man' syndrome, where senior managers make decisions to acquire innovations and then persuade employees (who may have different perspectives on such innovations) to implement them. It is easy for managers in road freight transport firms to overlook innovative ideas from grassroots level because of the low levels of education of most employees. But when managers disdain employees' inputs at ideation stage, they deprive firms of wider pools of innovation ideas, and lay the grounds for inadequate utilization of adopted technological innovations. This study highlights the need for managers to be aware of the implications of the disconnect between capital and labour because it is a manager-induced phenomenon and can be addressed through management practices.

For managers, acquiring knowledge, creating a culture for taking risks, and providing strategic and leadership guidance are not sufficient if employees are not involved and motivated to willingly explore value creation activities. Current practices only lead to high innovation capabilities which employees use to apply for jobs outside of the firm or industry, with no improvement to firm performance. Thus, the fusion of company assets (enabling resources) and employees' willingness (to creatively improve their tasks) for the firm is what breeds innovative results, and that is what will maintain skills in the industry.

7.5 (Updated) Final Thoughts

Although this study was executed at firm level, it evokes accounts of national-level innovation capacity. Nations, after all, whose firms went on to drive economic growth have done so on the back of heavy public spending on innovation programs. The United States, most Nordic countries and Asian tigers are such examples. In terms of policy, for instance, the recent literature on innovation is unanimous on two points. The first point is that what separates innovation-driven economies from developing economies is innovation policy programs that allow direct, collaborative partnerships between the private sector and research institutions. This means that the public sector does not only spend on traditional basic research and setting framework conditions for innovation, but it also directs huge investments in R&D infrastructures and in companies to create innovation. The second point is that strong public institutions for transacting collaborative innovation projects are central to the successful implementation of these policy programs.

On the surface, Namibia's national program on research, science, technology and innovation compares well with modern innovation policy programs that allows active public investment in the economy. The National Commission on Research Science and Technology (NCRST), with its dual role of regulating and providing funds for innovation, also resembles a support institution for innovation policy programs. Coupled with increasing expenditure (in real terms and as a percentage of GDP) on innovation science and technology over the past six years, it is regrettable that Namibia is ranked among the worst innovation performers in the world (at 107th out of 141 countries).

There is not enough data to assess public investments in innovation activities in Namibia. However, if NCRST's funding periods (of 6 to 24 months) and piecemeal investments average values (of up to 200 000 Namibia Dollars per innovation project) are assessment yardsticks, the country is choosing safe, incremental innovations over risky, experimental, radical innovations. Such an approach will promote competitive value, especially in service-industry firms, but will not stimulate innovation value, which requires radical, disruptive innovations in the economy.

In developing countries, public investment for innovation is constantly competing with social programs to combat poverty and provide basic services. As a result, innovation programs in Namibia, as in many developing countries, are resistant to solving local problems optimally because they are focused on developing capabilities for absorbing and adopting *foreign* technologies. Innovation is risky, time extensive and requires large investments that adversely impacts the capability of firms to establish, nurture and promote innovation.

7.6 Limitations of the Study

This research encountered limitations many of which are inherent in firm level studies of small economies. The first limitation is the population size. Like many industries in Namibia, the road freight transport industry comprises only a few enterprises. Thus, even though the response rate was high for firm-level studies- at 64 percent - the number of firms is inadequate to allow for complex statistical analyses.

This limitation should also be interpreted alongside reliability scores of innovation capability measurement instrument observed in this study. While all five constructs' reliability scores range between 0.705 - 0.855, and allow results to be generalized beyond participants to the population, with a small sample, transferability of the results beyond Namibia's road freight transport industry must be applied with caution.

The second limitation is embedded in the types of technological innovations (employed in this study) to determine the adoption of innovations. These technological innovations were selected based on factors unique to Namibia, i.e. types of goods the country imports and exports, long transit corridor

routes, single-directional traffic (the main cause for running empty trucks), and cargo safety along the routes. The generalization of these results should therefore be considered within these limits.

7.7 Recommendations for Future Research

This study identified four areas that can serve as opportunities for future research. The first area springs from the significant difference observed between the innovation capability of road freight transport firms established in the first decade after the road transport reform process and those established before independence. There is an opportunity to obtain more data to examine the reasons for this phenomenon.

The second area for possible future research relates to an attribute of firm type that is not common in the road freight transport industry, but found in other industries, namely unlimited liabilities firms. All firms that participated in this study are limited liability firms. There is therefore an opportunity to explore if firms with limited liabilities and those without limited liabilities innovate significantly differently. The proposed study would focus on micro and small enterprises as this is the category where majority of firms with unlimited liabilities reside.

The third possible area to focus on for future research is to compare the top-down innovation approach (where management engineers and drives innovation) to a bottom-up approach (where employees are responsible for initiating, evaluating and implementing innovation). Such a study can draw experiences from employee-driven innovation policies and practice in countries like Denmark, Finland and Germany.

Lastly, this study used the firm as the primary unit of analysis. This implies that the study predominantly relied on management perception to represent the firm. A follow-up study at both firm and individual levels is vital to compare the perceptions of innovation by management and employees - in the boardroom *and* in the driver's seat.

REFERENCES

Aardt, I.V., Aardt, C.V., Bezuidenhout, S. & Mumba, M. 2011. *Entrepreneurship and New Venture Management*. Southern Africa: Oxford University Press.

Ackermann, G. Hechter,T. & Louw, K. 2008. Current Status of Weigh-in-Motion in Sub-Sahara Africa." Proceedings of the International Conference on Heavy Vehicles HV, Paris.

Adams, R., Bessant, J. & Phelps, R. 2006. Innovation Management Measurement: A Review. *International Journal of Management Reviews,* 8(1): 21-47.

African Development Bank Group. 2002. *Aus-Rosh Pinah Road. Appraisal Report*. Infrastructure Department of North South and East Regions: African Development Bank.

African Development Bank, OECD & UNDP. 2014. *African Economic Outlook 2014: Global Value Chains and Africa's Industrialisation*. Tunisia: African Development Bank Group.

African Development Bank, OECD & UNDP. 2015. *African Economic Outlook: Regional Development and Spatial Inclusion*. Tunisia: African Development Bank Group.

African Development Bank, World Bank & Infrastructure Consortium Africa. 2011. *Handbook on Infrastructure Statistics.* Denmark: Africa Infrastructure Knowledge Program.

African Development Bank. 2013a. *African Development Report 2012: Towards Green Growth in Africa*. Tunisia: African Development Bank Group.

African Development Bank. 2014. *Namibia Country Strategy Paper 2014-2018*. Centurion: African Development Bank.

African Development Bank. n.d. *Road Transport Services and Infrastructure: Zimbabwe Report*. Tunisia: African Development Bank.

African Union. 2012. *Action Plan for Boosting Intra-African Trade. Zero Draft*. Addis Ababa: African Union.

Alila, P.O. Khayesi, M. Odhiambo, W. & Pederson, P.O. 2005. Development of African Freight Transport– The Case of Kenya. DIIS Working Paper no 2005/6. Copenhagen: Danish Institute for International Studies (DIIS).

Al-Khedher, M. A. 2012. Hybrid GPS-GSM Localization of Automobile Tracking System. *International Journal of Computer Science and Information Technology* 3 (6):75-85.

Alli, B.O. 2008. *Fundamental Principles of Occupational Health and Safety*. 2nd edn. Geneva: ILO.

Alwin, D.F. 2010. How Good is Survey Measurement? Assessing the Reliability and Validity of Survey Measures. In Marsden., V. & Wright, D (eds.). *Handbook of Survey Research*. 2nd edn. Bingley: Emerald Group Publishing Limited.

Amara, N., Landry, R., Becheikh, N. & Ouimet, M. 2008. Learning and Novelty of Innovation in Established Manufacturing SMEs. *Technovation,* 28(7):450-463.

Andruskiewicz, M., Murray, T., Sarber, B. & Sharpe, R. 2012. Promoting Namibia as a Hub for International Trade and Transport: Case Studies of Business Growth in the Transport and Logistics Industry. Unpublished Dissertation. Worcester: Worcester Polytechnic Institute.

Anon. 2012. Ease Fuel Costs and Environmental Impact. *Transport World Africa*. 10 (1):4-5

Antonelli, C. 1985. The Diffusion of an Organizational Innovation: International Data Telecommunications and Multinational Industrial Firms. *International Journal of Industrial Organizations*, 3 (1):109-118.

Armbruster, H. Bikfalvi, A. Kinkel, S. &Lay, G. 2008. Organizational innovation: The Challenge of Measuring Non-Technical Innovation in Large-Scale Surveys. *Technovation*, 28 (10):644-657.

Arvis, J. F., Saslavsky, D., Ojala, L., Shepherd, B., Busch, C. & Raj, A. 2014. *Connecting to Compete: Trade Logistics in the Global Economy. The Logistics Performance Index and its Indicators.* Washington: World Bank.

Atilola, G. O., Akpa, O. M. & Komolafe, I. O. O. 2010. HIV/AIDS and the Long-Distance Truck Drivers in South-West Nigeria: A Cross-Sectional Survey on the Knowledge, Attitude, Risk Behaviour and Beliefs of Truckers. *Journal of Infection and Public Health,* 3(4):166-178.

Autant-Bernard, C., Guironnet, J. P. & Massard, N. 2010. *The Determinants of Innovation Adoption*. Working Paper 1034. Lyon-St Étienne: GATE Groupe d'Analyse et de Théorie Économique.

Aven, T. 2007. A Unified Framework for Risk and Vulnerability Analysis Covering both Safety and Security. *Reliability Engineering and System Safety*, 92(6):745-754.

Awosan, K.J., Ibrahim, M.T.O., Arisegi, S.A. & Erhiano, E.E. 2014. Knowledge of HIV/AIDS Risk Perception, Sexual Lifestyle and Condom use Among Drivers in Sokoto Nigeria. *Journal of Infectious Diseases and Immunity*. (6)3:19-25.

Balasubramanian, N. & Lee, J. 2008. Firm Age and Innovation. *Industrial and Corporate Change,* 17(5):1019-1047.

Bank of Namibia. 2010. *The Role of SMEs in Employment Creation and Economic Growth: Lessons from other Countries.* Windhoek. BON.

Barka, H. B. 2012. *Border Posts, Checkpoints, and Intra-African Trade: Challenges and Solutions*. Abidjan: African Development Bank.

Battisti, G. & Stoneman, P. 2010. How innovative are UK firms? Evidence from the fourth UK community innovation survey on synergies between technological and organizational innovations. *British Journal of Management*, 21(1):187-206.

Beaulieu, J.K. 2005. *The Issues of Fatigue and Working Time in the Road Transport Sector*. Geneva: ILO

Benstowe, S. J. 2008. Long Driving Hours and Health of Truck Drivers. Unpublished Master's Thesis. New Jersey: New Jersey Institute of Technology.

Beuran, M., Gachassin, M.C. & Raballand, G. 2013. *Are there Myths on Road Impact and Transport in Sub-Saharan Africa?* Working Paper. University of Paris. [Online] available at: ftp://mse.univ-paris1.fr/pub/mse/CES2013/13049.pdf (Accessed March 2015).

Birkinshaw, J., Hamel, G. & Mol, M.J. 2008. Management Innovation. *Academy of Management Review,* 33(4):825-845.

Bishop, C.P., Shumway, C.R. & Wandschneider, P.R. 2010. Agent Heterogeneity in Adoption of Anaerobic Digestion Technology: Integrating Economic, Diffusion, and Behavioral Innovation Theories. *Land Economics,* 86(3):585-608.

Bresnahan, T. 2007. Creative Destruction in the PC Industry. In, Malerba, F & Brusoni, S. (eds.). Perspectives on Innovation. Cambridge: Cambridge University Press. 105-140.

Brown, I. & Russell, J. 2007. Radio Frequency Identification Technology: An Exploratory Study on Adoption in the South African Retail Sector. *International Journal of Information Management*, 27(4):250-265.

Bruce, J.R. 2014. Risky Business: How Social Psychology can Help Improve Corporate Risk Management. *Business Horizons*, 57(4):551-557.

Bruzelius, N.A., Poolman, F.W. & Ravenscroft, W. 2000. *The Namibian Road Sector Reform*. Conference Paper. South African Transport Conference. South Africa, 17-20 July.

Bryman, A. & Bell, E. 2011. *Business Research Methods*. 3rd edn. Oxford: Oxford University Press.

Bryman, A. 2008. *Social Research Methods*. 3rd edn. New York: Oxford University Press Inc.

Burgess, T. F., Shaw, N. E. & de Mattos, C. 2005. Organisational Self-assessment and the Adoption of Managerial Innovations. *International Journal of Productivity and Performance Management*, 54(2): 98-112.

Burke, W.W., Lake, D.G. & Paine, J.W. 2008. *Organization change: A comprehensive reader*. San Francisco: John Wiley & Sons.

Buxton, J. & Davidson, M. 1996. Building a Sustainable Growth Capability. *Strategy and Leadership*, 24(6):33-38.

Caggese, A. 2012. Entrepreneurial Risk, Investment, and Innovation. *Journal of Financial Economics*, 106(2):287-307.

Calantone, R.J. Cavusgil, S.T. & Zhao, Y. 2002. Learning Orientation, Firm Innovation Capability, and Firm Performance. *Industrial Marketing Management*, 31(6):515-524.

Chang, S. & Lee, M. 2008. The Linkage between Knowledge Accumulation Capability and Organizational Innovation. *Journal of knowledge management,* 12(1):3-20.

Chang, S. I., Hung, S. Y., Yen, D. C. & Chen, Y. J. (2008). The Determinants of RFID Adoption in the Logistics Industry: A Supply Chain Management Perspective. *Communications of the Association for Information Systems*, 23(1):12.

Cheng, J., Yeh, C. & Tu, C. 2008. Trust and Knowledge Sharing in Green Supply Chains. *Supply Chain Management: An International Journal*, 13(4):283-295.

Choi, S.B., Lee, S.H. & Williams, C. 2011. Ownership and Firm Innovation in a Transition Economy: Evidence from China. *Research Policy*, 40(3):441-452.

Christensen, J., Glaeser, K.P., Shelton, T., Moore, B. & Aarts, L. 2010. *Moving Freight with Better Trucks: Improving Safety, Productivity and Sustainability*. Discussion Paper 10. International Transport Forum: Joint Transport Research Centre.

Chuhan-Pole, P. 2014. *Africa's Pulse*. Washington DC: World Bank.

Connaughton, J. E. & Madsen, R. A. 2009. Regional Implications of the 2001 Recession. *The Annals of Regional Science*, 43(2): 491-507.

Cornell University, INSEAD & WIPO. 2015. *The Global Innovation Index 2015: Effective Innovation Policies for Development*. Geneva: WIPO.

Cornell University, INSEAD & WIPO. 2016. *The Global Innovation Index 2015: Winning with Global Innovation*. Geneva: WIPO

Coyle, J. J., Bardi, E. J. & Novack, R. A. 2000. *Transportation*. South-Western College Publishing/ Thomson Learning: Cincinnati.

Cronjé, J. N. 2015. Logistics management skills development: A Zimbabwean case. *Journal of Transport and Supply Chain Management*, 9(1):9.

Curtis, B. 2014. Implementing Uniform Loads through Africa. *Transport World Africa*, 12(1):5.

Dachs, B. & Peters, B. 2014. Innovation, Employment Growth, and Foreign Ownership of Firms: A European Perspective. *Research Policy*, 43(1):214-232.

Damanpour, F. & Aravind, D. 2012. Managerial Innovation: Conceptions, Processes, and Antecedents. *Management and Organization Review*, 8(2):423-454.

Damanpour, F. & Schneider, M. 2006. Phases of the Adoption of Innovation in Organizations: Effects of Environment, Organization and Top Managers. *British Journal of Management*, 17(3):215-236.

Damanpour, F. & Wischnevsky, J. D. 2006. Research on Innovation in Organizations: Distinguishing Innovation-Generating from Innovation-Adopting Organizations. *Journal of Engineering and Technology Management*, 23(4):269-291.

Damanpour, F. 1987. The Adoption of Technological, Administrative, and Ancillary Innovations: Impact of Organizational Factors. *Journal of management*, 13(4):675-688.

Damanpour, F. 1991. Organizational innovation: A Meta-Analysis of Effects of Determinants and Moderators. *Academy of Management Journal*, 34(3), 555-590.

Damanpour, F. 2010. An Integration of Research Findings of Effects of Firm Size and Market Competition on Product and Process Innovations. *British Journal of Management*, 21(4):996-1010.

Damanpour, F., Szabat, K.A. & Evan, W.M. 1989. The Relationship between Types of Innovation and Organizational Performance. *Journal of Management Studies*, 26(6):587-602.

Davies, I., Mason, R. & Lalwani, C. 2007. Assessing the Impact of ICT on UK General Haulage Companies. *International Journal of Production Economics*, 106(1):12-27.

De Araújo Burcharth, A. L. L., Lettl, C. & Ulhøi, J.P. 2015. Extending Organizational Antecedents of Absorptive Capacity: Organizational Characteristics that Encourage Experimentation. *Technological Forecasting and Social Change*, (90):269-284.

De Bod, A. & Havenga, J.H. 2010. Sub-Saharan Africa's Rail Freight Transport System: Potential Impact of Densification on Cost. *Journal of Transport and Supply Chain Management*, (4):89-101.

Dedrick, J. & West, J. 2003. *Why Firms Adopt Open Source Platforms: A Grounded Theory of Innovation and Standards Adoption*. Proceedings of the Workshop on Standard Making: A Critical Research Frontier for Information Systems. Seattle, WA. December 2003.

Delre, S.A., Jager, W. & Janssen, M.A. 2007. Diffusion Dynamics in Small-World Networks with Heterogeneous Consumers. *Computational and Mathematical Organization Theory*, 13(2):185-202.

Delre, S.A., Jager, W., Bijmolt, T.H. & Janssen, M.A. 2010. Will it Spread or Not? The Effects of Social Influences and Network Topology on Innovation Diffusion. *Journal of Product Innovation Management*, 27(2):267-282.

Demba, E., Ceesay, M.M. & Mendy, G. D. 2013. *Prevention of Work Related Accidents Including High Risk Sectors such as Agriculture, Construction and Mining: The Gambia Country Report*. Gambia: International Social Security Association.

Deschamps, J. 2008. *Innovation leaders: How Senior Executives Stimulate, Steer and Sustain Innovation*. San Fransisco: John Wiley & Sons.

Deutscher Entwicklungsdienst. 2007. *Project Proposal: Situation Analysis for the Namibian Transport Industry*. Windhoek: DED.

Developing Namibia's Transport Sector. *Informante*, 24 July 2014: 1-12.

Diederen, P., Van Meijl, H., Wolters, A. & Bijak, K. 2003. Innovation Adoption in Agriculture: Innovators, Early Adopters and Laggards. *Cahiers d'économie et Sociologie Rurales*, 67:30-50.

Dillman, D. A., Smyth, J. D. & Christian, L. M. 2009. *Internet, Mail, Phone and Mixed-Mode Surveys: The Tailored Design Method*. 3rd edn. New Jersey: John Wiley & Sons, Inc.

Dillman, D.A. & Messer, B. 2010. Mixed Modes Surveys, in Marsden, V. & Wright, D. (eds.). *Handbook of Survey Research*. 2nd edn. Bingley: Emerald Group Publishing Limited.

Dills, T. 2015. *The Changing Face of Incentive-Based Compensation.* [Online]. Available at: http://www.overdriveonline.com/the-changing-face-of-incentive-based-compensation/. (Accessed June 2015).

Dixon, N.M. 1999. *The Organizational Learning Cycle: How We Can Learn Collectively*. 2nd edn. Hampshire: Gower Publishing Limited

Dorsey, S. & Walzer, N. 1983. Workers' Compensation, Job Hazards, and Wages. *Industrial and Labor Relations Review*, 36(4):642-654.

Draper, P. 2010. *Rethinking the (European) Foundations of Sub-Saharan African Regional Economic Integration: A Political Economy Essay*. Working Paper No. 293. [Online]. Available at: http://www.oecd.org/dev/wp. (Accessed November 2014).

Droppa, D. 2014. Trucking a Tragedy Waiting to Happen. 24 October. *IOL Motoring*. [Online] Available at: http://www.iol.co.za/motoring/industry-news/trucking-a-tragedy-waiting-to-happen-1.1770006#.VYhNqkY31sk. (Accessed June, 2015)

Drucker, P.F. 2007. *Innovation and Entrepreneurship*. Oxford: Butterworth-Heinemann Publications.

Dullaert, W. & Zamparini, L. 2013. The Impact of Lead Time Reliability in Freight Transport: A Logistics Assessment of Transport Economics Findings. *Transportation Research*, 49(1):190-200.

Dutch Ministry of Economic Affairs, Agriculture and Innovation. 2012. *A Study on the Kenyan-Dutch Horticultural Supply Chain*. The Hague:.The Dutch Ministry of Economic Affairs, Agriculture & Innovation.

Dzisah, J. 2011. Mobilizing for Development: Putting the Triple Helix into Action in Ghana. In Saad, M. & Zawdie, G. (eds.). *Theory and Practice of Triple Helix Model in Developing Countries: Issues and Challenges*. New York: Taylor & Francis.

Earl, L. & Gault, F. 2006. *National Innovation, Indicators and Policy*. Cheltenham: Edward Elgar.

Elvegård. I. 2011. *Corridors of Hope Projects. Final Evaluation*. United States Agency for International Development – Namibia. Windhoek: USAID.

Energy Information Administration. 2010. *International Energy Outlook 2010*. U.S. Energy Information Administration. [Online] Available at: www.eia.gov/oiaf/ieo/index.html. (Accessed February 2015).

Essmann, H.E. 2009. Toward Innovation Capability Maturity. Unpublished Doctoral Dissertation. Stellenbosch: University of Stellenbosch.

Etzkowitz, H. & Leydesdorff, L. 2000. The Dynamics of Innovation: From National Systems and "Mode 2" to a Triple Helix of University–Industry–Government Relations. *Research Policy*, 29(2):109-123.

European Commission. 2014. *Report on the State of the EU Road Haulage Market.* Luxembourg: Publications Office of the European Union

Eurostat. 2012. The Community Innovation Survey 2012: The Harmonised Survey Questionnaire. [Online]. Available at: http://ec.europa.eu/eurostat/documents/203647/203701/Harmonised+survey+questionnaire+2012/164dfdfd-7f97-4b98-b7b5-80d4e32e73ee. (Accessed July 2014).

Fagerberg, J. & Srholec, M. 2008. National Innovation Systems, Capabilities and Economic Development. *Research Policy*, 37(9):1417-1435.

Fagerberg. 2006. Innovation: A Guide to the Literature. In, Fagerberg, J. Mowery, D.C. & Nelson, R. (eds.). *The Oxford Handbook of Innovation*. Oxford: Oxford University Press.

Federation of South and East African Road Freight Associations. 2014. Truck ban in Swaziland. FESARTA. 18 June. [Online] Available at: http://www.fesarta.org/1068. (Accessed March 2014.)

Federation of South and East African Road Freight Associations. 2012. Without Trucks SA Stops. *Transport World Africa*, 10(3):7

FESARTA. 2013. *ZIMRA Commissions a Non- Intrusive Scanner*. [Online] Available at: http://www.fesarta.org/924. (Accessed March 2015).

Field, A. 2013. *Discovering statistics using IBM SPSS statistics*. 4th edn. Los Angeles: Sage.

Fieldhouse, D. K. 1961. 'Imperialism': An Historiographical Revision1. *The Economic History Review*, 14(2): 187-209.

Finel, N. & Tapio, P. 2012. *Decoupling Transport CO2 from GDP*. Finland Future Research Centre, eBook 1, [Online]. Available at: http://www.utu.fi/fi/yksikot/ffrc/julkaisut/e-tutu/Documents/eBook_2012-1.pdf. (Accessed February 2015).

Fleming, L. Boko Haram Crisis: The Nigerian Truckers Risking Attack. *BBC News Africa*. 09 March. [Online] Available at: http://www.bbc.com/news/world-africa-31533391. (Accessed May 2015).

Freeman, C. 1982. *The Economics of Industrial Innovation*. 2nd edn. London: Frances Pinter (Publishers) Limited.

FreightWatch International. 2013. *Global Cargo Theft Threat Assessment*. FreightWatch International Supply Chain Intelligence Center. [Online] Available at: www.freightwatchintl.com. (Accessed January 2015).

Freund, C. & Rocha, N. 2010. *What Constrains Africa's Exports?* Policy Working Paper. Washington DC: World Bank.

Friese, S. 2014. *Qualitative Data Analysis with ATLAS.ti*. 2nd edn. Los Angeles: Sage.

Fukui, M., Nishinari, K., Yokoya, Y. & Ishibashi, Y. (2009) Effect of Real-Time Information upon Traffic Flows on Crossing Roads. *Physica A: Statistical Mechanics and Its Applications*, 388(7):1207-1212.

Ganapathi, S.L. & Nandi, S.K. 2014. *Logistics Management*. Oxford University Press: India

Garcia, R. & Calantone, R. 2002. A Critical Look at Technological Innovation Typology and Innovativeness Terminology: A Literature Review. *Journal of Product Innovation Management*, 19(2):110-132.

Geda, A. & Kebret, H. 2008. Regional Economic Integration in Africa: A Review of Problems and Prospects with a Case Study of COMESA. *Journal of African Economies*, 17(3): 357-394.

Geroski, P.A. 2000. Models of Technology Diffusion. *Research Policy*, 29(4):603-625.

Gibendi, R. 2014. Hauliers Sign Charter on EA Cargo Limits. *The East African*. 25 October. [Online] Available at: http://www.theeastafrican.co.ke/news/Hauliers-sign-charter-on-EA-cargo-limits/-/2558/2499258/-/4osyycz/-/index.html. (Accessed June 2015).

GIZ CSP. 2014. *Mitigating Emissions in the Transport Refrigeration Sector in South Africa: Introducing Innovative Logistics and Supply Structures in the South African Transport Refrigeration Sector to Mitigate Emissions*. Bonn: GIZ.

Grant, D. B., Trautrims, A. & Wong, C. Y. 2013. *Sustainable Logistics and Supply Chain Management: Principles and Practices for Sustainable Operations and Management*. London: Kogan Page Publishers.

Gray, D., Anable, J., Illingworth, L. & Graham, W. 2006. Decoupling the Link between Economic Growth, Transport Growth and Carbon Emissions in Scotland. [Online] Available at: ttp://www.gov.scot/resource/doc/935/0042647.pdf. (Accessed February 2015).

Green Truck Partnership. n.d. *Lift Axles: Case Study*. [Online] Available at: http://www.rms.nsw.gov.au/documents/about/environment/air/case-study-lift-axles.pdf. (Accessed May 2014).

Grobler, R. 2010. Mobilising Innovation as an Organisational Competence in Selected Namibian Companies. Unpublished Master's Thesis, Stellenbosch: University of Stellenbosch.

Gubbins, E.J. 2003. *Managing Transport Operations*. London: Kogan Page Publishers.

Guerrero, P. Lucenti, K. & Galarza, S.S. 2009. *Trade Logistic and Regional Integration in Latin America and the Caribbean*. Inter-American Development Bank. [Online]. Available at: http://www.iadb.org/wmsfiles/products/publications/documents/35031936.pdf. (Accessed February 2015).

Gwilliam, K. 2011. *Africa's Transport Infrastructure: Mainstreaming Maintenance and Management*. Washington DC: World Bank.

Hair, J.F., Money, A.H., Samouel, P. & Page, M. 2007. *Research Methods for Business*. England: John Wiley & Sons Ltd.

Hall, B.H. 2006. Innovation and Diffusion. In Fagerberg, J. Mowery, D.C. & Nelson, R. (eds.). *The Oxford Handbook of Innovation*. Oxford: Oxford University Press.

Hamel, G. & Prahalad, C.K. 1990. The Core Competence of the Corporation. *Harvard Business Review* 3:75-91.

Hamel, G. & Prahalad, C.K. 1994. *Competing for the Future: Breakthrough Strategies for Seizing Control of Your Industry and Creating the Markets of Tomorrow*. Massachusetts: Harvard Business School Press.

Hamel, G. 2006. The Why, What, and How of Management Innovation. *Harvard Business Review*, 84(2):72-84.

Hamilton, B. A. 2010. *Dakar-Bamako Corridor Cost of Transport Analysis*. Senegal: USAID Senegal.

Hanouz, M.D., Geiger, T. & Doherty, S. 2014. *The Global Enabling Trade Report 2014*. Geneva:World Economic Forum.

Hartzenberg, T. 2011. *Regional Integration in Africa*. World Trade Organization. [Online]. Available at: https://www.wto.org/english/res_e/reser_e/ersd201114_e.pdf. (Accessed November 2014).

Hazen, B. T. & Byrd, T. A. 2012. Toward Creating Competitive Advantage with Logistics Information Technology. *International Journal of Physical Distribution and Logistics Management*, 42(1):8-35.

He, Z. & Wong, P. 2004. Exploration vs. Exploitation: An Empirical Test of the Ambidexterity Hypothesis. *Organization Science*, 15(4):481-494.

Hesse, M. & Rodrigue, J.P. 2004. The Transport Geography of Logistics and Freight Distribution. *Journal of Transport Geography*, 12(3):171-184.

Heyns, G. & Luke, R. (2012). Skills Requirements in the Supply Chain Industry in South Africa. *Journal of Transport and Supply Chain Management*, 6(1):107-125.

Hobday, M. 1995. *Innovation in East Asia: The Challenge to Japan*. England: Edward Elgar.

Hoffman, A. J., Lusanga, K. & Bhero, E. 2013. A combined GPS/RFID system for improved cross-border management of freight consignments. In *AFRICON*, September 2013:1-8. IEEE.

Hu, L. & Randel, A.E. 2014. Knowledge Sharing in Teams: Social Capital, Extrinsic Incentives, and Team Innovation. *Group and Organization Management*. 39: 213-243.

Huergo, E. & Jaumandreu, J. 2004a. How does Probability of Innovation Change with Firm Age? *Small Business Economics*, 22(3-4):193-207.

Huergo, E. & Jaumandreu, J. 2004b. Firms' Age, Process Innovation and Productivity Growth. *International Journal of Industrial Organization*, 22(4): 541-559.

Huhtala, H. & Parzefall, M. R. 2007. A Review of Employee Well-Being and Innovativeness: An Opportunity for a Mutual Benefit. *Creativity and Innovation Management*, 16(3):299-306.

Hurt, H.T., Joseph, K. & Cook, C.D. 1977. Scales for the Measurement of Innovativeness. *Human Communication Research*, 4(1):58-65.

Hussain, M. 2013. Humanitarian Aid to CAR Stalls as Cameroon's Truckers Strike. Thomson Reuters Foundation. 07 September [Online] Available at: http://www.trust.org/item/20130902120309-mp2wq. (Accessed May 2015).

Hvide, H.K. & Panos, G.A. 2014. Risk Tolerance and Entrepreneurship. *Journal of Financial Economics*, 111(1):200-223.

Ibrahim, A.R., Zolait, A.H.S., Subramanian, S. & Ashtiani, A.V. 2009. Organizational Innovative Capabilities: An Empirical Study of Malaysian Firms. *Journal of Innovation and business best Practices*, 1(2):9-18.

ICF International. 2009. *Final Report Sub-Saharan Africa Refinery Project Executive Summary*. Maryland: World Bank and the African Refiners Association.

Iizuka, M., Mawoko, P. & Gault, F. 2015. *Innovation for Development in Southern & Eastern Africa: Challenges for Promoting ST&I Policy*. Maastricht: United Nations University-MERIT.

Indongo, N. Maharero, T. & Hangula, M. 2014. *Assessing the Scope of Procurement and the Relevance of Procurement Financing in Namibia for SMEs. Prepared for Namibia Procurement Fund*. Windhoek: Nampro Fund

Infrastructure Consortium for Africa. 2013. *Boosting African Trade Cross-Border Harmonisation of Transport Policy and Regulation*. ICA Plenary Meeting: Background Paper. [Online]. Available at: http://www.icafrica.org/fileadmin/documents/ICAmeeting/2013AnnualMeeting/PLENARY%20BACKGROUND%20PAPEROct30.pdf. (Accessed February 2015).

Inside Mining. 2011. Green Technology Inhibited by Fuel Quality: Trucks Technology. *Inside Mining*, 4(7):44-46.

Institute for Public Policy Research. 2009. *Namibia Business and Investment Climate (NAMBIC) Survey*. Prepared for Namibia Chamber of Commerce and Industry and Namibia Manufacturers Association, funded by GIZ. Windhoek: IPPR.

Institute for Public Policy Research. 2012. *Namibia Business and Investment Climate (NAMBIC) Survey*. Prepared for Namibia Chamber of Commerce and Industry and Namibia Manufacturers Association, funded by GIZ. Windhoek: IPPR.

Institute for Public Policy Research. 2013. *Namibia Business and Investment Climate (NAMBIC) Survey*. Prepared for Namibia Chamber of Commerce and Industry and Namibia Manufacturers Association, funded by GIZ. Windhoek: IPPR.

Institute for Public Policy Research. 2014. *Namibia Business and Investment Climate (NAMBIC) Survey*. Prepared for Namibia Chamber of Commerce and Industry and Namibia Manufacturers Association, funded by GIZ. Windhoek: IPPR.

Intergovernmental Panel on Climate Change. 2007. *Climate Change 2007: Synthesis Report*. [Online]. Available at: https://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf. (Accessed on June 2015).

International Labour Association. 2005. *HIV/AIDS in the Transport Sector of Southern African Countries: A rapid Assessment of Cross-Border Regulations and Formalities* – Technical Cooperation 3. Geneva: ILO.

International Labour Organization. 1996. *Recording and Notification of Occupational Accidents and Diseases: An ILO code of practice.* ILO: Geneva.

International Labour Organization. 2010. *List of Occupational Diseases (Revised 2010) – Identification and Recognition of Occupational Diseases: Criteria for Incorporating Diseases in the ILO list of Occupational Diseases*. Geneva: ILO.

International Labour Organization. 2014. *Implementation of the Decent Work Agenda in West Africa: Results of Activities of the Decent Work Technical Support Team*-ILO Country Office in Dakar (DWT/CO-Dakar). Dakar: ILO.

International Organization for Migration, 2008. *HIV Hot Spot Mapping and Situational Analysis Along the Kampala – Juba Transport Route.* Kampala: IOM.

International Organization for Migration, 2009. *A Response Analysis of HIV/AIDS Programming along Transport Corridors in Uganda*. Kampala: IOM.

International Organization for Migration. 2010. *Spaces of Vulnerability: Moving Beyond Stigmatization of Migrants*. Switzerland: IOM.

International Road Federation. 2008. *Intelligent Transportation Systems (ITS)*. IRF Bulletin Special Edition. Geneva: IRF.

International Road Federation. 2012. *The IRF Vienna Manifesto on ITS: Smart Transport Policies for Sustainable Mobility*. Geneva: International Road Federation.

International Road Transport Union. 2013. *The International Road Transport Union Driving Progress since 1948*. Geneva: IRU.

International Road Transport Union. 2015. *Annual Report*. Geneva: IRU.

International Telecommunications Union. 2015. *ICT Facts and Figures*. Geneva: International Telecommunications Union.

International Trade Center. 2012. *Program For Building African Capacity For Trade (PACT II): Regional Trade for Global Gains.* [Online]. Available at: http://www.intracen.org/uploadedFiles/intracenorg/Content/About_ITC/Where_are_we_working/Multi-country_programs/Pact_II/PACT%20II%20Case%20StudiesFIN.pdf. (Accessed April 2015).

International Transport Forum. 2010. *Reducing Transport Greenhouse Gas Emissions: Trends and Data*. OECD. [Online]: Available at: www.internationaltransportforum.org. (Accessed November 2014).

International Transport Workers Federation. 2014. *Challenges for Road Transport Unions and Workers in the Trucking Industry: The TWU Australia's Safe Rates Approach*. London: TWU

International Transport Workers Federation. 2015. Kenyan truck drivers demand union rights. [Online] Available at: http://www.itfglobal.org/en/campaigns-solidarity/campaigns/kenyan-truck-drivers-demand-union-rights/. (Accessed June, 2015).

IRIN News. 2008. *Rwanda-Uganda: Cross-Continent Truckers Risk More than HIV*. 23 October. [Online] Available at: http://www.irinnews.org/report/81082/rwanda-uganda-cross-continent-truckers-risk-more-than-hiv. (Accessed May, 2015).

Iroegbu, S. 2012. PhD, MBA Holders Apply as Truck Drivers at Dangote Group. *This Day Live*. 03 November. [Online] Available at: http://www.thisdaylive.com/articles/phd-mba-holders-apply-as-truck-drivers-at-dangote-group/129518/. (Accessed May 2015).

Jafta, R. C. C. 2003. The Introduction of New Technology in a Mature Industry: An Evolutionary Analysis of the South African Textile Industry. Unpublished Doctoral Dissertation. Stellenbosch: University of Stellenbosch.

Japan International Cooperation Agency. 2015. *Master Plan for Development of an International Logistics Hub for SADC Countries in the Republic Of Namibia*. Windhoek: Government of the Republic of Namibia.

Jauch, H. 2010. *Namibia's Changing Labour Relations*. Paper Prepared for New Era. [Online] Available at: http://vivaworkers.org/wp-content/uploads/2013/01/Namibian-labour-realtions-2010.pdf. (Accessed February 2014).

Jauch, H., Edwards, L., Cupido, B. & Resource, L. 2009. *A Rich Country with Poor People: Inequality in Namibia*. Windhoek: Labour Resource and Research Institute.

Jo, S.J. & Joo, B. 2011. Knowledge Sharing: The Influences of Learning Organization Culture, Organizational Commitment, and Organizational Citizenship Behaviors. *Journal of Leadership and Organizational Studies*, 20(2):1-12.

Johansson, B., Ruivo, P., Oliveira, T. & Neto, M. 2012. *Evaluating Determinants for ERP Use and Value in Scandinavia: Exploring Differences between Danish and Swedish SMEs*. Paper presented at 6th European Conference on Information Management and Evaluation. 12 September, Reading: Academic Conferences International Limited.

Kadhikwa, G. & Ndalikokule, V. 2007. *Assessing the Potential of the Manufacturing Sector in Namibia*. Bank of Namibia: Windhoek

Kahn, M. & Menéndez, L.S. 2014. *Southern Africa Innovation Support Program. Study on Regional Innovation in the SADC Region*. 2nd report. Argentina: Innovos Group SA Córdoba.

Kamhungira, T. 2015. Striking Drivers Ordered to Return 39 SA Trucks. *Daily News.* [Online]. Available at: https://www.dailynews.co.zw/articles/2015/02/03/striking-drivers-ordered-to-return-39-sa-trucks. (Accessed May 2015).

Karo, E. & Kattel, R. 2016. *How to Organize for Innovation: Entrepreneurial State and Organizational Variety*. Working Paper in Technology Governance and Economic Dynamics no.66. [Online] Available at: http://technologygovernance.eu/files/main/2016012808374242.pdf. (Accessed February 2016).

Kassie, M., Jaleta, M., Shiferaw, B., Mmbando, F. & Mekuria, M. 2013. Adoption of Interrelated Sustainable Agricultural Practices in Smallholder Systems: Evidence from Rural Tanzania. *Technological forecasting and social change*, 80(3):525-540.

Kenya Subsidiary Legislation. 2014. *Self-Regulatory Vehicle Load Control Charter*. Kenya Gazette Supplement No.79. Nairobi: Government Printer.

Keulder, C. & LeBeau, D. 2006. *Ships, Trucks and Clubs: The Dynamics of HIV Risk Behaviour in Walvis Bay*. Windhoek: IPPR.

Kiderlen, T. R., Conteh, M., Roll, S., Seeling, S. & Weinmann, S. 2015. Cross-Sectional Study Assessing HIV-Related Knowledge, Attitudes and Behavior in the Namibian Truck Transport Sector: Readjusting HIV Prevention Programs in the Workplace. *Journal of Infection and Public Health*, 8(4):346-354.

Kiesling, E., Günther, M., Stummer, C. & Wakolbinger, L.M. 2012. Agent-Based Simulation of Innovation Diffusion: A Review. *Central European Journal of Operations Research*, 20(2):183-230.

Kigongo, O. 2014. *WTO Agreement on Trade Facilitation: Implications for LLDCs*. Kampala: Uganda National Chamber of Commerce.

Klerck, G. 2008. Industrial Relations in Namibia since Independence: Between Neo-liberalism and Neo-corporatism? *Employee Relations*, 30(4):355-371.

Knowledge Management and Communication Capacity - Uganda. 2014. *Most at Risk Populations - Long Distance Truck Drivers and HIV/AIDS in Uganda: Synthesis of Information and Evidence to Inform the Response.* [Online] Available at: http://www.kmcc.org.ug. (Accessed March 2015).

Koberg, C.S., Uhlenbruck, N. & Sarason, Y. 1996. Facilitators of Organizational Innovation: The Role of Life-Cycle Stage. *Journal of business venturing*, 11(2):133-149.

Koellinger, P. 2008. The Relationship between Technology, Innovation, and Firm Performance - Empirical Evidence from e-business in Europe. *Research Policy*, 37(8):1317-1328.

Krajewska, M. A. & Kopfer, H. 2006. Collaborating Freight Forwarding Enterprises. *OR spectrum*, 28(3):301-317.

Kruk, B.C. 2006. *Hinterland Connections and Intermodal Transport*. World Bank. [Online]. Available at: http://siteresources.worldbank.org/INTTRANSPORT/Resources/336291-1152796664200/2749337-1152801097421/kruk-hinterland_intermodal_short20060403.pdf. (Accessed March 2015).

Kuan, K. K. & Chau, P. Y. 2001. A Perception-Based Model for EDI Adoption in Small Businesses Using a Technology–Organization–Environment Framework. *Information and Management*, 38(8):507-521.

Kumar, D. 2013. Transport Dynamics in sub-Saharan Africa: Supply Chain Logistics. *Transport World Africa*, (11)2:22.

Kumar, K. 2001. Technology for Supporting Supply Chain Management: Introduction. *Communications of the ACM*, (44)6:58-61.

Kumar, N., Stern, L. W. & Anderson, J. C. 1993. Conducting Interorganizational Research Using Key Informants. *Academy of Management Journal*, 36(6):1633-1651.

Kunaka, c. & Carruthers, R. 2014. *Trade and Transport Corridor Management Toolkit*. Washington DC: World Bank.

Lall, S. & Pietrobello, C. 2003. *Africa's Technology Gap: Case Studies on Kenya, Ghana, Tanzania and Uganda*. Switzerland: United Nations.

Landman, M. 2014. Strategic Logistics Investment: Training. *Transport World Africa*, 12(6):38-38.

Landman, M. 2015. The Human Investment: Training. *Transport World Africa*, 13(1):38-38.

LaRRI. 2007. *Centralised Bargaining in Namibia's Road Transport Industry: Options and Challenges*. Prepared for Namibia Transport and Allied Workers Union (NATAU) and funded by the Friederich Ebert Stiftung. Windhoek: LaRRI.

Larsen, G.D. & Ballal, T.M. 2005. The Diffusion of Innovations within a UKCI Context: An Explanatory Framework. *Construction Management and Economics*, 23(1):81-91.

Lassen, S. 2015. Kenya Truck Drivers Strike for Union, Against Company Abuse. *The Militant*. 27 April. [Online]. Available at: http://www.themilitant.com/2015/7915/791532.html. (Accessed May, 2015)

Latham, S. F. & Braun, M. 2009. Managerial Risk, Innovation, and Organizational Decline. *Journal of Management,* 35(2):258-281.

Lawson, B. & Samson, D. 2001. Developing Innovation Capability in Organisations: A Dynamic Capabilities Approach. *International Journal of Innovation Management*, 5(3):377-400.

Lazonick, W. 2006. The Innovative Firm. In Fagerberg, J., Mowery, D.C. & Nelson, R. (eds.). *The Oxford Handbook of Innovation*. Oxford: Oxford University Press.

Lee, D. & Ahn, J. 2007. Reward Systems for Intra-Organizational Knowledge Sharing. *European Journal of Operational Research,* 180(2):938-956.

Lehtonen, M. 2006. Decoupling Freight transport from GDP–Conditions for a 'Regime Shift'. *Global Environmental Change*, 17: 18.

Levy, K. E. C. 2015. The Contexts of Control: Information, Power, and Truck-Driving Work. *The Information Society*, (31)2:160-174.

Liebowitz, J. 2001. Knowledge Management and its Link to Artificial Intelligence. *Expert systems with applications,* 20(1):1-6.

Lin, A. & Chen, N. C. (2012). Cloud Computing as an Innovation: Perception, Attitude, and Adoption. *International Journal of Information Management*, 32(6):533-540.

Lin, S. 2011. Exhaust System Reliability Evaluation. *International Journal of Reliability, Quality and Safety Engineering*, 18(04):327-340.

Lind, J. 2005. Ubiquitous Convergence: Market Redefinitions Generated by Technological Change and the Industry Life Cycle. In *DRUID Academy Winter 2005 Conference*. 27 - 29 January, Sweden.

Ling, Y. A. N., Simsek, Z., Lubatkin, M. H. & Veiga, J. F. 2008. Transformational Leadership's Role in Promoting Corporate Entrepreneurship: Examining the CEO-TMT Interface. *Academy of Management journal*, 51(3):557-576.

Links, F. 2010. *Namibia's Skills Deficits: Cross Sectoral Perceptions and Experiences*. Prepared for Namibia Employer's Federation and funded by ILO. Windhoek: NEF.

Lockridge, D. 2015. Commentary: Would You Drive for Your Fleet? *Trucking Info*. [Online]. Available at: http://www.truckinginfo.com/channel/drivers/article/story/2015/03/would-you-drive-for-your-fleet.aspx. (Accessed May 2015).

Lundvall, B. 2007. National Innovation Systems: Analytical Concept and Development Tool. *Industry and Innovation*, 14(1):95-119.

Lundvall, B. A. (2009). Innovation as an Interactive Process: User-Producer Interaction to the National System of Innovation: Research Paper. African *Journal of Science, Technology, Innovation and Development*, 1(2 -3):10-34.

Lundvall, B. Joseph, K.J. Chaminade, C. & Jan, V. (eds.). 2009. *Handbook of Innovation Systems and Developing Countries: Building Domestic Capabilities in a Global Setting*. Cheltenham: Edward Elgar.

Lusaka Times. 2011. Striking Tanzanian Truck Drivers Force Nakonde Border to Close. 20 July. [Online] Available at: http://www.lusakatimes.com/2011/07/20/striking-tanzanian-truck-drivers-force-nakonde-border-close/. (Accessed May 2015)

Lutombi, J. 2015. Snapshot of the Truck Safety Campaign: Khomas Erongo and Otjozondjupa. The Motor Vehicle Accident Fund. Windhoek: MVA.

Lwiza, J. V., Kilewo, L.H., Malisa, B.T. & Kivuyo, J.E. 2013. *Vehicle Overload Control on Trunk Roads in Tanzania*. Dar es Salaam: Tanzania National Roads Agency (TANROADS).

MacLeod, D. & Clarke, N. 2009. *Engaging for Success: Enhancing Performance through Employee Engagement: A Report to Government*. London: Department for Business, Innovation and Skills.

Majoni, W. K. 2014. The Vulnerability Factors to HIV Transmission among Long Distance Truck Drivers Working from Windhoek, Namibia. Unpublished Master's Thesis, Stellenbosch: Stellenbosch University.

Malango, V. 2015. Mining Industry Performance in 2014. In *Mining Conference*. The Chamber of Mines of Namibia. 20 May, Windhoek.

Malerba, F. & Brusoni, S. 2007. *Perspectives on Innovations*. Cambridge: Cambridge University Press.

Malerba, F. & Vonortas, N.S. 2009. *Innovation networks in industries.* Edward Elgar Publishing

Manpower Group. 2014. The Talent Shortage Continues: How the Ever Changing Role of HR Can Bridge the Gap. [Online] Available at: http://www.manpowergroup.us/campaigns/talent-shortage-2014/assets/pdf/2014_talent_shortage_wp_us.pdf. (Accessed February 2015).

March, J.G. 1991. Exploration and Exploitation in Organizational Learning. *Organization Science*, 2(1):71-87.

Marchet, G., Perego, A. & Perotti, S. 2009. An Exploratory Study of ICT Adoption in the Italian Freight Transportation Industry. *International Journal of Physical Distribution & Logistics Management*, 39(9): 785-812.

Marope, M.T. 2005. *Namibia Human Capital and Knowledge Development for Economic Growth with Equity*. Washington, DC: World Bank.

Martensen, A., Dahlgaard, J. J., Mi Park-Dahlgaard, S. & Grønholdt, L. 2007. Measuring and Diagnosing Innovation Excellence-Simple Contra Advanced Approaches: A Danish Study. *Measuring Business Excellence*, 11(4):51-65.

Martin, J. 2004. Corridors of Hope Regional HIV/AIDS Cross-Border Prevention Program. Secondary Analysis and Document Review. Windhoek: United States Agency for International Development – Namibia.

Martínez-Román, J.A. Gamero, J. & Tamayo, J.A. 2011. Analysis of Innovation in SMEs Using an Innovative Capability-Based Non-Linear Model: A Study in the Province of Seville (Spain). *Technovation*, 31(9):459-475.

Maswabi, A. 2015. Dry Port Links Botswana with World. *Botswana Daily News*. 31 March.

Matiko, J. 2010. Injury and Disease Reporting in Tanzania. *African Newsletter on Occupational Health and Safety*, 20(3)48-50.

Maurya, K., Singh, M. & Jain, N. 2012. Real Time Vehicle Tracking System Using GSM and GPS Technology-An Anti-theft Tracking System. *International Journal of Electronics and Computer Science Engineering*, 1(3):2277-1956.

Maylor, H. & Blackmon, K. 2005. *Researching Business and Management*. New York: Palgrave Macmillan.

Mazzucato, M. 2014. A Mission-Oriented Approach to Building the Entrepreneurial State. *Innovate UK* (November). [Online] Available at: http://marianamazzucato.com/innovate-uk.pdf. (Accessed March 2016).

McKinnon, A. 2009. Innovation in Road Freight Transport: Achievements and Challenges. In International Transport Forum. Innovat*ion in Road Transport: Opportunities for Improving Efficiency*. Lisbon: Heriot-Watt University.

Megevand. C., Dulal. H., Braune. L. & Wekhamp. J. 2013. *Deforestation Trends in the Congo Basin: Reconciling Economic Growth and Forest Protection*. Working Paper no. 3 – Transport. Washington, DC: The World Bank.

Meyn, M., Peruzzo, A. & Kennan, J. 2013. *Implications for Namibia in the Tripartite Free Trade Agreement*. Windhoek: Namibian Trade Forum.

Miller, K. D., Zhao, M. & Calantone, R. J. 2006. Adding Interpersonal Learning and Tacit Knowledge to March's Exploration-Exploitation Model. *Academy of Management Journal*, 49(4):709-722.

Minister of Education. 2014. *Budget Motivation Speech for the Year 2014-2015 Financial Year*, 13 March. Windhoek: Government of the Republic of Namibia.

Minister of Labour and Social Welfare. 2012. *Address at the Occasion of the Official Opening of the 8th National Congress of the Namibia Transport and Allied Workers Union* (NATAU), 19 September. Okahandja: Ministry of Labour and Social Welfare.

Minister of Trade and Industry. 2013. *Statement at the Growth at Home Conference*. 28 November. Windhoek: Government of the Republic of Namibia.

Ministry of Industrialization, Trade and SME Development. 2015. *National Policy on Micro, Small and Medium Enterprises in Namibia.* Windhoek: Government of the Republic of Namibia.

Ministry of Labour and Social Welfare. 2006. *Namibia Occupational Skills Assessment Survey (NOSAS) 2006: Report of Findings*. Windhoek: Government of the Republic of Namibia.

Ministry of Trade and Industry. 2009. *National Enterprise and Establishment Census*. Windhoek: Government of the Republic of Namibia.

Ministry of Trade and Industry. 2013. *Namibia's Industrial Policy Implementation Strategy*. Windhoek: Government of the Republic of Namibia.

Ministry of Works, Transport and Communication. 2000. *The Namibian Road Sector Reform*. Windhoek: Government of the Republic of Namibia.

Ministry of Works, Transport and Communication. 2000. *The Namibian Road Sector Reform: Background, Structure and Philosophy*. Windhoek: Government of the Republic of Namibia.

Mirzabeiki, V. 2013. An Overview of Freight Intelligent Transportation Systems. *International Journal of Logistics Systems and Management*, 14(4):473-489.

Moore, G. C. & Benbasat, I. 1991. Development of an Instrument to Measure the Perceptions of Adopting an Information Technology Innovation. *Information Systems Research*, 2(3):192-222.

Motor Vehicle Accident Fund of Namibia. 2014. *Road Crash and Claims Report*. Windhoek: Motor Vehicle Accident Fund of Namibia.

Motor Vehicle Accident Fund. 2015. Joint Statement by NRSC, MVA Fund, NAMPOL, Ministries of Works and Transport and Namibia Defense Force, Roads Authority and City Of Windhoek: Launch of Independence and Easter Road Safety Campaign 2015. Windhoek: Motor Vehicle Accident Fund.

Mouchili, I.N & Prinsloo, G.C. 2008. The Role of the Transport Sector in the New Partnership for Africa's Development (Nepad). *Journal of Transport and Supply Chain Management*, (2)1:41-57.

Mraihi, R. 2012. *Transport Intensity and Energy Efficiency: Analysis of Policy Implications of Coupling and Decoupling*. INTECH Open Access Publisher.

Muchie, M. & Baskaran, A. 2009. The National Technology System Framework: Sanjaya Lall's Contribution to Appreciative Theory. *International Journal of Institutions and Economics*, 1(1):134-155.

Muchie, M. 2004. Resisting the Deficit Model of Development in Africa: Re-thinking through the Making of an African National Innovation System. *Social Epistemology*, 18(4):315-332.

Nabseth, L. & Ray, G. 1974. *The Diffusion of New Industrial Processes: An international Study*, Cambridge: Cambridge University Press.

Namibia Economist. 2013. Need for Financial Empowerment in SME Logistics. *Namibia Economist*, 11 October.

Namibia Logistics Association. 2014. *Excerpts from the Chairman's Report 2013*. Windhoek: Move NLA.

Namibia Logistics Association. 2016. NLA Response: Research in Progress- Innovation Capacity of Road Freight Transport Operators, e-mail sent to A.Kangombe, 27 January. Available e-mail: info@nla.org.na.

Namibia Logistics Association. n.d. *Driver Development Programme*. Windhoek: Namibia Logistics Association.

Namibia Statistics Agency. 2012. *Namibia 2011 Population and Housing Census Main Report*. Windhoek: Namibia Statistics Agency.

Namibia Statistics Agency. 2013. *Annual National Accounts 2013*. Windhoek: Namibia Statistics Agency.

Namibia Statistics Agency. 2014. *Annual Trade Statistics Bulletin 2014*. Windhoek: Namibia Statistics Agency.

Namibia Statistics Agency. 2014. *The Namibia Labour Force Survey 2013 Report*. Windhoek: Namibia Statistics Agency.

Namibia Statistics Agency. 2015. *Annual Trade Statistics Bulletin.* Windhoek: Namibia Statistics Agency.

Namibia Training Authority. 2014. *Transport, Warehousing and Logistics Sector Skills Plan*. Windhoek: Namibia Training Authority.

Nampower. 2015. *Annual Report 2015*. Windhoek.

Nan, N., Zmud, R. & Yetgin, E. 2014. A Complex Adaptive Systems Perspective of Innovation Diffusion: An Integrated Theory and Validated Virtual Laboratory. *Computational and Mathematical Organization Theory,* 20(1):52-88.

Nathan Associates. 2012. *Impact of Road Transport Industry Liberalization in West Africa*. United States Agency for International Development. [Online]. Available at: http://www.nathaninc.com/sites/default/files/Pub%20PDFs/WestAfricatransportliberalization.pdf. (Accessed November 2014).

National Commission on Research Science and Technology. 2014. *Annual Report 2013/2014*. Windhoek.

National Commission on Research Science and Technology. 2014. *Annual Report 2014/2015*. Windhoek.

National Commission on Research Science and Technology. 2014a. *The National Program on Research, Science, Technology and Innovation*. Windhoek: National Commission on Research Science and Technology.

National Highway Traffic Safety Administration. 2014. *Traffic Safety Facts 2012 Data: Large Trucks*. U.S Department of Transport [Online]. Available at: http://www-nrd.nhtsa.dot.gov/Pubs/812032.pdf. (Accessed February 2015).

National Planning Commission. 2012. *National Human Resource Plan 2010-2015*. Windhoek: Office of the President.

National Planning Commission. 2013. *Fourth National Development Plan (NDP4) 2012/13 – 2016/2017*. Windhoek: Office of the President.

National Planning Commission. 2014. *Annual Report 2014/2014*. Windhoek: Office of the President.

National Road Safety Council & Motor Vehicle Accident Fund. 2014. *Status of Road Deaths in Namibia*. Windhoek: NRSC & MVA.

Naysmith, S. & Rubincam, C. 2012. Women in the Driver's Seat: An Exploratory Study of Perceptions and Experiences of Female Truck Drivers and their Employers in South Africa. *Journal of Southern African Studies*, 38(3):579-599.

Ncube, J. 2013. A Critical Analysis of the New Labour Act Number 11 of 2007 In Light of the Law on Labour Brokerage. Unpublished Mater Dissertation. Windhoek: University of Namibia.

Ndhlovu. N. 2012. Truck Drivers Striking Over Pathetic Salary. *IOL News*. 26 September. [Online] Available at: http://www.iol.co.za/news/crime-courts/truck-drivers-striking-over-pathetic-salary-1.1390272#.VWWUvkY31sk. (Accessed on June 2015).

Ndulu, B. J. 2006. Infrastructure, Regional Integration and Growth in Sub-Saharan Africa: Dealing With the Disadvantages of Geography and Sovereign Fragmentation. *Journal of African Economies*, 15(2): 212-244.

Neely, A. & Hii, J. 2012. The Innovative Capacity of Firms. *Nang Yan Business Journal*, 1(1):47-53.

Neely, A., Filippini, R., Forza, C., Vinelli, A. & Hii, J. 2001. A Framework for Analysing Business Performance, Firm Innovation and Related Contextual Factors: Perceptions of Managers and Policy Makers in Two European Regions. *Integrated Manufacturing Systems,* 12(2):114-124.

Nelson, R.R. 2007. Understanding Economic Growth as the Central Task of Economic Analysis. In, Malerba, F & Brusoni, S. (eds). *Perspectives on Innovation*. Cambridge: Cambridge University Press.

NEPAD Planning and Coordinating Agency. 2010. *African Innovation Outlook 2010*. Pretoria: AU-NEPAD.

NEPAD Planning and Coordinating Agency. 2014. *African Innovation Outlook II Report*. Pretoria: AU-NEPAD.

New Tracking Technology. *Financial Mail,* 26 October 2006:52.

Newnam, S. & Goode, N. 2015. Do not Blame the Driver: A Systems Analysis of the Causes of Road Freight Crashes. *Accident Analysis and Prevention,* 76:141-151.

Ngcongco, N.L. 2014. An Exploratory Study of the Knowledge, Attitudes and Sexual Practices of Bulk Vehicle Operators at a Company in Gaborone, Botswana. Unpublished Master's Thesis: University of Stellenbosch.

Nielsen, D.L. Jesperson, H. Petersen, T. & Hansen, L.G. 2003. Freight Transport Growth: A Theoretical and Methodological Framework. *European Journal of Operational Research*, 144(2):295-305.

Nonaka, I. & Konno. N. 1998. The Concept of "BA": Building a Foundation for Knowledge Creation. In, Nonaka, I. (ed.). *Knowledge Management: Critical Perspectives on Business and Management*. Oxon: Routledge.

Nordengen, P. 2011.*The Road Transport Management System and Observed Success in South Africa*. Maputo Corridor Logistics Initiative Annual General Meeting and Conference. 30 September. Maputo.

O'Neal, C.R. Thorelli, H.B. & Utterback, J.M. 1973. Adoption of Innovations by Industrial Organizations. *Industrial Marketing Management*, 2(3):235-250.

Ocheni, S. & Nwankwo, B. C. 2012. Analysis of Colonialism and its Impact in Africa. *Cross-Cultural Communication*, 8(3), 46-54.

O'Connor, G.C., Ravichandran, T. & Robeson, D. 2008. Risk Management through Learning: Management Practices for Radical Innovation Success. *The Journal of High Technology Management Research*, 19(1):70-82.

Oerlemans, L. A. & Pretorius, M. W. 2006. Some Views on Determinants of Innovative Outcomes of South African firms: An Exploratory Analysis Using Firm-Level Data. *South African Journal of Science*, 102(11-12):589-593.

Office of the Prime Minister. 2004a. Companies Act (Act No. 28 of 2004). *Government Gazette of the Republic of Namibia*. Windhoek: Office of the Prime Minister.

Office of the Prime Minister. 2007b. Labour Act, 2007 (Act No. 11 of 2007). *Government Gazette of the Republic of Namibia.* Windhoek: Office of the Prime Minister

Okamura, K. & Vonortas, N. S. 2009. Partnership Networks and Knowledge Networks in Five Sectors. In, Malerba, F. & Vonortas, N. S. (eds). *Innovation Networks in Industries*. Cheltenham: Edward Elgar.

Oke, A., Burke, G. & Myers, A. 2007. Innovation Types and Performance in Growing UK SMEs. *International Journal of Operations and Production Management*, 27(7):735-753.

Okojie, O. 2010. Reporting Systems of Occupational Diseases in Nigeria. *African Newsletter on Occupational Health and Safety*, 20(3):51-53.

Oliveira, T. & Martins, M. F. 2011. Literature Review of Information Technology Adoption Models at Firm Level. *The Electronic Journal Information Systems Evaluation*, 14(1):110-121.

Organisation for Economic Co-operation and Development. 1997. *National Innovation Systems*. Paris: OECD.

Organisation for Economic Co-operation and Development. 2005. *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*. Paris: OECD.

Ortega, M.J.R. 2010. Competitive Strategies and Firm Performance: Technological Capabilities' Moderating Roles. *Journal of Business Research*, 63(12):1273-1281.

Oyelaran-Oyeyinka, B. 2012. Systems of Innovation and Capability: An Institutional Perspective. In Siyanbola, W., Egbetokun, A., Adebowale, B. A. & Olamade, O. (eds.). *Innovation Systems and Capabilities in Developing Regions*. Burlington: Gower Publishing Company.

Padeco. 2011. *Study for the Harmonization of Vehicle Overload Control in the East African Community*. Japan International Cooperation Agency. [Online]. Available at: http://www.trademarksa.org/sites/default/files/publications/Study. (Accessed December 2014).

Padilla-Perez, R., Vang, J. & Chaminade, C. 2009. Regional Innovation Systems in Developing Countries: Integrating Micro and Meso-level Capabilities. In, Lundvall, B., Joseph, K, J., Chaminade, C & Vang, J. (eds.). *Handbook of Innovation Systems and Developing Countries: Building domestic capabilities in a global setting*. Cheltenham: Edward Elgar. 140-182.

Parker, D. 2009. Road Freight Set for Bumpy Ride in 2009. *Engineering News*. [Online] Avaliable at: http://www.engineeringnews.co.za/article/road-freight-set-for-bumpy-ride-in-2009-2009-01-30. (Accessed May 2015).

Peansupap, V. & Walker, D.H. 2006. Innovation Diffusion at the Implementation Stage of a Construction Project: A Case Study of Information Communication Technology. *Construction Management and Economics*, 24(3):321-332.

Pearson, J.M. & Grandon, E.E. 2005. An Empirical Study of Factors that Influence e-Commerce adoption/non-Adoption in Small and Medium Sized Businesses. *Journal of Internet commerce*, 4(4):1-21.

Pedersen, P.O. 2001. Freight Transport under Globalisation and its Impact on Africa. *Journal of Transport Geography*, 9(2):85-99.

Pedersen, P.O. 2003. Development of Freight Transport and Logistics in Sub-Saharan Africa: Taaffe, Morrill and Gould Revisited. *Transport Reviews*, 23(3):275-297.

Perego, A., Perotti, S. & Mangiaracina, R. 2011. ICT for Logistics and Freight Transportation: A Literature Review and Research Agenda. *International Journal of Physical Distribution and Logistics Management*, 41(5):457-483.

Piecyk, M.I. & McKinnon, A.C. 2009. *Environmental Impact of Road Freight Transport in 2020: Full Report of a Delphi Survey*. [Online]. Available at: http://www.greenlogistics.org/SiteResources (Accessed March 2015).

Pinard, M.I. 2010. *Overload Control Practices in Eastern and Southern Africa: Main Lessons Learned. Sub-Saharan Africa Transport Policy Program*. Washington, DC: World Bank.

Porter, M.E. 2008. *Competitive advantage: Creating and sustaining superior performance*. New York: Simon and Schuster.

Powell, D. 2012. Compensating Differentials and Income Taxes. *Journal of Human Resources*, 47(4):1023-1054.

PricewaterhouseCoopers International Limited. 2012. *Transportation and Logistics 2030: Volume 5 – Winning the Talent Race*. [Online] Available at: http://www.pwc.com/en_GX/gx/transportation-logistics/pdf/pwc-tl-2030-volume-5.pdf.(Accessed 18 June 2014).

PricewaterhouseCoopers. 2007. *HIV/AIDS Impact Assessment Study for the Transport Sector in Namibia. Final Report*. Windhoek: Ministry of Works, Transport and Communications.

Quintas, P. 2002. Managing Knowledge in a New Century. In, Little, S. Quintas, P. & Ray, T. *Managing Knowledge: An Essential Reader*. London: Sage Publication.

Raballand, G. & Macchi, P. 2008. *Transport Prices and Costs: The Need to Revisit Donors Policies in Transport in Africa*. Washington, DC: World Bank.

Raballand, G., Kunaka, C. & Giersing,B. 2008. *The Impact of Regional Liberalization and Harmonization in Road Transport Services: A focus on Zambia and Lessons for Landlocked Countries.* Washington, DC: World Bank Publications.

Ramamoorthy, N., Flood, P., Slattery, T. & Sardessai, R. 2005. Determinants of Innovative Work Behaviour: Development and Test of an Integrated Model. *Creativity and Innovation Management*, 14(2):142-150.

Ramani, R., Valarmathy, S., SuthanthiraVanitha, N., Selvaraju, S., Thiruppathi, M. & Thangam, R. 2013. Vehicle Tracking and Locking System Based on GSM and GPS. *International Journal of Intelligent Systems and Applications*, 5(9):86-93.

Ramijin, H. & Albaladejo, M. 2002. Determinants of Innovation Capability in Small Electronics and Software Firms in Southeast England. *Research Policy*, 31(7):1053-1067.

Ranaiefar, F. 2012. *Intelligent Freight Transportation Systems*. California: Institute Of Transportation Studies.

Ranganathan. R & Foster, V. 2011. *ECCAS's Infrastructure: A Continental Perspective*. Policy Research Working Paper no. 5857. Washington DC: The World Bank.

Rasulzada, F. & Dackert, I. 2009. Organizational Creativity and Innovation in Relation to Psychological Well-Being and Organizational Factors. *Creativity Research Journal*, 21(2-3):191-198.

Road Traffic Management Corporation. 2011. *Road Traffic Report*. Republic of South Africa: Department of Transport.

Road Transport Management System. 2014. *Benefits of Accreditation*. Road Transport Management System. [Online]. Available at: http://www.rtms.co.za/becoming-accredited/benefits-of-accreditation. (Accessed June 2015).

Roads Authority. 2014. *Annual Report 2013/2014*. Windhoek: Roads Authority.

Rodriguez, D. A., Targa, F. & Belzer, M. H. 2006. Pay Incentives and Truck Driver Safety: A Case Study. *Industrial and Labor Relations Review*, 59(2):205-225.

Rogers E.M. 1962. *Diffusion of Innovation*: London: Free Press.

Rogers, E.M. 2003. *Diffusion of Innovation*. 5th edn. London: Free Press.

Rogers, M. 2004. Networks, Firm Size and Innovation. *Small Business Economics*, 22(2):141-153.

Ruivo, P., Oliveira, T. & Neto, M. 2012. ERP Use and Value: Portuguese and Spanish SMEs. *Industrial Management and Data Systems,* 112(7):1008-1025.

Runji, J. 2003. *Road Sector Reform in Namibia*. Paper presented at the Senior Road Executive Seminar in Pretoria, South Africa.

Sahin, I. 2006. Detailed Review of Rogers' Diffusion of Innovations Theory and Educational Technology-Related Studies Based on Rogers' Theory. *Online Submission,* 5(2):14-23.

Saltzman, G. M. & Belzer, M. H. 2007. *Truck Driver Occupational Safety and Health: 2003 Conference Report and Selective Literature Review*. DHHS (NIOSH) Publication No. 2007-120.

Samb, F., Fall, M., Berthaud, Y. & Bendboudjema, F. 2015. Evaluation of the Impact of Truck Overloading on Flexible Compacted Gravel Lateritic Soil's Pavements by FEM with Cast3M©. *Geomaterials*, 5(1):19-24.

Sarantakos, S. 2005. *Social Research*. 3rd edn. New York: Palgrave Macmillan.

Saris,.W.E., Van der Velde, W. & Gallhofer, I. 2004. Development and Improvement of Questionnaires Using Predictions of Reliability and Validity. In, Presser, S., Rothgeb, J. M., Couper, M. P., Lessler, J. T., Martin, E., Martin, J. and Singer, E. (eds.). *Methods for testing and evaluating survey questions*. New Jersey: John Wiley and Sons, Inc.

Sarkar, A. 2009. E-Commerce Adoption and Implementation in Automobile Industry: A Case Study. *International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering*, 3(10):573-580.

Saunders, M. Lewis, P. & Thornhill, A. 2012. Research Methods for Business Students. 6th edn. England: Pearson Publishing.

Saunila, M. & Ukko, J. 2012. A Conceptual Framework for the Measurement of Innovation Capability and its Effects. *Baltic Journal of Management*, 7(4):355-375.

Saunila, M. & Ukko, J. 2014. Intangible Aspects of Innovation Capability in SMEs: Impacts of Size and Industry. *Journal of Engineering and Technology Management*, 33:32–46.

Saunila, M., Pekkola, S. & Ukko, J. (2014). The Relationship between Innovation Capability and Performance: The Moderating effect of Measurement. *International Journal of Productivity and Performance Management*, 63(2):234-249.

Saushini, E. 2014. Transport Data, e-mail sent to A.Kangombe, 16 June. Available e-mail: esaushini@nsa.org.na.

Savage, C.J., Fransman, L. & Jenkins, A.K. 2013a. *Becoming a Regional Gateway by Developing Logistics Hubs: A Blessing or a Curse?* Unpublished Paper Delivered at the Annual Conference and PhD Workshop. 4-6 September 2013, Birmingham.

Savage, C.J., Fransman, L. & Jenkins, A.K. 2013b. Logistics in Namibia: Issues and Challenges. *Journal of Transport and Supply Chain Management*, 7(1):1-8.

Schuler, P. 2013. Namibia: Economic Outlook Growth Prospects. In, *Private Sector Review on the State of the Namibian Economy Conference*. 11 March, Windhoek.

Schumpeter, E.B. (ed.). 1954. *History of Economic Analysis*. New York: Oxford University Press.

Schumpeter, J.A. 1942. *Capitalism, Socialism and Democracy*. 3rd edn. New York: Harper & Brothers Publishers.

Schwab, K. & Sala-i-Martin, X. (eds.). 2014. *The Global Competitiveness Report 2011-2012*. Geneva: World Economic Forum.

Scott, S.G. & Bruce, R.A. 1994. Determinants of Innovative Behaviour: A Path Model of Individual Innovation in the Workplace. *Academy of Management Journal*, 37(3):580-607.

Seidel, J. V. 1998. *Qualitative Data Analysis*. [Online]. Available at: http://www.qualisresearch.com/qda_paper.htm (originally published as Qualitative Data Analysis. In, The Ethnograph v5.0: A Users Guide, Appendix E, 1998, Colorado Springs, Colorado: Qualis Research).

Seydack, G. 2011. Footprints, Paths and Tracks. In, Hoff,C. (ed). *History of the Namibian Road Sector*. Windhoek: Roads Authority.

Sherbourne, R. 2010. *Guide to the Namibian Economy 2010*. Windhoek: Institute for Public Policy Research.

Sherbourne, R. 2012. *Assessing Market Demand for Private Equity and Venture Capital Initiative for Emerging Small and Medium Sized Enterprises in Namibia*. Prepared for Business Financial Solutions. Windhoek: BFS.

Shipilov, A., Gulati, R., Kilduff, M., Li, S. & Tsai, W. 2014. Relational Pluralism Within and Between Organizations. *Academy of Management Journal*, 57(2):449-459.

Shippers Council of Eastern Africa. 2013. *East Africa Logistics Performance Survey 2012: Cost, Time and Complexity of the East African Logistics Chain*. 2nd edn.

Silverman, D. 2006. *Interpreting Qualitative Data: Methods for Analysing Talk, Text and Interaction*. 3rd edn. London: Sage Publications

Simon, D. 1996. *Transport and Development in the Third World*. London: Routledge.

Simon, D., 1986. *Noose or Lifeline? The Role of Transport in Independent Namibia*. Working Paper 231. Institute of Transport Studies. Leeds: University of Leeds.

Simon. 2014. Hope for the Trucking Sector. *Transport World Africa*. 16 October. Available at: http://www.transportworldafrica.co.za/2014/10/16/hope-for-the-trucking-sector (Accessed February 2015).

Simuyemba, S. 2000. Linking Africa through Regional Infrastructure. *Economic Research Papers*, 2007(64). African Development Bank. Available at: http://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/00157662-EN-ERP-64.PDF (Accessed February 2015).

Sivak, M. & Schoettle, B. 2014. *Mortality from Road Crashes in 193 Countries: A Comparison with other Leading Causes of Death.* Michigan: The University of Michigan Transportation Research Institute.

Skarzynski, P. & Gibson, R. 2008. *Innovation to the Core*. Massachusetts: Harvard Business School Press.

Smart, A. U., Bunduchi, R. & Gerst, M. 2010. The Costs of Adoption of RFID Technologies in Supply Networks. *International Journal of Operations and Production Management*, 30(4):423-447.

Smith, C. 2013. *Walvis Bay Corridors: A Case Study*. Paper presented at the Port Management Association of Southern Africa Conference. 4-5 November, Durban.

Smith, K. 2006. Measuring Innovation. In Fagerberg, J. Mowery, D.C. & Nelson, R. (eds.). *The Oxford Handbook of Innovation*. Oxford: Oxford University Press.

Smyth, J. D., Dillman, D. A., Christian, L. M. & O'Neill, A. C. (2010). Using the Internet to Survey Small Towns and Communities: Limitations and Possibilities in the Early 21st Century. *American Behavioral Scientist*, 53(9):1423-1448.

Sørensen, J.B. & Stuart, T.E. 2000. Aging, Obsolescence, and Organizational Innovation. *Administrative Science Quarterly*, 45(1):81-112.

South African National Standard. 2010. *Transport of Dangerous Goods - Operational Requirements for Road Vehicles*. [Online]. Available at: https://law.resource.org/pub/za/ibr/za.sans.10231.2010.pdf. (Accessed on May 2015)

Southern Africa Innovation Support Program. 2012. *Summary of the Assessment Study Done on Innovation Systems in Four SAIS Participating Countries: Final Report for Submission to Supervisory Board*. Windhoek: SAIS.

Southern Africa Innovation Support Program. 2014. *SAIS Country Annual Report for Namibia 2013-2014*. Windhoek: SAIS,

Southern African Development Community. 2008. *Protocol on Science Technology and Innovation*. Gaborone: SADC.

Srholec, M. 2009. Does Foreign Ownership Facilitate Cooperation on Innovation and quest; Firm-Level Evidence from the Enlarged European Union. *European Journal of Development Research*, 21(1):47-62.

Steenkamp, C. 2014. NLA Membership 2014: Category – Operating. E-mail sent to A. Kangombe, 7 April. Available e-mail address: ops@nla.org.na.

Stoneman, P. 2002. *The Economics of Technological Diffusion*. Oxford: Blackwell.

Sub Saharan Africa Transport Policy Program. 2012. *Annual Report.* Washington DC: World Bank.

Sub Saharan Africa Transport Policy Program. 2013. *Annual Report*. Washington DC: World Bank.

Sundbo, J. 1998. *The Theory of Innovation: Enterpreneurs, Technology and Strategy*. Cheltenham: Edward Elgar Publishing.

Swann, G.P. 2009. *The Economics of Innovation: An Introduction.* Cheltenham*:* Edward Elgar Publishing.

Tancott, G. 2013. Kasumbalesa Border Post Closes. *Transport World Africa*. 19 September. [Online]. Available at: http://www.transportworldafrica.co.za/2013/09/19/kasumbalesa-border-post-closes/. (Accessed on May 2015).

Tancott, G. 2014. Scania Driver of the Year now Open to All Truck Drivers. *Transport World Africa*. 17 March. [Online)]. Available at: http://www.transportworldafrica.co.za/2014/03/17/scanias-driver-of-the-year-now-open-to-all-truck-drivers/. (Accessed February 2015).

Taniguchi, E. & Thompson, R.G. 2003. *Innovations in Freight Transport*. Southampton: WIT Press.

Tassey, G. 2013. Beyond the Business Cycle: The Need for a Technology-Based Growth Strategy. *Science and Public Policy*, 40(3):293-315.

Teece, D. & Pisano, G. 1994. The Dynamic Capabilities of Firms: An Introduction. *Industrial and Corporate Change*, 3(3):537-556.

Teravaninthorn, S. & Raballand, G. 2009. *Transport Prices and Costs in Africa: A Review of the Main International Corridors*. Washington DC: World Bank.

Thambiran, T. & Diab, R. D. 2011. Air pollution and climate change co-benefit opportunities in the road transportation sector in Durban, South Africa. *Atmospheric Environment*, 45(16):2683-2689.

Thérin, F. 2007. *Handbook of Research on Techno-entrepreneurship*. Edward Elgar Publishing.

Thompson, V. A. 1965. Bureaucracy and Innovation. *Administrative Science Quarterly*, 10(1):1-20.

Tidd, J. 2001. Innovation Management in Context: Environment, Organization and Performance. *International Journal of Management Reviews*, 3(3):169-183.

Tjihenuna, T. 2013. Low Wages Fuel Drug Trafficking – Union. *The Namibian*, 07 June.

Tjivikua. T. 2013. *Welcome Remarks at the Chartered Institute of Logistics and Transport (CILT) International Diploma Graduation 2013*. Windhoek: Polytechnic of Namibia.

Tohidinia, Z. & Mosakhani, M. 2010. Knowledge Sharing Behaviour and its Predictors. *Industrial Management and Data Systems*, 110(4):611-631.

Toubia, O. 2006. Idea Generation, Creativity, and Incentives. *Marketing Science*, 25(5):411-425.

Transport World Africa. 2009. New Low Emission Engine for HCV Range. *Transport World Africa*. 7(6):4-5.

Transport World Africa. 2012. Road Freight Association Conference 2012. 23 May. [Online] Available at: http://www.transportworldafrica.co.za/2012/05/23/updates-from-the-rfa-2012-conference/. (Accessed on March 2015).

Transport World Africa. 2013. Appropriate Technology for Southern Africa. *Transport World Africa*. 11(1) 4:5.

Transport World Africa. 2014. Hope for the Trucking Sector. 16 October. [Online]. Available at: http://www.transportworldafrica.co.za/2014/10/16/hope-for-the-trucking-sector/. (Accessed March 2015).

Transport World Africa. 2015. Putting tyre safety first. *Transport World Africa*. (1)13:17

Tucker, R.B. 2001. Strategy Innovation Takes Imagination. *Journal of Business Strategy*, 22(3):23-27.

UK Department of Transport. 2010. *Truck Specification for Best Operational Efficiency. Freight Best Practice*. [Online]. Available at: http://ukerc.rl.ac.uk/pdf/Truck_Best_Operational_Efficiency.pdf. (Accessed September 2014).

UNCTAD. 2007. *Leveraging Offshore Financing to Expand African Non-Traditional Exports: The Case of the Horticultural Sector*. UNCTAD Series on Innovative Financing in the Commodity Sector and Dynamic Industries. Geneva: United Nations.

UNCTAD. 2011. ASYCUDA World Report 2011. *Handbook of Global Customs Automation*. Geneva: United Nations.

UNCTAD. 2013. *Economic Development in Africa*. Geneva: United Nations.

UNCTAD. n.d. ASYCUDA++: *Description of Application Software: Functional Overview*. Geneva: United Nations

UNDP. 2011. *Mobility Migration and HIV Vulnerability of Populations along the Ports of the Red Sea and Gulf of Aden: Situation and Response Analysis*. MENA Regional Office: UNDP.

United Nations Economic Commission for Africa. 2011. *Fossil Fuels in Africa in the Context of a Carbon Constrained Future*. Working Paper 12. Addis Ababa: United Nations Economic Commission for Africa African Climate Policy Centre.

United Nations Economic Commission for Africa. 2016. *Innovation, Competitiveness and Regional Integration*. Addis Ababa: United Nations Economic Commission for Africa African Climate Policy Centre.

United Nations Environment Program. 2012. *The Emissions Gap Report 2012: A UNEP Synthesis Report*. Nairobi: United Nations Environment Program (UNEP).

United States International Trade Commission. 2012. *Trade Facilitation in the East African Community: Recent Developments and Potential Benefits*. Washington DC: United States International Trade Commission.

Utterback, J. & Afuah, A. 2000. Sources of Innovative Environments: A Technological Evolution Perspective. In, Ács, Z. J. (ed.). *Regional Innovation, Knowledge and Global Change*. London: Pinten. 169-85.

Vaismoradi, M., Turunen, H. & Bondas, T. 2013. Content Analysis and Thematic Analysis: Implications for Conducting a Qualitative Descriptive Study. *Nursing and health sciences*, 15(3):398-405.

Van der Aa, W. and Elfring, T. 2002. Realizing Innovation in Services. *Scandinavian Journal of Management*, 18(2):155-171.

Van der Doef, M. & Maes, S. 1999. The Job Demand-Control (-support) Model and Psychological Well-Being: A Review of 20 Years of Empirical Research. *Work and stress*, 13(2):87-114.

Van Rooyen, B. 2010. An intelligent platform for safe and efficient road transport: transport logistics. *CSIR Science Scope*, 5(1):26-27.

Vanderschuren, M. 2008. Safety improvements through intelligent transportation systems: A South African case study based on microscope simulation modelling. *Accident Analysis and Prevention*, 40 (2):807-817.

Varis, M. & Littunen, H. 2010. Types of Innovation, Sources of Information and Performance in Entrepreneurial SMEs. *European Journal of Innovation Management*, 13(2):128-154.

Vega, A., Chiasson, M. & Brown, D. 2011. Adoption and Programme Contexts Effect in the Support to the Informatisation of SMEs. In *34th Institute for Small Business and Entrepreneurship (ISBE) Conference on Sustainable Futures: Enterprising Landscapes and Communities*. 9-10 November, Sheffield.

Verny, J. 2007. The importance of decoupling between freight transport and economic growth. *European Journal of Transport and Infrastructure Research*. (7)2:113-128.

Verspagen, B. 2007. Understanding Economic Growth as the Central Task of Economic Analysis. In, Malerba, F & Brusoni, S. (eds.). *Perspectives on Innovation*. Cambridge: Cambridge University Press. 42-63.

Visser, J., Van Binsbergen, A. & Nemoto, T. 1999. Urban Freight Transport Policy and Planning. In *First International Symposium on City Logistics*. July, Cairns.

Walvis Bay Corridor Group. 2013a. *Integration of SME's on Logistics and Transport in Walvis Bay Corridor*. Windhoek: WBCG.

Walvis Bay Corridor Group. 2013b. SME Transporters Enhance Skills in Logistics. *e-Corridor Electronic Newsletter of the Walvis Bay Corridor*. Windhoek: Walvis Bay Corridor Group.

Walvis Bay Corridor Group. 2014a. Forum Launched to aid Namibia's Logistics Hub Aspiration. *e-Corridor Electronic Newsletter of the Walvis Bay Corridor*. Windhoek: Walvis Bay Corridor Group.

Walvis Bay Corridor Group. 2014b. *Annual Review 2012/2013*. Windhoek: Walvis Bay Corridor Group.

Ward, N. & Baretto, E. 2011. *Technical Report: Road Freight Transport Services Diagnostic Study*. Gaborone: USAID Southern Africa.

Watson, B.P. n.d. *Historical Planning and Designs*. Civil Engineering Department Course Manual. Polytechnic of Namibia.

World Bank & International Monetary Fund. 2015. *Global Monitoring Report 2014/2015: Ending Poverty and Sharing Prosperity*. Washington DC: World Bank

World Bank Group. 2014. The Big Business of Small Enterprises Evaluation of the World Bank Group Experience with Targeted Support to Small and Medium-Size Enterprises, 2006 –2012. Washington DC: World Bank.

World Bank. 2009a. *Freight Transport for Development Toolkit: Road Freight. Where is the Economy Going? Follow that Truck - The Road Freight Industry in Low and Middle Income Countries*. Washington DC: World Bank.

World Bank. 2009b. Transport against HIV/AIDS: Synthesis of Experience and Best Practice Guidelines. Washington DC: World Bank.

World Bank. 2011a. *Harnessing Regional Integration for Trade and Growth in Southern Africa*. Africa Region: World Bank

World Bank. 2011b. *Fostering Technology Absorption in Southern African Enterprises*. Washington DC: World Bank.

World Bank. 2012. *Regional Transport and Trade Logistics in Namibia: A Policy Note*. Windhoek: World Bank.

World Bank. 2013. Doing Business Report. Smarter Regulations for Small and Medium-Sized Enterprises. Washington DC: World Bank.

World Bank. 2015. *Doing Business Report. Going Beyond Efficiency*. Washington DC: World Bank.

World Economic Forum. 2014. *Global Competitiveness Report 2014/2015*. Geneva: World Economic Forum.

World Health Organization. 2008. *HIV/AIDS Epidemiological Surveillance Report for the WHO African Region 2007 Update.* Regional Office for Africa: World Health Organization.

World Health Organization. 2013. *Global Status Report on Road Safety 2013: supporting a decade of action*. World Health Organization. [Online]. Available at: http://apps.who.int/iris/handle/10665/78256. (Accessed December 2014).

WWF-SA. 2013. *Employment in the South African Transport Sector - Low Carbon Frameworks*. Cape Town: WWF South Africa's Low-Carbon Frameworks programme.

Xu, Q., Chen, J., Shou, Y & Liu, J. 2012. *Leverage Innovation Capability: Application of Total Innovation Management in China's SMEs*. Singapore: World Scientific Publishing Co. PTE. Ltd.

Yamin, S., Mavondo, F., Gunasekaran, A. & Sarros, J.C. 1997. A Study of Competitive Strategy, Organisational Innovation and Organisational Performance among Australian Manufacturing Companies. *International Journal of Production Economics*, 52(1):161-172.

Yang, J. 2012. Innovation Capability and Corporate Growth: An Empirical Investigation in China. *Journal of Engineering and Technology Management*, 29(1):34-46.

Zhou, K.Z., Gao, G.Y., Yang, Z. & Zhou, N. 2005. Developing Strategic Orientation in China: Antecedents and Consequences of Market and Innovation Orientations. *Journal of business research*, 58(8):1049-1058.

Zhu, K., Kraemer, K. L. & Xu, S. 2006. The Process of Innovation Assimilation by Firms in Different Countries: A Technology Diffusion Perspective on E-business. *Management Science*, 52(10):1557-1576.

Zhu, X., Mukhopadhyay, S. K. & Kurata, H. 2012. A Review of RFID Technology and its Managerial Applications in Different Industries. *Journal of Engineering and Technology Management*, 29(1):152-167.

Zimbabwe Revenue Authority .2013. *ZIMRA Commissions a Non-Intrusive Scanner*. Zimbabwe Revenue Authority. [Online]. Available at: http://www.zimra.co.zw/index.php?option=com_contentandview=articleandid=2096:zimra-commissions-a-non-intrusive-scannerandcatid=4:storyandItemid=85. (Accessed May 2015).

ANNEXURES

Annex 1: Research Instruments

UNIVERSITEIT•STELLENBOSCH•UNIVERSITY
jou kennisvennoot • your knowledge partner

Innovation Capability and Adoption of Innovation in Namibia's Road Freight Transport Industry Survey- Transporters Questionnaire

Please take time to read the information below before taking part in this study. This study has been approved by the Faculty of Economics and Management Sciences at Stellenbosch University to assess the innovation capacity of road freight transport operators in Namibia. Your answers will be treated strictly confidential and will in no way be linked to you or your company's identity. Only aggregate results will be included in the final report. Participation is voluntary and you may withdraw at any time without penalty. The survey will take about 15 minutes. If you have any question or concern about this study, please contact Anna Kangombe at 061 388623 /0811286694 or akangombe@gmail.com .

Faculty of Economics and Management sciences

Section A: General Information

1. **Company Name**:
2. **Year of Establishment**:
3. **Town/Settlement**:
4. **Place of Company headquarters**:
5. **Position of Respondent**:
6. **Number of employees**
    a) Permanent:
    b) Temporary/Casuals:
    c) Others:

7. Please indicate the number of permanent employees with the following highest levels of education.

Levels of qualification	Number of full time employees
a)Primary level education	
b)Matric/Grade 12	
c)Certificate	
d)Diploma	
e)Bachelors	
f)Higher than a Bachelor's Degree	
g)Other_____	

8. What is the Legal Status of your company? Please tick one.

a) Sole Proprietorship ____ b) Partnership/Joint Venture_____ c) Closed Corporation____

d) Private Company (Pty) Ltd____ e) Public Company _____ f) Branch of Foreign Company __

g)Others____

Please tell us what your company' performance has been in the past 3 years by ticking the appropriate answers to each of the following statements.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
9. Our sales have gone up in the past 3 years					
10. Our customer base has gone up in the past 3 years					
11.The value of our total assets have gone up in the past 3 years					
12. The total number of employees in our company has gone up in the past 3 years					

Please tell us what your performance expectations are for the next 3 years by ticking the appropriate answers to each of the following statements.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
13. We expect our sales to increase in the next 3 years					
14. We expect our customer base to increase in the next 3 years					
15. We expect the total value of our assets to increase in the next 3 years					
16.We expect to employ more people in the next 3 years					

How important are the following stakeholders to your business as <u>sources</u> of <u>new ideas (</u>please tick the appropriate answer for each stakeholder)?

	Very Unimportant	Unimportant	Neutral	Important	Very Important
17.Suppliers of equipment, materials, components, or software					
18.Customers/Clients					
19.Competitors and other transport and logistics operators					
20. Financial Institutions					
21.Government Ministries, Municipalities, Town Councils					
22.Walvis Bay Corridor Group					
23. Professional and Industry Associations i.e NLA, NATA, NCCI etc					
24.Universities, Polytechnic and other higher education institutions					
25. Conferences, Trade fairs and Expos					
26.Consultants					
27. Family					
28.Others , Specify					

29. Which are the three top sources of new ideas for your company?

a) Most important source:
b) Second:
c) Third:

Section B: Adoption of Innovation

30. Do you use any of the following systems / technologies in your company? If yes, please indicate the year you first started using them.

	yes	Year first used	**No**
a)Lift Axles			
b)Satellite Vehicle Tracking System			
c)Fleet Management System Software			

Definitions:

Lift Axle *or liftable axle is: An axel that may be raised or lowered to the ground to provide greater load-carrying capacity, or to comply with axle weight requirements.*

Satellite Vehicle Tracking System*: A tracking system that provide information on the location of your vehicle, speed, direction etc.*

Fleet Management System Software*: A computer software that help users collect, store, and process all information related to their fleet from acquisition all the way to disposal.*

Section C: Innovation Capability

How much do you agree or disagree with the following statements (Please tick the appropriate answer for each statement)?

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
31.Learning is encouraged in our company					
32.We compare our services with other organizations in the industry					
33.We often request our clients to give us honest feedback on our services					
34.We include stakeholders' inputs into our planning					
35. We consider learning as an investment in our company					
36. All our employees have opportunities to further their learning					
37. Our organization does not encourage employees to learn through external contacts					
38.Our company encourages employees to come up with new ideas					
39.Our employees are willing to try out new ways of doing things					
40.Our Organization allows for mistakes when experimenting new ideas					
41. Employees know that they can be critical of our current ways of doing things					
42. We actively seek new ways of doing things					
43. Our organization is afraid to take bold decisions					
44. We do not judge the quality of our decisions					
45.Employee performance is linked to contribution of new ideas					
46.When employees come up with great ideas, they receive bonuses					
47.Managers personally thank employees who come up with great new ideas					
48. Employees are treated equally regardless of the division they are in					
49. Employees prosper in our organization					
50. There are opportunities for flexible hours in our organization					
51. Tasks allocation in our organization is not flexible					
52.Our managers offer a lot of guidance to employees who want to try out new ideas					

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
53.When faced with problems, our managers actively seek new solutions from employees					
54.Our managers always take new ideas to the upper level for further development and possible implementation					
55.We have a budget dedicated to research and business development activities					
56. All employees are committed to the vision of our organization					
57. Employees do not view themselves as part of the organization					
58. Managers do not always provide feedback to employees					
59.There is a lot of information sharing in our organization					
60.There are platforms for employees across departments to learn from one another					
61.Top management always emphasize on knowledge sharing in the company					
62. There is a lot of cooperation among employees in our organization					
63. Lessons learned in each division are not shared with the whole organization					
64. There are rules that restrict communication among different division					

Section D

65. Please list any <u>barriers</u>/<u>constraints</u> that in your opinion may prevent the use of:

a) Lift Axles

_____
_____
_____
_____
_____

b) Satellite Vehicle Tracking Systems

_____
_____
_____
_____
_____

c) Fleet Management System Softwares

_____
_____
_____
_____
_____

66. Will you be willing to take part in a short follow on interview to discuss some of the innovation activities in your organization? Please tick.

Yes_____ No _____

UNIVERSITEIT•STELLENBOSCH•UNIVERSITY
jou kennisvennoot • your knowledge partner

Innovation Capability and Adoption of Innovation in Namibia's Road Freight Transport Industry Survey- Freight Forwarders Questionnaire

Please take time to read the information below before taking part in this study. This study has been approved by the Faculty of Economics and Management Sciences at Stellenbosch University to assess the innovation capacity of road freight transport operators in Namibia. Your answers will be treated strictly confidential and will in no way be linked to you or your company's identity. Only aggregate results will be included in the final report. Participation is voluntary and you may withdraw at any time without penalty. The survey will take about 15 minutes. If you have any question or concern about this study, please contact Anna Kangombe at 061 388623 /0811286694 or akangombe@gmail.com .

- Faculty of Economics and Management sciences

Section A: General Information

1. **Company Name**:
2. **Year of Establishment**:
3. **Town/Settlement**:
4. **Place of Company headquarters**:
5. **Position of respondent**:
6. **Number of employee**

    d) Permanent:

    e) Temporary/Casuals:

    f) Others:

7. Please indicate the number of permanent employees with the following highest levels of education.

Levels of qualification	Number of full time employees
a)Primary level education	
b)Matric/Grade 12	
c)Certificate	
d)Diploma	
e)Bachelors	
f)Higher than a Bachelor's Degree	
g)Other_____	

8. What is the Legal Status of your company? Please tick one.

a) Sole Proprietorship ____ b) Partnership/Joint Venture_____ c) Closed Corporation____

d) Private Company (Pty) Ltd____ e) Public Company _____ f) Branch of Foreign Company __

g)Others____

Please tell us what your company' performance has been in the past 3 years by selecting the best option to the following statements.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
9. Our sales have gone up in the past 3 years					
10. Our customer base has gone up in the past 3 years					
11.The value of our total assets have gone up in the past 3 years					
12. The total number of employees in our company has gone up in the past 3 years					

Please tell us what your performance expectations are for the next 3 years by selecting the best option to the following statements.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
13. We expect our sales to increase in the next 3 years					
14. We expect our customer base to increase in the next 3 years					
15. We expect the total value of our assets to increase in the next 3 years					
16.We expect to employ more people in the next 3 years					

How important are the following stakeholders to your business as sources of new ideas (please select the best option to the following statements)?

	Very Unimportant	Unimportant	Neutral	Important	Very Important
17.Suppliers of equipment, materials, components, or software					
18.Customers/Clients					
19.Competitors and other transport and logistics operators					
20. Financial Institutions					
21.Government Ministries, Municipalities, Town Councils					
22.Walvis Bay Corridor Group					
23. Professional and Industry Associations i.e NLA, NATA, NCCI etc					
24.Universities, Polytechnic and other higher education institutions					
25. Conferences, Trade fairs and Expos					
26.Consultants					
27. Family					
28.Others , Specify					

29. Which are the three top sources of new ideas for your company?

d) Most important source:
e) Second:
f) Third:

Section B: Adoption of Innovation

30. Do you use any of the following methods / technologies in your company? If yes, please indicate the year you first started using them.

	yes	Year first used	No
a)Radio-Frequency Identification (RFID)			
b)Electronic Data Interchange (EDI)			
c) Automated System for Customs Data (Asycuda)			

Section C: Innovation Capability

How much do you agree or disagree with the following statements (Please select the best option to the statements)?

	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
31.Learning is encouraged in our company					
32.We compare our services with other organizations in the industry					
33.We often request our clients to give us honest feedback on our services					
34.We include stakeholders' inputs into our planning					
35. We consider learning as an investment in our company					
36. All our employees have opportunities to further their learning					
37. Our organization does not encourage employees to learn through external contacts					
38.Our company encourages employees to come up with new ideas					
39.Our employees are willing to try out new ways of doing things					
40.Our Organization allows for mistakes when experimenting new ideas					
41. Employees know that they can be critical of our current ways of doing things					
42. We actively seek new ways of doing things					
43. Our organization is afraid to take bold decisions					
44. We do not judge the quality of our decisions					
45.Employee performance is linked to contribution of new ideas					
46.When employees come up with great ideas, they receive bonuses					
47.Managers personally thank employees who come up with great new ideas					
48. Employees are treated equally regardless of the division they are in					
49. Employees prosper in our organization					
50. There are opportunities for flexible hours in our organization					
51. Tasks allocation in our organization is not flexible					
52.Our managers offer a lot of guidance to employees who want to try out new ideas					
53.When faced with problems, our managers actively seek new solutions from employees					

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
54.Our managers always take new ideas to the upper level for further development and possible implementation					
55.We have a budget dedicated to research and business development activities					
56. All employees are committed to the vision of our organization					
57. Employees do not view themselves as part of the organization					
58. Managers do not always provide feedback to employees					
59.There is a lot of information sharing in our organization					
60.There are platforms for employees across departments to learn from one another					
61.Top management always emphasize on knowledge sharing in the company					
62. There is a lot of cooperation among employees in our organization					
63. Lessons learned in each division are not shared with the whole organization					
64. There are rules that restrict communication among different division					

Section D

65 Please list any <u>barriers</u>/<u>constraints</u> that in your opinion may prevent the use of:

a) Radio-frequency identification RFID

_____
_____
_____
_____
_____

b) Electronic Data Interchange (EDI)

_____
_____
_____
_____
_____
_____

c) Automated System for Customs Data (Asycuda)

_____
_____
_____
_____
_____
_____

UNIVERSITEIT•STELLENBOSCH•UNIVERSITY
jou kennisvennoot • your knowledge partner

Innovation Capability and Adoption of Innovation in Namibia's Road Freight Transport Industry Survey- Follow up Interview

Thank you for participating in our study on innovation capacity in Namibia's road freight transport industry and for agreeing to complete part 2 of the survey. There are 8 follow up questions in this session and they are about the experience of innovation in your firm. Your answers will remain confidential and will only be discussed in the study at an aggregate level.

Interview with: ----------

Date----------

1. Briefly take me through a typical day in your organization

2. From the survey results, you indicated that you have (***insert the technological innovations that the organization adopted***), can you please describe the process that led to acquiring and using this technology (ies)?

- Starting from how the need for that innovation was identified
- Who identifies needs to innovate?
- How are decisions taken?
- Who is involved in the decisions?

3. Is this typically the process that is used in obtaining and using new technologies in your organization? Please explain

4. What is your company's experience with new ideas that originate from employees about new technologies or new ways of carrying out tasks (both truck drivers and non-truck drivers)?

5. How does your company encourage employees to come up with new (innovative) ideas?

6. Would you say you are using (***insert technologies that are adopted in that firm***) to its fullest, half of its features or less than half?

7. In the initial survey, a question was asked if your company uses (**insert name of technological innovation**) and the results show that you do not, why is that?

8. Please describe labour relations in your company.

Annex 2 Barriers for Adopting

Theme	Statements
Additional and initial capital required	Some systems are complicated and you need to hire a technical person to operate the system or send the current staff for training
	Too expensive for us to obtain right now
	Too expensive to maintain
	Tend to give mechanical problems which are costly to maintain
	Criminals keep finding ways to deactivate security systems and we need to keep investing in better systems, which costs a lot
	Too expensive
	Lack of training, we need to train people first
	It is not enough to get the system, you still need people who are able to use and maintain the system
	The small additional costs that one overlooks, they do add up substantially and hinders full use
	We need to find time and a consultant to understand how the system works

Annex 3 Post Hoc Test Tables on Innovation Capability and firm performance

TableA3.1 Level of Innovation Capability and Firm Legal Status – t-Test

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means						
								95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Innovation Capability mean	1.717	.198	-3	39	.009	-.3065	.11204	-.53314	-.07991
			-3	34	.011	-.3065	.11421	-.53873	-.07432

Table A3.2 Commitment to Learning and Legal Status of the Firm – t-Test

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Mean Score Learning	Equal variances assumed	.088	.768	-2.62	39	.012	-.38551	.14699	-.68283	-.0882
	Equal variances not assumed			-2.61	36.89	.013	-.38551	.14799	-.68539	-.0856

Table A3.3 Intra-organizational Learning and Legal Status of Firm – t-Test

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the ...	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Mean Score Intra-organizational Learning	Equal variances assumed	1.962	.169	-.847	39	.402	-.13238	.15628	-.44849	.18374
	Equal variances not assumed			-.832	34.107	.411	-.13238	.15904	-.45554	.19079

Table A3.4 Level of Risk and Legal Status of Firm – t-Test

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Mean Score Risk	Equal variances assumed	5.576	.023	-3.377	39	.002	-.50820	.15049	-.81259	-.20381
	Equal variances not assumed			-3.262	28.77	.003	-.50820	.15580	-.82696	-.18944

Table A3.5 Level of Rewards and Legal Status of Firm – t-Test

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Mean Score Rewards	Equal variances assumed	.343	.562	-1.62	39	.113	-.25701	.15844	-.57749	.06347
	Equal variances not assumed			-1.59	34.16	.120	-.25701	.16121	-.58456	.07055

Table A3.6 Strategy and Leadership with Legal Status of Firm – t-Test

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Mean Score Stratergy and Leadership	Equal variances assumed	.571	.454	-1.81	39	.077	-.21172	.11674	-.44784	.02440
	Equal variances not assumed			-1.78	33.9	.084	-.21172	.11889	-.45337	.02993

Table A3.7 Adoption of Innovation and Legal Status of the Firm – Chi-Square Test

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	8.588[a]	3	.035
Likelihood Ratio	9.662	3	.022
Linear-by-Linear Association	8.157	1	.004
N of Valid Cases	41		

Table A3.8 Adoption of Innovation and Legal Status of the Firm – Symmetric Measures

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.458	.035
	Cramer's V	.458	.035
N of Valid Cases		41	

Table A3.9 Performance and Legal Status of Firm – t-Test

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
performance mean	Equal variances assumed	1.298	.262	-1.60	38	.117	-.46970	.29320	-1.06325	.12386
	Equal variances not assumed			-1.59	35.42	.120	-.46970	.29514	-1.06860	.12921

Table A3.10 Integrative Innovation Capability and Performance

		Innovation Capability
Innovation Capability	Correlation Coefficient	1.000
	Sig. (2-tailed)	.
	N	41
Sales	Correlation Coefficient	.188
	Sig. (2-tailed)	.246
	N	40
Customer base	Correlation Coefficient	.173
	Sig. (2-tailed)	.286
	N	40
Value of our total assets	Correlation Coefficient	.256
	Sig. (2-tailed)	.111
	N	40
Number of employees	Correlation Coefficient	.117
	Sig. (2-tailed)	.472
	N	40

Table A3.11 Learning and Firm Performance Spearman's rho

		Commitment to learning
Commitment to learning	Correlation Coefficient	1.000
	Sig. (2-tailed)	.
	N	41
Sales	Correlation Coefficient	.105
	Sig. (2-tailed)	.521
	N	40
Customer base	Correlation Coefficient	.019
	Sig. (2-tailed)	.909
	N	40
Value of total assets	Correlation Coefficient	.172
	Sig. (2-tailed)	.290
	N	40
Number of employees	Correlation Coefficient	.036
	Sig. (2-tailed)	.826
	N	40

Table A3.12 Risk and Firm Performance Spearman's rho

		Risk Attitude
Risk Attitude	Correlation Coefficient	1.000
	Sig. (2-tailed)	.
	N	41
Sales	Correlation Coefficient	.079
	Sig. (2-tailed)	.626
	N	40
Customer base	Correlation Coefficient	.076
	Sig. (2-tailed)	.642
	N	40
Value of total assets	Correlation Coefficient	.121
	Sig. (2-tailed)	.456
	N	40
Number of employees	Correlation Coefficient	-.009
	Sig. (2-tailed)	.954
	N	40

Table A3.13 Rewards and Firm Performance Spearman's rho

		Rewards Systems
Rewards Systems	Correlation Coefficient	1.000
	Sig. (2-tailed)	.
	N	41
Sales	Correlation Coefficient	.127
	Sig. (2-tailed)	.436
	N	40
Customer base	Correlation Coefficient	.043
	Sig. (2-tailed)	.792
	N	40
Value of total assets	Correlation Coefficient	.145
	Sig. (2-tailed)	.372
	N	40
Number of employees	Correlation Coefficient	.048
	Sig. (2-tailed)	.768
	N	40

Annex 4: Detailed Description of Namibia's Innovation Landscape and the Road Freight Transport Industry

A4.1 Namibia's Innovation Landscape

Like in most of Sub-Saharan Africa, innovation in Namibia has historically been limited to science and technology (Southern Africa Innovation Support, 2014). Efforts to distinguish innovation from science and technology in Africa started in 2005 with the African Science, Technology and Innovation Indicator initiative, aimed at developing common indicators for an innovation report (NEPAD Planning and Coordinating Agency, 2010). This Africa-wide initiative resulted in the development of regional frameworks such as the SADC Protocol on Science, Technology and Innovation, which Namibia signed in 2008 alongside other SADC member countries (Southern African Development Community, 2008).

Although Namibia does not have an innovation-specific policy, innovation initiatives, projects and activities are enshrined in other national policies and growth strategies, such as Vision 2030, National Development Plan 4, the Growth at Home Strategy, the Research Science and Technology Act, and the Industrial Policy (Marope, 2005; Southern Africa Innovation Support, 2014). An innovation specific policy in Namibia is needed to direct innovation activities by identifying laws that incentivize firms (entrepreneurs) to invest in the exploitation of new knowledge. The policy will also set the frame for the implementation of such laws in the country. For instance, the policy will fast-track the introduction of the Business Intellectual Property Bill which has only been tabled recently, through a process that has lasted over five years. As Iizuka *et al.* (2015) have argued, there is 'too much importance placed on the academic contribution and too little attention given to the commercialisation [of] knowledge created or to meeting societal needs' in southern Africa.

In 2014, the country established a National Commission on Science and Technology (NCRST) to 'coordinate, develop and facilitate the promotion of research science and technology' (Minister of Education, 2014:14). Unique about the NCRST is its dual function of promoting innovation activities in the country by providing an enabling policy environment and offering funding resources (National Commission on Research Science and Technology, 2014).

Currently, Namibia's official innovation statistics are reported using research and development (R&D) data. As revealed in the *African Innovation Outlook II* report, Namibia's innovation data for the private sector is incomplete, while for the government sector, its information only covers personnel data (NEPAD Planning and Coordinating Agency, 2014). Part of this weakness can be observed in fluctuating and missing data on R&D expenditure for the period 2010 to 2013, while allocations from 2014 to 2016 show a steady upward trend (see Figures A4.1 and A4.2 below).

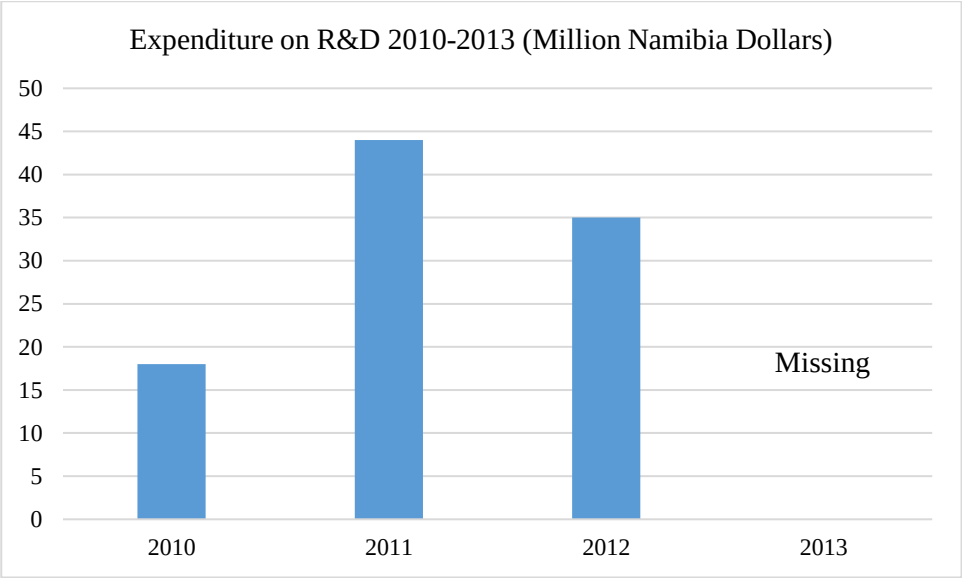

Figure A4.1 Namibia's R&D expenditures between 2010 and 2013

Source: Author, based on data from National Commission on Research Science and Technology (2014a:69)

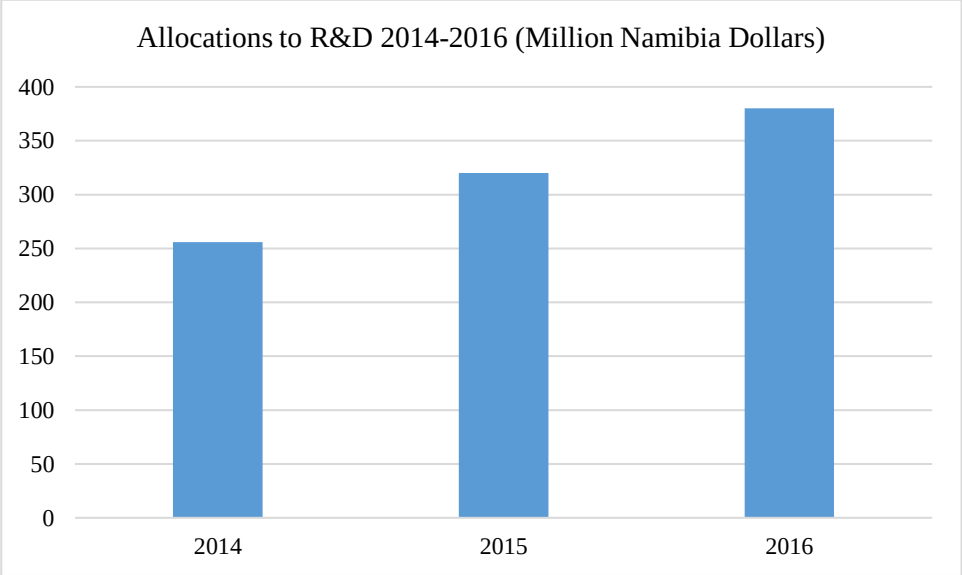

Figure A4.2 Namibia's R&D allocation between 2014 and 2016

Source: Author, based on data from National Commission on Research Science and Technology (2014a:70)

Even though there are no documented evidence of direct effects for uncoordinated innovation activities in the country, the most recent Global Innovation Index (2014/2015; 2015/2016) ranks Namibia 107th out of 141 countries and 93 out of 128 countries respectively (Cornell University, INSEAD & WIPO, 2015:30). The country features among nations with 'below-par performances' (*ibid.*). To address its persistent poor innovation performance, Namibia recently introduced a three-

year rolling national program on research science technology and innovation, which not only focuses on regulatory and tax incentives, but also has an innovation fund to stimulate novel activities in priority research areas (National Planning Commission, 2014; National Commission on Research Science and Technology, 2014a). While it is too early to evaluate the effectiveness of these innovation programs, available data shows that NCRST's funding periods are relatively short, ranging between 6 and 24 months with average values of up to Namibia Dollars 200 000 per project (National Commission on Research Science and Technology, 2015:46). Notwithstanding that the NCRST innovation fund is still in its infancy stage, it is unlikely that this safe approach will produce radical innovations which frequently require large investments and time. The results of prior innovation efforts in the country (or lack thereof) are discussed next. This is done by analysing Namibia's competitiveness, which, as in any other country, is a result of its innovation activities.

Innovation, Competitiveness and the Road Freight Transport Industry in Namibia

The purpose of innovation is to improve competitiveness and create growth (Lawson & Samson, 2001). The World Economic Forum (2014:4) defines competitiveness as 'the set of institutions, policies, and factors that determine the level of productivity of a country'. The report ranks countries on 12 principles of competitiveness, which comprise three types of economies, as indicated in Figure A4.3 below. These are factor-driven economies, efficiency-driven economies and innovation-driven economies.

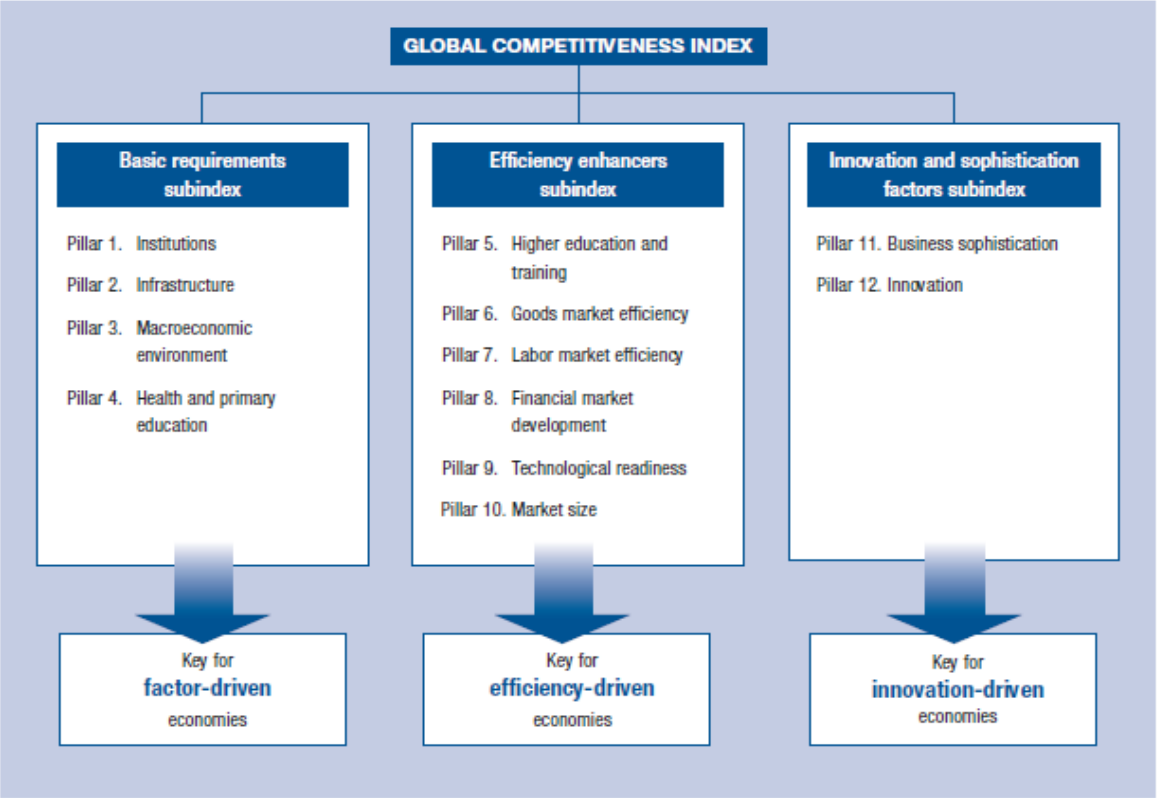

Figure A4.3 Global Competitiveness Index Framework

Source: World Economic Forum (2014:9)

One of the desired outcomes of Namibia's National Development Plan 4 is for the country to become the most competitive economy in the SADC region (National Planning Commission, 2013:139). At present, the country's overall competitiveness is ranked 90th out of 144 countries in the world by the Global Competitiveness Report 2014/2015 (World Economic Forum, 2014:13). This places Namibia in the third position in the region, behind Botswana at 74th and South Africa at 56th. What should be noted from the same report is Namibia's road quality ranking, which at 28th is the highest in Africa and on par with the United Kingdom (*ibid.* 429). Namibia is classified as an efficiency-driven economy (see Figure 4.5), which the Institute for Public Policy Research (2014) credits to the country's strongly functioning institutions and good infrastructure. The country's overall competitiveness ranking by the World Economic Forum (2014) supports findings by the World Bank's *Doing Business Report 2015*[26], that recorded slow improvement in Namibia's business regulation reforms over the past decade, and which ranked the country's overall performance at 88th

[26] *Doing Business Report* is the World Bank's annual series that since 2003 began monitoring the reform of business regulations across member countries (World Bank, 2013). The reforms are aimed at improving private sector's competitiveness and they measure the ease of doing business in 189 countries

out of 189 countries in 2014 (World Bank, 2014:206). Below, in Table A4.1, are Namibia's overall competitiveness rankings from the Global Competitiveness Index Report and the Doing Business Report.

Table A4.1 Overall Competitiveness Ranking for Namibia 2004 – 2015

Ranking	**2004**	**'05**	**'06**	**'07**	**'08**	**'09**	**'10**	**'11**	**'12**	**'13**	**'14**	**'15**
WEF GCI	52	63	72	89	80	74	74	83	92	90	88	85
(Out of)	(104)	(107)	(125)	(131)	(134)	(133)	(139)	(142)	(144)	(148)	(144)	(140)
Doing Business	71	71	78	63	68	66	94	106	90	98	88	101
(Out of)	(130)	(141)	(141)	(141)	(141)	(141)	(144)	(152)	(185)	(189)	(189)	(189)

Source: Adapted from Institute for Public Policy Research (2014:45)

While Namibia's overall ranking is not poor by regional comparisons, it is ranked 118th out of 189 countries for trading across borders, which covers the number of documents required to import or export goods, the time it takes for customs clearance, and the cost to export and import by seaport (World Bank, 2015:222). This rating indicates inefficient transport services caused by border-crossing delays in Namibia, even though no data on land transport was taken into account in compiling the ratings. This means that no data on trading across borders with Angola and South Africa (Namibia's two main trading partners in the region) was included.

Also in 2013, an industry-specific survey, the Logistics Performance Index (LPI), ranked Namibia 93rd out of 160 countries (Arvis *et al.*, 2014:36). Although the LPI is a relatively new instrument, the results for Namibia show a similar trend as in the Global Competitiveness Index and the Doing Business rankings. A comparison to regional and income group scores (presented in Tables A4.2 and A4.3) shows that Namibia's logistics performance fares well in Sub-Saharan Africa, and that the country is among the top three performers in the SADC region.

Table A4.2 Namibia Logistics Performance Index Comparisons to Income Group and Sub Saharan Region – 2014.

Country	LPI Score	Customs	Infrastructure	International shipments	Logistics competence	Tracking & tracing	Timeliness
Upper middle income	2.82	2.58	2.67	2.87	2.76	2.81	3.22
Namibia	2.66	2.27	2.57	2.70	2.69	2.56	3.15
Sub-Saharan Africa	2.46	2.27	2.27	2.49	2.41	2.48	2.84

Source: Author's compilation based on data sets from Arvis *et al.* (2014)

Table A4.3 Namibia Logistics Performance Index Comparisons with SADC countries

	overall LPI score	overall LPI rank	Scores				
			Customs	Infrastructure	Logistics quality & competence	Tracking and tracing	Timeliness
South Africa	3.43	34	3.11	3.20	3.62	3.30	3.88
Malawi	2.81	73	2.79	3.04	2.86	2.63	2.99
Namibia	2.66	93	2.27	2.57	2.69	2.56	3.15
Angola	2.54	112	2.37	2.11	2.31	2.59	3.02
Mauritius	2.51	115	2.25	2.50	2.48	2.34	2.88
Botswana	2.49	120	2.38	2.23	2.58	2.40	2.94
Zambia	2.46	123	2.54	2.31	2.47	2.47	2.91

Source: Author's calculation based on data from Arvis *et al*. (2014;34-37)

However, a closer analysis of the countries scores over the past 8 years (see Table A4.4) shows that even though the ranking has increased, the overall scores have not changed much. This signals slow improvements in the logistics industry, which could explain Namibia's poor performance in its income group.

Table A4.4 Namibia Logistics Performance Index 2007-2014

	2007	2010	2012	2014
LPI Rank	126	152	89	93
LPI Score	2.16	2.02	2.65	2.66

Source: Author's compilation based on data sets from Arvis *et al*. (2014)

A4. 2. Namibia's System of Innovation and the Regional Infrastructure Context

At the regional level, Namibia's system of innovation is among the highest; ranked 5th .by the *2016 Global innovation Index*, just after South Africa, Mauritius, Rwanda and Botswana (Cornell University, INSEAD & WIPO, 2016). The primacy of this ranking reflects high investment in the country's inputs of innovation[27], especially in the freight transport sector. It has been argued that regional integration promotes innovation and enhances competitiveness (Utterback & Afuah, 2000, Padilla-Perez, Vang & Chaminade, 2009). Larger markets, as submitted by (United Nations Economic Commission for Africa, 2016:45) incentivises 'economic entities (firms, entrepreneurs) to commercialize their intellectual property assets [that are] embedded in knowledge generated through R&D and through non-R&D routine learning [in order] to exploit economies of scale'. With majority of Sub-Saharan African economies still dependent on commodity exports, there is potential for local value addition (Ocheni & Nwankwo, 2012).

[27] The innovation input sub index consists of five pillars: institutions, human capital and research, infrastructure, market sophistication and business sophistication (Cornell University, INSEAD & WIPO, 2016:14)

Namibia's system of innovation, from the infrastructure development and institutions perspectives arguably provide regional and global integration opportunities by connecting markets and facilitating the movement of goods and people. The opportunities will not only upgrade but also create new production systems from the learning impetus. As the region moves up the value chain addition process, its products and services also become competitive in global markets, generating better employment conditions and reducing poverty.

There is however limited complementarity of Namibia's investment in the regional system of innovation in terms of quality transport infrastructure and institutions, partly due to a long history of patrimonialism in most Sub-Saharan African countries (Acemoglu & Robinson, 2010). This is evidenced in the region's ambitious infrastructure development programmes such as the *Program for Infrastructure Development in Africa* and *SADC Regional Infrastructure Development Master Plan* which are poorly funded from local resources.

One of the results of an inefficient regional innovation ecosystem is individual African countries' poor performance on innovation outputs. For instance, while Namibia's regional ranking is high on innovation input at 5, its innovation output is ranked lower at 13. The country's efficiency ratio which measures the value of outputs to inputs is even lower at 102 out of 128 countries. These rankings reveal a weak national system of innovation for Namibia. They uncover a gap between the country's innovation capability and the translation of these capabilities into commercial value. Summing up Namibia's innovation context, Schuler (2013:5-6) maintains that the country's competitive position, which is a reflection of its system of innovation 'is falling, because others are improving' and that Namibia is 'standing still while others race'. Since this observation has also been expressed several times by the Namibia Business and Investment Climate Survey[28] from 2009 to 3013, it is important to examine what it means for Namibia's road freight transport industry (Institute for Public Policy Research, 2013). In Namibia, efficient road freight transport services are among the key competitive factors in the country's national development framework.

A4.3 Road Safety and Trucks in Namibia

Road safety in Namibia has in recent years attracted controversial attention. In 2014, for instance, a study by the Transportation Research Institute at the University of Michigan reported that Namibia's road crash fatality rate was 45 per 100 000 people, the highest in the world (Sivak & Schoettle,

[28] The Namibia Business and Investment Climate (NamBIC) Survey is a series of annual reports that monitor the improvement of the regulatory business environment, including access to and cost of finance, border procedures taxes, government services and public administration.

2014:6). These statistics followed the World Health Organization's (2013: 248) *Global Status Report on Road Safety* which put Namibia's road crash fatality rate at 25 per 100 000 people. Even though the findings of both institutions were disputed by Namibia's National Road Safety Council and the Motor Vehicle Accident Fund, the trend shows that road safety in general is becoming a concern (see Figure A4.4 below).

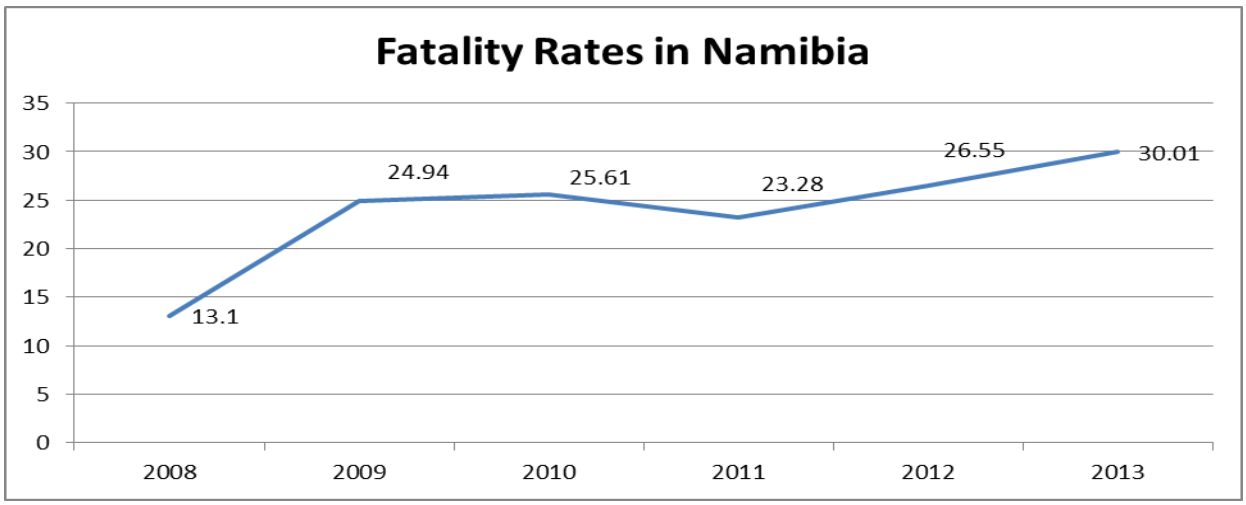

Figure A4.4 Fatality Rates in Namibia 2008-2013

Source: National Road Safety Council and Motor Vehicle Accident Fund (2013:2)

Recent statistics from Roads Authority (2014) and the Motor Vehicle Accident Fund (2014) show that, despite trucks accounting for 6.2 percent[29] of the total vehicle population, which stood at 326 862 in 2014, trucks are involved in 7.6 percent of total road accidents. This, even factoring in the fact that the number of trucks involved in road accidents decreased by 11 percent from 453 in 2013 to 402 in 2014. Thus, even though the World Bank (2012) and the Japan International Cooperation Agency (2015) list Namibia's road transport services among the safest in the region in terms of accidents and theft, recent statistics signal caution in proceeding forward. Their assessments confirm the global cargo threat levels by FreightWatch International (2013), where Namibia and Botswana's risk levels are only elevated, while the rest of the region is moderately high to severe. This means that, in addition to the economy of scale that is expected from the Walvis Bay Port expansion and logistics hub activities, Namibia also has the potential to attract 'high-value and time-sensitive cargo' on the basis of safety relative to alternative routes (World Bank, 2012:11).

[29] This implies that in 2014, the number of registered trucks in Namibia was 20 302 trucks.

A4.5 Summary

This section supplied a description of Namibia's innovation landscape, its effect on the country's competitiveness, its meaning for the road freight transport industry, and its ability to serve the country's economic development activities. The section found that the promotion of innovation activities in Namibia is still in its infancy. Innovation in the country is particularly constrained by the fragmented system of innovation, which is evidenced by the absence of adequate national innovation data. The limited innovation activities in the country are further observed in the country's competitiveness, which has not shown significant improvement over the past decade.

The section also found that Namibia's road infrastructure is of a high standard and the government is in the process of expanding the infrastructure capacity, but there are still concerns regarding the capacity of road freight operators to compete at regional level.