CROSS-BORDER ROAD TRANSPORT AGENCY

CROSS-BORDER FLOW CALCULATOR

ECONOMIC IMPACT ASSESSMENT REPORT

FOR TRANS-KALAHARI CORRIDOR

MARCH 2021

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FIGURES

TABLES

ACRONYMS

C-BFC	Cross-Border Flow Calculator
C-BRTA	Cross-Border Road Transport Agency
BW	Botswana
GPS	Global Positioning System
ICT	Information and Communication Technology
JBC	Joint Border Committee
MAX	Maximum value
MIN	Minimum value
NM	Namibia
OSBP	One-Stop Border Post
PE	Physical Examination
PoE	Port of Entry
RSA	Republic of South Africa
SADC	Southern African Development Community
TKC	Trans Kalahari Corridor
VOC	Vehicle Operating Cost

EXECUTIVE SUMMARY

The Cross-Border Road Transport Agency (C-BRTA or the Agency) collaborated with the University of Stellenbosch to complete this Cross-Border Flow Calculator (CBFC) Economic Impact Assessment (EIA) Report (or the report) for transit time and delays that are encountered by cross-border road transport on certain sections of the Trans-Kalahari Corridor (TKC).

The report was compiled using qualitative and quantitative data collected by C-BRTA in 2019 on the segment of the TKC corridor in South Africa. The data was used in the calculation of trade logistics costs for Skilpadshek and Kopfontein border posts, the Zeerust Truck Stop and the two traffic control centres, Bapong and Zeerust on the segment of the corridor. The average transit time data variables were used in a logistics cost formula to infer new trade logistics costs resulting from the delays.

It is envisaged that the research results from the EIA assessment will assist stakeholders in the corridor, relevant government departments responsible for trade and cross-border road transport movement facilitation including regulatory authorities such as C-BRTA and its counterparts to have firm understanding of the significant negative economic impact cross-border delays have on logistics costs and trade, supported by accurate cost figures.

The following are the key findings:

- For Skilpadshek, the actual cost of delays was R132 232 955 for northbound and R30 054 732 southbound traffic. This was based on average delays of 21 hours 45 minutes, traveling northbound from South Africa into Botswana and 13 hours 48 minutes travelling southbound from Botswana to South Africa. The findings highlighted the fact that delays at Skilpadshek border post are prolonged and incur great costs. Implications for future research should consider the impact of how Covid-19 has affected the clearance procedures, as well as reflect on how the mathematical topic of queuing theory is present at border posts
- Similarly transit times for Kopfontein and Zeerust Truck Stop were used together with the modelling of freight flow to calculate logistics costs for the two locations. Through the realisation of these calculated costs due to border delays, a strong emphasis was placed on the need to decrease border delays at Kopfontein Border post and the truck stop. Driver questionnaires further provided qualitative insights for the border posts by obtaining the border post users' views on the operation at both Skilpadshek and Kopfontein border posts
- The new logistics costs calculated for Kopfontein Border post and for the Zeerust truck stop combined are R185 155 895 for northbound and R33 303 114 for southbound and the combined logistics costs are R218 459 009. The transit times were calculated, with the inclusion of Zeerust truck stop transit times for sampled vehicles. The driver questionnaires indicated problems and suggestions for the two border posts.

Tables below illustrate percentage changes in costs excluding externalities (noise, pollution, etc.) and including externalities respectively.

Percentage change of border post costs within the total trade logistics costs excluding externalities.

Excluding Externalities from Total Trade Logistics Costs	Initial Percentage Border Post costs	Percentage savings of Border Post costs	New Percentage Border Post costs after savings.
Kopfontein SB	7.08%	4.74%	2.35%
Kopfontein NB	10.29%	7.11%	3.18%
Total (Kopfontein)	9.63%	6.62%	3.01%

Percentage change of border post costs within the total trade logistics costs including externalities.

Including Externalities from Total Trade Logistics Costs	Initial Percentage Border Post costs	Percentage savings of Border Post costs	New Percentage Border Post costs after savings.
Kopfontein SB	6.25%	4.18%	2.07%
Kopfontein NB	8.98%	6.21%	2.77%
Total (Kopfontein)	8.42%	5.79%	2.63%

The delays resulting in the costs indicated above were linked to a number of factors which include outdated border crossing procedures which heavily contributed to the delays experienced at Skilpadshek border post, inefficiencies associated with customs control operations, cumbersome document processing, staff shortages, network issues, infrastructure constraints and bureaucracy. The logistics costs established show that there is a delay problem at Kopfontein Border post, which negatively impacts every vehicle using this border post. Further research will be needed to reduce these delays and consequently decrease the logistics costs of the border post users.

While the economic impact assessment calculation provided invaluable insights insofar as the cost of delays is concerned, the study had limitations because only a portion of the corridor was involved. However, the findings from the study provide invaluable insight to the negative impact of long transit times and delays that are experienced by cross-border road transport on the TKC.

The following key interventions are recommended to address the challenges, and by so doing reducing the resultant costs related to long transit times and delays:

- Implementation of One Stop Border Posts (OSBP) at both border posts. OSBPs have proven to lessen transit time between borders as part of the procedures can be merged, thus alleviating the issue of duplicated activities
- Harnessing technology and restructuring border procedures to accommodate rising traffic volumes and for future growth in the volume of freight moving through borders.

Going forward, it is recommended that, an end-to-end assessment be conducted, incorporating all the points on the TKC where delays are encountered. Meanwhile, findings presented in this report should be strong indication that more needs to be done to eliminate or address corridor bottlenecks which result in long transit times and high logistics costs.

1 INTRODUCTION

The Cross-Border Road Transport Agency (C-BRTA or the Agency) collaborated with the University of Stellenbosch towards completion of this Cross-Border Flow Calculator (CBFC) Economic Impact Assessment (EIA) Report (or the report) for transit time and delays that are encountered by cross-border road transport on certain sections of the Trans-Kalahari Corridor (TKC).

The aim of the study was to conduct EIA using the average transit time that a truck experiences on the Trans-Kalahari Corridor, with a view to understand and quantify the effect of transit time on trade logistics costs. The report was compiled using qualitative and quantitative data collected by C-BRTA in 2019 on the segment of the TKC corridor in South Africa. The data was used in the calculation of trade logistics costs for Skilpadshek and Kopfontein border posts, the Zeerust Truck Stop and the two traffic control centres, Bapong and Zeerust on the segment of the corridor.

To understand the context of the study and approach taken in this report, it is important to look at the contribution of transport costs to total logistics costs. In 2014, transport costs accounted for 57% of total logistics costs, followed by inventory carrying costs (15.2%), warehousing (14.6%) and management & administrative costs (13.5%) (Havenga, Simpson, King, de Bod & Bruin, 2016). With freight transport costs accounting for the bulk of trade logistics costs, it is imperative to reduce these expenses where possible, to realise the benefits that follow (Jacoby & Minten, 2009).

Due to trucks standing idle in corridors and at border posts for extensive periods of time, this unnecessarily extends the cash-to-cash cycle between the sender and receiver of the goods. This could result in frustrating the receiving party, consequently losing a business partner in the future. Thus, identifying key problems causing delays and how they impact trade logistics costs could allow for more streamlined border post practices, encouraging higher levels of intra-African trade.

1.1 Project Background

The C-BRTA developed a CBFC Model for measuring transit time at border posts and in corridors in 2017-18. This was followed by pilot studies focusing on measurement of transit time at a number of border posts and the segment of the TKC corridor in South Africa, looking at multiple nodes of the corridor. The purpose of the CBFC is to:

- Quantify Transit Time and identify bottlenecks to seamless flow of cross-border traffic
- Enable estimation of the economic impact of long Transit Times and delays.

It is expected that understanding of the two objectives above would enable figuring out of solutions for addressing corridor bottlenecks and reducing transit times which would result in efficient flow of both goods and passengers in the region.

Several reasons and objectives informed the development and piloting of the Cross-Border Flow Calculator. There is evidence from regional corridor studies conducted in Southern

African Development Community (SADC) confirming that there are high logistics costs incurred in regional corridors that negatively affect the import and export business. This has unfortunately rendered SADC region unattractive for foreign direct investment and goods produced and traded uncompetitive. Furthermore, the high logistics costs continue to affect intra-regional trade as well as market integration and the overall competitiveness of the regional market. It is arguably and partly, for this reason that the rate of industrialisation within the region continues to lag behind in comparison to other developing regions such as the Asian counterparts.

Equally important is the fact that delays at border posts and resultant long transit times are a burden, not just to domestic and regional economies, but impede the seamless flow of passenger transport between countries. Other than affecting passenger comfort, safety, social wellbeing and cause fatigue, it also has a negative impact especially on small-scale traders, who often use public transport for transportation of their consignments. The inefficiencies experienced along the corridors are a result of border post delays and contribute significantly to the high logistics costs within the region. These delays increase the cost of doing business and affect regional trade and market integration as well as the global competitiveness of the region.

The absence of a tool or mechanism in the country (South Africa) for calculating border-crossing transit time and for computing the economic impact of these delays has been a matter of concern. Prior to the development of the Cross-Border Flow Calculator/ Model (C-BFC) now at piloting phase, it was not possible to predict travel times for both freight and passenger along corridors and across commercial border posts servicing the country. Passenger and freight transport operators continue to complain about the inefficiencies and delays at the various commercial border posts, which contribute to high costs incurred in the course of doing business.

To address the challenges raised above, the Cross-Border Road Transport Agency therefore developed a Cross Border Flow Calculator/ Model, during the 2017-18 financial year, to calculate border-crossing transit times and to establish the extent of transit delays and ultimately estimate the economic impact of the delays experienced by cross-border traffic. Dwell time for commercial cross-border vehicles is an important performance indicator of supply-chain as this affects asset utilisation and has a negative impact on vehicle operating costs (VOC).

In order to test the functionality of the C-BFC, the C-BRTA identified several points on the TKC for piloting of the calculator and commissioned several surveys aimed at collecting data to pilot the tool. This report is an outcome of the pilot surveys conducted on the South African portion of the Trans Kalahari Corridor. The surveys lasted for seven days where a combination of driver personal interviews, determination and recording of vehicle registration numbers and arrival/departure times were recorded at designated points as indicated. Data collected at these points was used to establish transiting time and delays by measuring minimum, mean, median and maximum transit times for commercial trucks, buses and cross-border taxis

It is therefore envisaged that going forward, the C-BFC will assist in providing real-time data on transit time and travel times across corridors focusing on key nodes, and will have a range of tangible benefits, including improved decision making insofar as planning and targeted interventions aimed at improving cross-border road transport and trade flow is concerned.

1.2 Project Location

Figure 1 below shows the locations on the Trans Kalahari Corridor where data was collected.

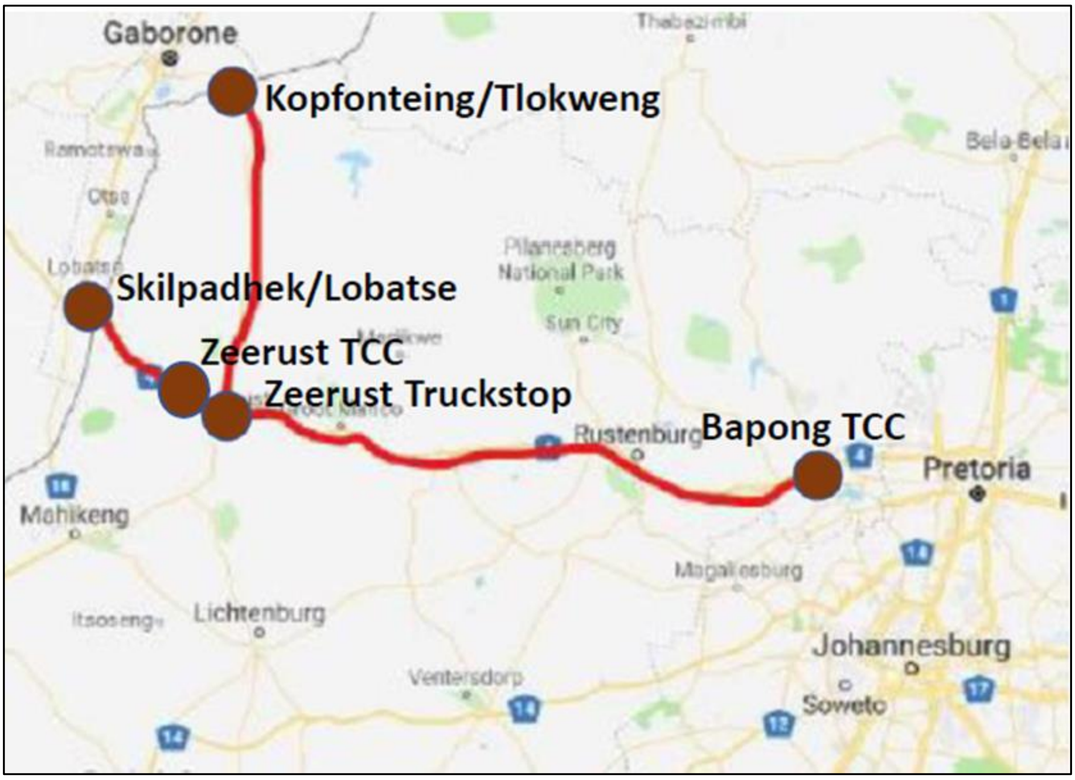

Figure 1 Trans Kalahari Corridor Survey points

The Trans Kalahari Corridor has three major commercial border posts, two of which are between South Africa and Botswana, namely Skilpadshek/Lobatse and Kopfontein/Tlokweng as shown in **Figure 1**. The third one is between Botswana and Namibia (Mamuno border post). The TKC corridor is used by road transport operators transporting commodities and passengers between South Africa and its two SACU neighbours, Botswana and Namibia. The corridor also links South Africa with Angola as it connects into the Trans Cunene Corridor.

1.4 Study objectives

The main aim of the study was to investigate and determine the EIA of Transit Time and delays established using the segregated and block transit times for cross border traffic flows on the Trans Kalahari Corridor. The objectives of the study were to:

- Quantify Transit Time and identify bottlenecks to seamless flow of cross-border traffic

- Enable estimation of the economic impact of long Transit Times and delays, amongst others.

The data was extracted from a Study conducted by C-BRTA on ‘Assessment of the transit times for freight and public transport passenger vehicles (both taxis and buses)’ which was undertaken on the Trans Kalahari Corridor over a period of seven days, from the 7^{th} to the 14^{th} of November 2019.

The specific objectives for this study were as follows:

- To establish segregated and block transit time baselines for the time taken by trucks to pass through the two borders by gathering arrival and departure times of trucks at the points of entry and exit
- To establish if time spend at border posts is a result of time required for formal clearance procedures or may be due to other reasons
- To identify specific issues that impede the free movement of vehicles across borders
- To identify problems encountered by trucks using border posts.

During the surveys, traffic observation was conducted over 18 hours at all stations except at Bapong Traffic Control Centre TCC where the observations were 24 hours, over the seven days. The data obtained was analysed to calculate transit times for each side of Skilpadshek/Pioneer Gate and Kopfontein/Tlokweng border posts and at inland points: Zeerust TCC, Zeerust Truck Stop and Bapong TCC. The transit times are vital inputs to the finalisation of the Cross-Border Flow Calculator Model and for the eventual automation of the transit calculation project. It planned that the block transit will form a baseline in the implementation of future interventions on the Trans Kalahari Corridor.

1.5 Structure of report

The report comprises the following sections:

- Section 1: Introduction and Background: Highlights the project background, objectives of the study and explains the purpose of this report
- Section 2: Cross-Border Flow Calculator Model: Outlines the three levels of the Model
- Section 3: Methodology and data collection process
- Section 4: EIA Results: Provides a detailed Analysis of the EIA
- Section 5: Conclusion and Recommendations: Concludes this report and provides some recommendations for future similar studies.

2 CROSS-BORDER FLOW CALCULATOR MODEL

2.1 Introduction

The Cross-Border Flow Calculator has three levels. The different levels provide different levels of analysis depending on depth of detail that may be required in the calculation of transit times at specific border posts. The three levels of the CBFC are:

- Block Transit Time
- Segregated Transit Time
- Detailed Analytical Transit Time.

2.2 Block Transit Time

The Model for calculation of Block Transit Time is presented below. This Model when applied provides block time taken to between start time of border processes on one side of the border and the time the vehicle is acquitted on the other side of the border. It does not do any analysis of how much time is spent on either side of the border or for each process.

Block Transit Time (Border Post) $= \sum(Exit^{™}\ Border\ Post\ Side_b - Arrival^{™}\ Border\ Post\ Side_a)$

Where:

- $Exit^{™}\ Border\ Post\ Side_b$ is the time when the vehicle is acquitted and exits the border on the second side of the border
- $Arrival^{™}\ Border\ Post\ Side_a$ is the time when the border crossing processes commence when the vehicle has arrived at the first side of the border.

This Model can be applied to establish overall transit time at a border or conduct comparative assessment of border post performance i.e. between border posts and to track performance of a border over time.

2.3 Segregated Transit Time

The model for calculating Segregated Transit Time is presented below. This model, when applied breaks down transit time into two portions: time spent on one side of the border and on the other side.

Segregated Transit Time is established calculating time taken between start time of border processes when the vehicle arrives and time the vehicle is acquitted and leaves one side of the border to cross to the other side. Then it adds the time taken between start time of border processes when the vehicle arrives on the other side and the time the vehicle is acquitted and leaves the second side of the border to continue its journey.

Segregated Transit Time (Border Post)

$$= \sum \left(Exit^{™}\ Border\ Post\ Side_a - Arrival^{™}\ Border\ Post\ Side_a \right) + \sum (Exit^{™}\ Border\ Post\ Side_b - Arrival^{™}\ Border\ Post\ Side_b)$$

- $Exit^{™}\ Border\ Post\ Side_a$ is the time when the vehicle is acquitted and exits the border on the first side of the border
- $Arrival^{™}\ Border\ Post\ Side_a$ is the time when the border crossing processes commence once the vehicle has arrived at the first side of the border
- $Exit^{™}\ Border\ Post\ Side_b$ is the time when the vehicle is acquitted and exits the border on the second side of the border
- $Arrival^{™}\ Border\ Post\ Side_b$ is the time when the border crossing processes commence once the vehicle has arrived at the second side of the border.

The Model provides a basic level of analysis that determines the time spent on each side of the border. Thus, it can be applied to provide information on the level of inefficiency associated with each side of the border. However, it does not determine the exact processes that cause inefficiencies.

2.4 Detailed Analytical Transit Time

The Model for calculation of Detailed Analytical Transit Time is presented below. The application of this Model breaks down transit time into two portions: time spent on one side of the border and on the other side of the border. Secondly, it breaks down the time spent on either side of the border into exact durations spent conducting each of the border crossing processes on both sides of the border.

Detailed Analytical Transit Time is established by summing up time taken executing each border crossing process on both sides of the border. This Model enables the establishment of durations associated with each process undertaken, calculating time taken between the start time of border processes when the vehicle arrives and the time the vehicle is acquitted and leaves one side of the border to cross to the other side. It then adds the time taken between start time of border processes when the vehicle arrives on the other side and the time the vehicle is acquitted and leaves the second side of the border to continue its journey.

Detailed Analytical Transit Time

$$= \sum Border\ Post\ Side_a\ (P^{™}1 + P^{™}2 + P^{™}3 + P^{™}4 \ldots\ldots.. + P^{™}(n-1) + P^{™}n) + \sum Border\ Post\ Side_b\ (P^{™}1 + P^{™}2 + P^{™}3 + P^{™}4 \ldots\ldots.. + P^{™}(n-1) + P^{™}n$$

- $Border\ Post\ Side_a\ is$ first side of the border
- $Border\ Post\ Side_b$ is the second side of the border
- P™1 is time spent executing border crossing process one
- P™2 is time spent executing border crossing process two
- P™3 is time spent executing border crossing process three
- P™4 is time spent executing border crossing process four
- P™$n-1\ is$ time spent executing second last border crossing process
- P™$n\ is$ time spent executing the last border crossing process.

The Model provides detailed level of analysis which enables determination of time spent on each process on either side of the border. Thus, it can be applied to provide information on the level of inefficiencies associated with each process and enable targeted interventions and improvements.

2.5 Conclusion

The focus of the pilot of the Model in the current financial year was be limited to the analysis of Block Transit Time and Segregated Transit Time only on the South Africa side of the TKC. This report therefore provides analysis of transit times for Kopfontein/Tlokweng, Skilpadshek/Pioneer Gate border posts, Zeerust TCC, Zeerust Truckstop and Bapong TCC based on outcomes of surveys conducted.

3 RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This section provides information on the sources of data and the methods used to conduct the EIA.

3.2 Research Design

The approach to theory development for this research was deductive in nature as the research made use of existing theory as a foundation. Saunders *et al.* (2016:714) defines a deductive approach as "*involving the testing of a theoretical proposition by the employment or a research strategy specifically designed for the purpose of testing*".

The research was based on an explanatory case study of the vehicle transit times on the TKC corridor. The transit times and delays experienced by cross-border road transport on the corridor were measured. With this data, logistics costs related to the transit times and delays were calculated. The progression of the research is cross-sectional in nature as the data that was used for this study was captured over a period of a week, for one year (Saunders *et al.,* 2016:200).

3.3 Research Methodology

To understand the impact of border delays on vehicle transit times and the reasons for the transit times and delays experienced in the corridor, a mixed methods approach was incorporated into the research. Quantitative and qualitative data were used and analysed, making use of numeric as well as non-numeric data. This was due to the fact that a mixed methods approach allows for a deeper understanding of the data presented (Saunders *et al.,* 2016:169).

To calculate the logistics costs incurred because of long transit times and cross border delays, the Logistics Cost Model (LCM) and Freight Demand Model (FDM) were used. Once calculations were complete, Microsoft Excel and Tableau were used to visually portray the results using appropriate charts and graphs.

3.3.1 Quantitative research methods

For this research, most of the results stem from quantitative data, although qualitative data is used to support the conclusions reached from analysing the quantitative data. The quantitative data consisted of vehicle transit times through the northbound and southbound gates at Skilpadshek. This allowed the researcher to analyse the scope of the border delays. For this study, mathematical formulas and statistical analysis were used conjunctively when working on the data to extract the needed information to assist in answering the research questions.

3.3.2 Qualitative research methods

Interviews with truck drivers carried out by the CBRTA form the basis of the qualitative data. Contained in the interview data, are the truck drivers' first-hand experiences as to why they believe these delays occur. Qualitative aspects included in the research methods proved to be appropriate to this study, as it assisted in providing context for the transit time data provided by the CBRTA.

3.4 Secondary Data

The nature of this study involved the use of secondary data exclusively recorded and supplied by the CBRTA to credibly answer the research questions stated. Secondary data refers to data that had originally been collected for some other purpose, which can be further analysed to infer additional or different knowledge, interpretations, or conclusions (Saunders *et al.,* 2016:316). Two sets of secondary data were supplied, one focusing on transit times through Skilpadshek and the other centred around providing freight flow volumes and commodity groups from Zane Simpson.

Parts of the research results stem from survey-based secondary data which refers to present data initially collected for some other purpose by means of a survey strategy, usually questionnaires. Such data generally refers to government agencies, which was made available in data tables as a downloadable matrix on Microsoft Excel raw data for secondary analysis (Saunders *et al.,* 2016:322).

3.5 Cross-Border Road Transport Agency's Data Recording Points and Process

The CBRTA recorded the transit times of the trucks at four points at the Skilpadshek border post, capturing the entry and exit times of the vehicles along with driver questionnaires. The format of the data provided by the CBRTA was in Microsoft Excel format as quantitative, unprocessed data. The data was recorded manually.

The process involved individuals to be positioned at various points across the border to measure the time that it took for a vehicle to pass through the gates by noting the arrival time and exit time, as well as number of days spent, if necessary. The date of entry and exit was recorded along with the vehicle registration. Maximum and minimum transit times were provided, as well as the average daily segregated transit times. The points below match those of the physical boundaries found at Skilpadshek as illustrated in Figures 2 and 3.

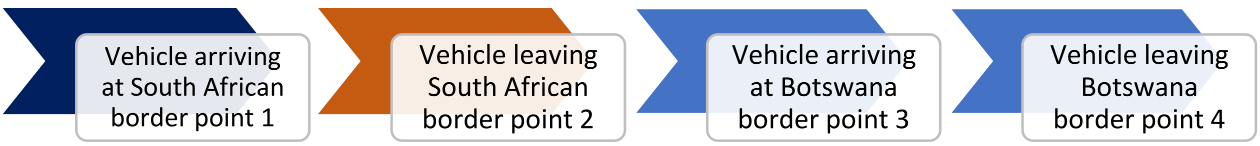

Figure 2: Recording points where the CBRTA captured the transit times of vehicles leaving South Africa entering Botswana (northbound)

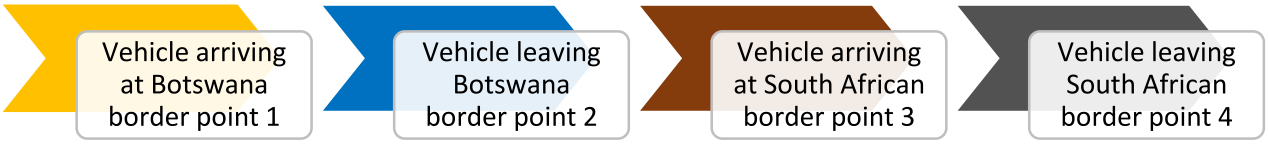

Figure 3: Recording points where the CBRTA captured the transit times of vehicles leaving Botswana entering South Africa (southbound)

Data entries were recorded for 566 vehicles passing through the southbound points and 579 vehicles for the northbound points, over a period of one week in November 2019. The truck operator's experiences involving the length of time spent at the border during the customs process as well as the category of commodities transported through Skilpadshek were also recorded by the CBRTA.

3.5.1 Freight flow movement data

The second data set contains data of freight flow volumes through Botswana as well as a breakdown of the various commodities travelling through Skilpadshek. Figures explored through this data set were in respect to importing and exporting activities, to and from Botswana.

3.6 Key Constructs and Variables

For this study, the constructs and variables need to be defined. The constructs listed highlight the main recurring themes and concepts throughout this research, whilst the variables aid in measuring activities linked to the constructs (Saunders *et al.,* 2016:450).

The key construct of this research is trade logistics costs. Trade logistics costs is calculated according to the logistics cost mode (LCM) as well as the freight demand model (FDM) encompassing all costs involved in the movement of freight from a point of origin, across border posts, arriving at the desired destination. The unit of measure for the trade logistics costs is in Rands. The variables relating to trade logistics costs include:

- Transport costs
- Inventory carrying costs
- Management and administrative costs
- Additional logistics costs due to cross border delays.

Transport costs are comprised of both the fixed and variable costs involved in the transportation leg of the journey. Additional logistics costs due to border delays include costs such as costs of lost driver productivity, as this is the opportunity cost of the driver doing something productive, when this is not possible due to the border delays.

A sub-construct is cross border delays defined as trucks standing stationary at the border post for a lengthy period. Variables linked to cross border delays are time centric, specifically the time it takes from when a truck arrives to the border post, until departure, measured in days, hours and minutes. According to Havenga *et al.* (2013) these delays result in an increase in costs. The analysis involved measuring the time delay and then translating the time delay into costs. The variable of time impacts trade logistics costs in the following ways.

A prolonged delay can cause the fixed cost component of the truck to increase as well as result in an increase in the opportunity cost of holding stock. Border delays cause longer order cycles due to the unpredictability of the time delay as well as instability in inventory levels causing safety stock to rise (Havenga *et al.,* 2013).

3.7 Limitations of this research

Due to the transit time data being recorded manually, this left room for error, such as transit times not being as accurately recorded as if they were to be captured using electronic scanners. In future, with the use of appropriate technology, this manual data collection process would be sped up, realising a reduction in errors and freeing up time for the data capture to work on additional tasks that require human input. In addition, only two data capturers were employed. Employing more staff to be stationed at various outposts along the border would yield more accurate results, limiting the risk of the two staff members being overwhelmed with tasks.

4 DATA COLLECTION AND ANALYSIS

4.1 Introduction

Sections below outlines the process that was followed with respect to data collection and analysis.

4.2 Quantitative Data

A composite approach was followed in the analysis of the quantitative data provided. The data was filtered and organised for the appropriate use related to this study. Structuring the data required basic data analysis skills within the field of Microsoft Excel. Once the data was assembled in the required format, the data was converted to display the concepts discussed in a visual representation.

4.1.1 Nature of the data

The CBRTA recorded numerous aspects of data at several border posts between South Africa and Botswana in November 2019. Recordings in the data stretched over a period of one week. The structure of the data includes assembled spreadsheets of the transit times of the trucks arriving and departing at the recording points named northbound and southbound gates of Skilpadshek. Recordings for each individual vehicle's entrance and departure was captured with time being the variable of interest documented on each vehicle. Vehicle transit time proved to be a crucial variable of interest as it was analysed to determine delay times.

Along with vehicle transit times, questionnaires answered by the truck drivers stating their concerns as to why unreasonable delays were occurring at Skilpadshek were provided. Data of freight flows passing through the border were captured and supplied by Zane Simpson. This was processed to determine a current freight flow model needed for the trade logistics cost calculation.

4.2 Qualitative data

Data provided by the CBRTA aided in calculating more accurate trade logistics costs that encompass the current topic of border delays into the final calculation. Interviews conducted by an employee of the CBRTA with the truck drivers help to substantiate the reasoning behind why these delays were so apparent.

4.3 Validity and Reliability of Findings

Saunders *et al.* (2016) defines validity as *“the extent to which data collection methods accurately measure what they were intended to measure”*. The validity of this study was preserved by ensuring that trustworthy data from a credible government agency was used. For the accuracy of this study, the data was cross-checked. A process of filtering and grouping quantitative data for Skilpadshek border post was conducted with the use of Microsoft Excel. The qualitative data was validated through the means of cross-checking the most relevant reasons for delays sourced from the interviews with reoccurring themes discussed in the literature review. The validity of the figures used in the calculation were thoroughly checked for accuracy by Zane Simpson as well as Crynos Mutendera who is employed by the CBRTA.

5 REASRCH RESULTS

5.1 Introduction

This section of the report illustrates the importance of analysing the data and obtaining results from which conclusions are drawn. Surveys provided by the CBRTA based on truck transit times through the Skilpadshek border, in conjunction with freight flow information from Zane Simpson, were used to calculate results from the data.

5.2 Quantitative analysis results

This section consists of a detailed analysis of the quantitative data used for the purpose of answering the listed research questions

5.2.1 CBRTA metadata

The metadata provided by the CBRTA was captured within three Microsoft Excel files named:

- Appendix 1- Results for Segregated Transit Times
- Appendix 2- Results for Block Transit Times
- Appendix 3- Results for drivers’ questionnaires at Skilpadshek.

For this study, data from Appendix 1, 2 and 3 were used, as Appendix 1 contained recorded times of the trucks entering and exiting each border point, including data for the Zeerust truck stop. Appendix 2 recorded the block transit times between Skilpadshek and Pioneer Gate. Appendix 3 provided valuable insights from the drivers passing through the Skilpadshek border post as to why they believed such unnecessary delays were occurring.

Four points of interest were used to capture transit time data on the South African and Botswana borders:

- Skilpadshek northbound (South Africa)
- Pioneer Gate northbound (Botswana)
- Pioneer Gate southbound (Botswana)
- Skilpadshek southbound (South Africa).

As a truck arrived at an entry or exit point, the CBRTA captured the following data, as portrayed in Table 3. Table 3 is a generic outline of the various data entries captured at the four border stop points.

Table 1: Metadata of variables of interest recorded at entry and exit stages

Variables of Interest	Example of a record	Definition of variable of interest	Unit of measurement	Data category	Type of data
Count	1	The amount of times a truck was recorded passing the border	Count/Number	Quantitative	Ordinal
Vehicle class	Class 4	The observed vehicle class	Text	Qualitative	Nominal
Arrival Day	Thursday	Entry day of arrival	Text	Qualitative	Nominal
Arrival Date	7	Entry date of arrival	Date/time	Qualitative	Ordinal
Arrival Month - Year	Nov - 19	Entry month and year of arrival	Date/Time	Quantitative	Ordinal
Exit Date	8	Vehicle exit date of departure	Date/Time	Quantitative	Ordinal
Days Spent	1	Amount of days the vehicle is delayed at border	Date/Time	Quantitative	Nominal
Vehicle Registration	B119APF	Vehicle registration number	Text	Qualitative	Nominal

Time In	16:05	Time of arrival	Date/Time	Quantitative	Ratio
Exit Time	18:47	Time of departure	Date/Time	Quantitative	Ratio
Segregated Transit Time (hh:mm)	26:42	Hours and minutes of the vehicle waiting at border	Date/Time	Quantitative	Ratio
Skilpadshek Northbound	Spreadsheet heading	From South African border to Botswana	Text	Qualitative	Nominal
Pioneer Gate Northbound	Spreadsheet heading	From Botswana border into Botswana	Text	Qualitative	Nominal
Pioneer Gate Southbound	Spreadsheet heading	From Botswana to Botswana border	Text	Qualitative	Nominal
Skilpadshek Southbound	Spreadsheet heading	From Botswana border into South Africa	Text	Qualitative	Nominal

5.2.2 Botswana Road Freight metadata

To calculate updated logistics costs incorporating time delays at Skilpadshek, certain road freight data was used from 2018. Data, supplied by Zane Simpson, contained the following variables of interest and calculations. Figures for Botswana's importing and exporting activities were calculated, as shown in Table 4. Figures relating to Botswana are incorporated in the calculation of the updated logistics costs for Skilpadshek. These calculated figures made it possible to calculate new logistics costs at the Skilpadshek border that were influenced by the delay times at the border points, which are explored at a later stage of the "Research Results" section.

Table 2: Road freight data for Botswana

Region	Botswana	
International trade activity	Export to Botswana	Import from Botswana
Road Tons	3 294 813	969 651
Road Tkm	2 012 822 155	557 677 396
Value of Road Freight	R106 684 919 001	R12 225 665 555
Road Transport costs	R1 696 964 791	R514 945 102
Road Externality costs	R465 110 054	R128 864 522
Road ATD within SA borders (km)	611	575
Average ton value of Road freight	R32 380	R12 608

From Table 4 above, road tonnes, refers to the amount of freight moved on the road. Road tkm, are the ton kilometres of freight transported on the road. This was simply derived as taking the road tons and multiplying it by the distance travelled by the truck. Road ATD within SA borders refers to the Average Travelled Distance within SA borders. This figure was calculated as a weighted average of all road freight movements.

5.3 Transit time data supplied by the CBRTA

Once the data from the CBRTA had been collected, it was important to check the validity of the data entries captured, to justify their accuracy. The time frame that the survey lasted, stretched for a period of one week. Entry and exit points at the four posts were checked to make sure that they match the same timeframe as each other. The data was cleaned with the use of MS Excel, ensuring that only relevant data was used for deriving time delays related to Skilpadshek.

5.3.1 Truck recordings

Through analysing the data in the “segregated transit times” data file, the number of trucks recorded at each of the four stops were obtained for both northbound and southbound movements. The CBRTA made use of a random sampling method when recording truck entries at each point of interest, giving each truck an opportunity to be logged. Figure 8 visually portrays the number of observations recorded individually at the four points. The recording of the trucks was not synchronised as the number of trucks observed did not coincide with each other at the different points.

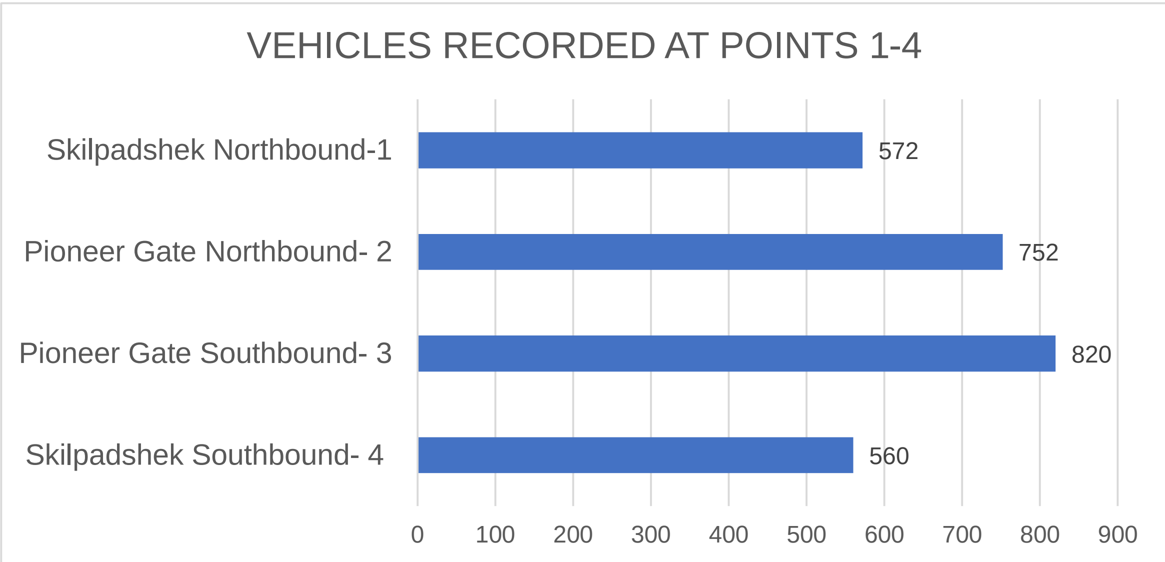

Figure 3: Truck observations recorded at points 1-4

The process of recording and matching truck entry times with their exit times was done by taking the registration and vehicle code of a truck arriving at the border point and subtracting the exit time from the arrival time. This resulted in the time showing the delay experienced at each border point. An example of a typical entry is shown in Table 5, which was recorded at the Skilpadshek northbound point.

Table 3: Matched data of entry and exit times of trucks

Count	Entry Reg & Class	Entry Date & Time	Exit Reg & Class	Exit Date & Time	Days spent	Time taken to travel through border (hh:mm)
1	B706BHF_4	07-11-19 15:44	B706BHF_4	08-11-19 19:42	1	27:58
1	CF158123_4	09-11-19 09:03	CF158123_4	09-11-19 14:59	0	5:56

5.4 Truck Transit Time Recording Process

The cycle chart below shows the detailed, step-by-step process of how the CBRTA went about recording transit times for trucks that passed through the Skilpadshek border post travelling into Botswana as well as a route of departure. The green icons indicate the South African side of the border, while the blue icons indicate the Botswana side of the border.

Figure 4: Border process of truck time recordings for valid entries

5.4.1 Recorded Truck Transit Times

Using the segregated transit time data supplied by the CBRTA spanning across a period of one week, it was possible to calculate the average time a truck spent at each of the four border posts. Tables 6-9 show the transit times recorded. The details of the Tables include minimum transit time, average transit time, median transit time and maximum transit time.

Table 4: Skilpadshek northbound - 1

Skilpadshek northbound - 1 (572 vehicles)	Days	Hours	Min
Minimum Transit Time (days: hours: min)	0	0	4
Average Transit Time (days: hours: min)	0	12	24
Median Transit Time (days: hours: min)	0	5	18
Maximum Transit Time (days: hours: min)	6	11	32

Table 5: Pioneer Gate northbound - 2

Pioneer Gate northbound - 2 (752vehicles)	Days	Hours	Min
Minimum Transit Time (days: hours: min)	0	0	1
Average Transit Time (days: hours: min)	0	7	3
Median Transit Time (days: hours: min)	0	0	41
Maximum Transit Time (days: hours: min)	6	13	30

Table 6: Pioneer Gate southbound - 3

Pioneer Gate southbound - 3 (820 vehicles)	Days	Hours	Min
Minimum Transit Time (days: hours: min)	0	0	1
Average Transit Time (days: hours: min)	0	3	51
Median Transit Time (days: hours: min)	0	0	9
Maximum Transit Time (days: hours: min)	6	5	16

Table 7: Skilpadshek southbound - 4

Skilpadshek southbound - 4 (560 vehicles)	Days	Hours	Min
Minimum Transit Time (days: hours: min)	0	0	3
Average Transit Time (days: hours: min)	0	6	52
Median Transit Time (days: hours: min)	0	0	23
Maximum Transit Time (days: hours: min)	6	14	24

5.4.2 Dispersion of the Transit Time Data

By analysing the transit time tables above, certain summaries of the data were reached. When travelling northbound, it took on average 12hrs 24min to travel from the South African entry point to the South African exit point, while it took on average 7hrs 3min to travel from the Botswana entry point to the Botswana exit point.

By referring to Tables 10-11, it can be inferred that when travelling northbound, it took on average 12hrs 50minutes to travel from the South African point of entry to the Botswana point of exit, meaning that it took on average 12hrs 50minutes for South Africa to export goods through the Skilpadshek border to Botswana. When travelling southbound, it took on average 8hrs 23minutes to travel from the Botswana entry point to the South African exit point. Through this calculated time, one can infer that it took on average 8hrs 23minutes for South Africa to import goods through the Skilpadshek border from Botswana.

Table 8: Skilpadshek to Pioneer Gate Northbound Block Transit Time

Skilpadshek/Pioneer Gate Northbound (498 vehicles)	Hours	Min
Average Transit Time (hours: min)	12	50

Table 9: Pioneer Gate to Skilpadshek Southbound Block Transit Time

Pioneer Gate/Skilpadshek Southbound (665 vehicles)	Hours	Min
Average Transit Time (hours: min)	8	23

Figure 6 portrays both the northbound and southbound block transit times through the studied border posts in a box and whisker graph. On the vertical axis, NB Hrs refers to the transit time of Skilpadshek to Pioneer Gate, in a northbound direction. SB_Hrs refers to the transit time of

Pioneer Gate to Skilpadshek in a southbound direction. Due to the copious number of outliers experienced in the data for the southbound freight movement, a logarithmic scale was used to accommodate for these outliers to include both direction of freight movements onto the same figure.

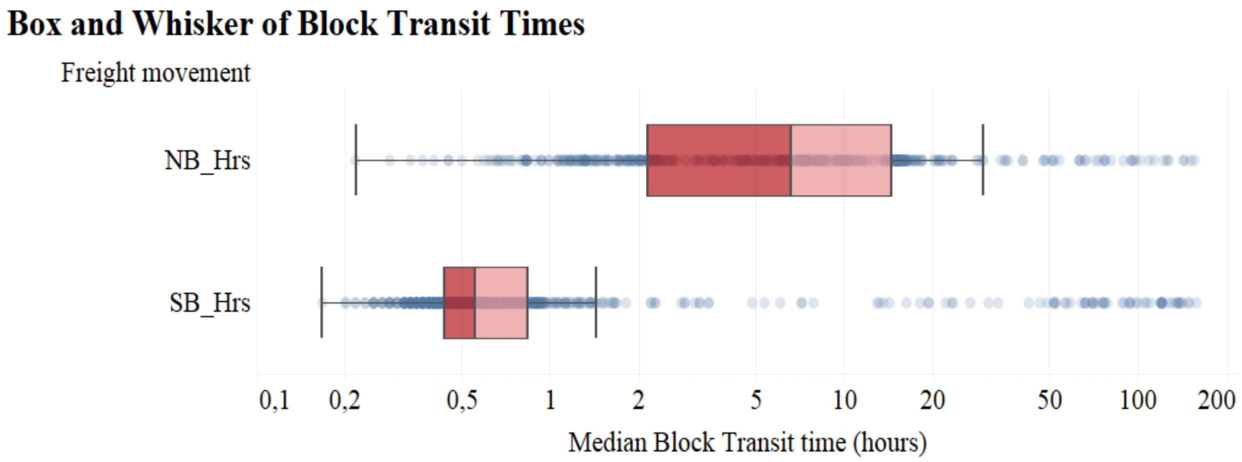

Figure 5: Box and whisker plot of northbound and southbound block transit times

Figure 7 shows a heatmap of the combined block transit times for the northbound and southbound freight movements. The heatmap was able to bring forth an underlying pattern in the data. From the end of Thursday until the end of Saturday, the transit times are higher as compared to the other weekdays, as represented by the darker shades of red portraying times of the day that border clearance is slow. The times on the upper horizontal axis 6-21 refer to the time of day from 06h00 to 21h00. No trucks were recorded after 21h00 as this was when the recordings stopped for the day.

Heatmap of Transit Times (hours)

	Date and time (in)															
Weekday of Date and time (in)	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Monday	0,6	0,6	2,9	1,9	0,5	0,6	0,8	1,9	1,5	1,1	0,6	0,9	1,3	0,6	0,7	0,3
Tuesday	3,6	1,9	1,8	0,8	0,8	1,6	0,6	1,3	1,1	0,8	0,8	0,9	1,1	0,8	0,6	9,8
Wednesday	0,5	0,6	1,2	2,9	1,3	7,4	0,5	0,5	0,9	0,4	0,5	14,5	0,7	0,8	0,6	13,9
Thursday	3,8	0,5	0,4	0,4	0,8	0,6	0,7	0,4		14,6	14,0	0,6	0,6	0,7	0,5	63,4
Friday	10,4	10,2	0,5	2,6	8,4	8,5	73,2	120,8	66,2	16,0	15,2	1,0	0,5	0,6	0,7	59,1
Saturday	76,9	7,0	1,0	5,6	6,4	6,9	7,3	7,1	0,4	17,2	0,7	15,2	15,9	0,8	0,6	15,4
Sunday	6,9	0,8	0,5	4,5	0,9	1,1	3,2	2,3	3,7	1,1	0,8	0,6	1,3	0,8	0,7	0,5

Figure 6: Heatmap of combined northbound and southbound median block transit times

5.5 Zeerust Truck Stop Transit Time Data

The Zeerust truck stop is a mandatory checkpoint that all trucks need to pass through on their journey. Transit times were recorded at the Zeerust truck stop for both northbound (NB) and southbound (SB) freight movements. The average transit time through the Zeerust truck stop in a northbound direction was an average of 8 hrs 55 minutes, which is the dark shade of green in Figure 8 on the tree map below. The minority of the tree map is made up of the southbound movement. This transit time was recorded at an average of 5 hours 25 minutes, represented by the lighter shade of green below. Table 10 summarises the average transit times for the Zeerust truck stop.

Table 10: Zeerust Truck Stop Average Transit Times

Average Transit Time (hours: min)	Hours	Min
Northbound (NB) (317 vehicles)	8	55
Southbound (SB) (197 vehicles)	5	25

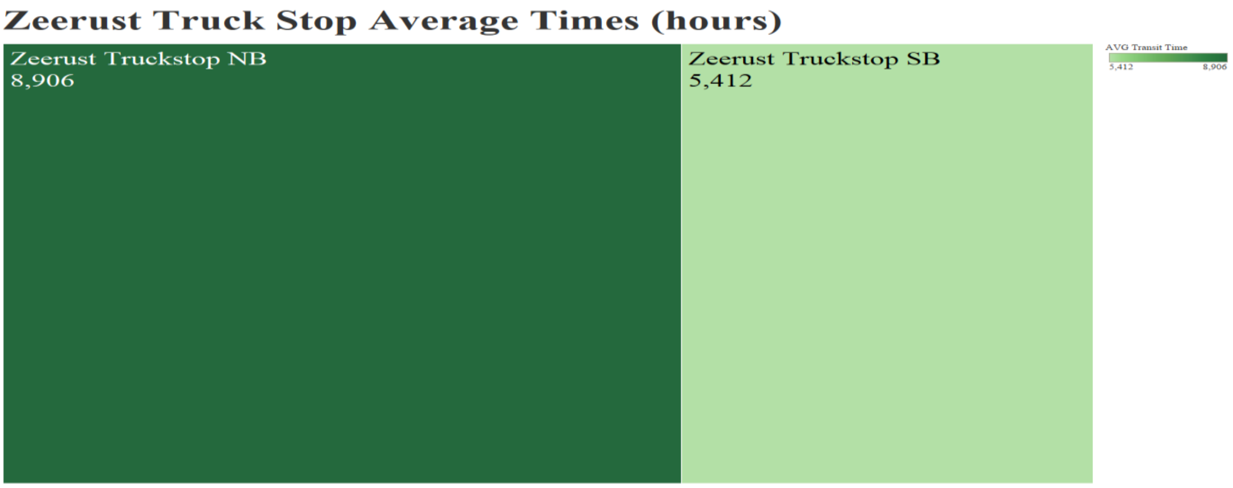

Figure 7: Tree map of the Zeerust truck stop average transit times (hours)

5.5.1 Combined Transit Time Data

To calculate accurate trade logistics costs, the full delay that a truck experiences when passing through the border needs to be accounted for. The average transit time for a truck to pass through Skilpadshek as well as the delay experienced at the Zeerust truck stop is shown in Table 13.

Table 11: Combined transit time

Average Transit Time (hours: min)	Hours	Minutes
Northbound	21	45
Southbound	13	48

5.6 Driver Questionnaires

From the data provided by the CBRTA, a separate MS Excel file was captured, with details of answered driver questionnaires. The layout of the questionnaire directed at the truck drivers included seven questions, some more relevant to the study than others. The total respondents summed up to 294 answers in the raw data, before it was cleaned of any irrelevant or incomplete answers. Data was cleaned with respect to the submitted driver comments, which after being cleaned, amounted to 139 valid comments.

5.6.1 Processed driver questionnaire answers

The seven questions were as follows:

- Where is your origin of departure?
- Where is your final destination?
- What are the commodities transported?
- Are there any alternative routes?
- How often do you use this border?
- Average time at border?
- Comments (reasons relating to lengthy border delays)

Answers section:

Question 1 was asked to gain a broad insight linked to where the bulk of the trucks depart from. Question 2 provided the destination of where the truck was headed. Question 3 was asked to determine what the popular commodities passing through the Skilpadshek border were, to see whether any of the commodity groups contributing significantly to the total percentage were time sensitive freight. Question 4 was not used in this research results chapter. Q5 was asked to provide a greater understanding of how often a driver must travel through Skilpadshek, which was linked to Question 6.

5.6.2 Origin and destination of drivers

Seventy-three percent (73%) of trucks were found to depart from South Africa, whilst 8% departed from Botswana, 10% departed from Namibia and the rest departed from other Southern African countries. Botswana was the most popular destination for trucks, accounting for 57% of the total, with South Africa accounting for 16% and Namibia accounting for 20%. The rest were bound to other Southern African destinations.

5.6.3 Commodities transported

Figure 14 below, portrays a detailed figure of the commodity types flowing through the Skilpadshek border post.

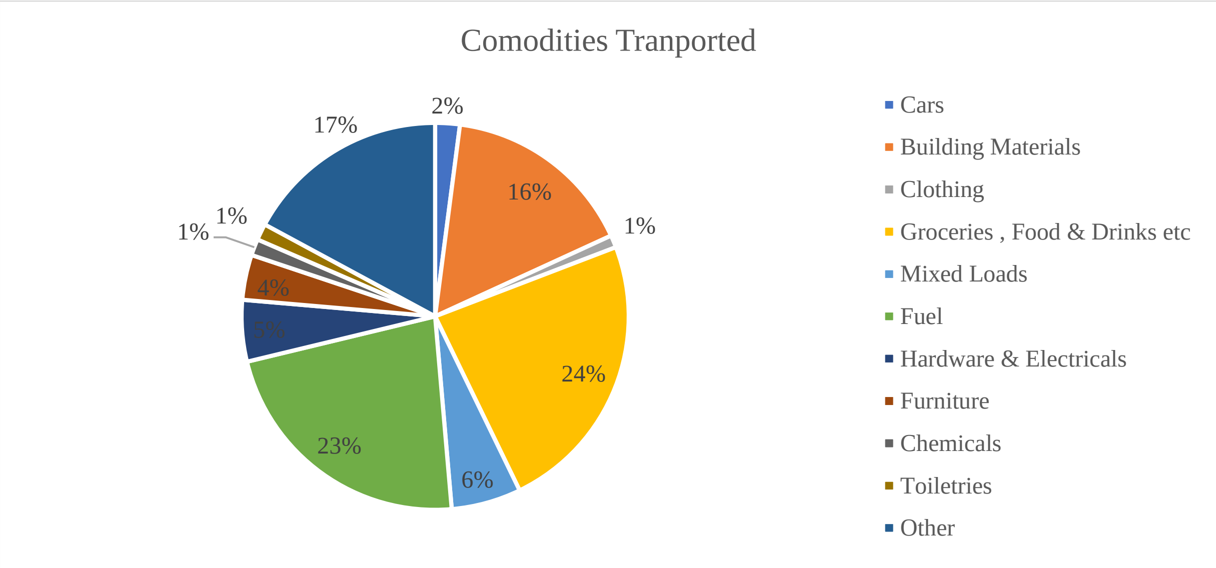

Figure 8: Commodity groups transported through Skilpadshek

5.6.4 Border usage frequency and average time

This section of the questionnaire was answered by 294 respondents. Blank answers were filtered out of the pivot table. The answers from the drivers were analysed and grouped into subsets for simpler visual interpretation. Respondents were found to use the border on a daily, weekly or monthly basis. Figure 14 indicates how often respondents passed through Skilpadshek border.

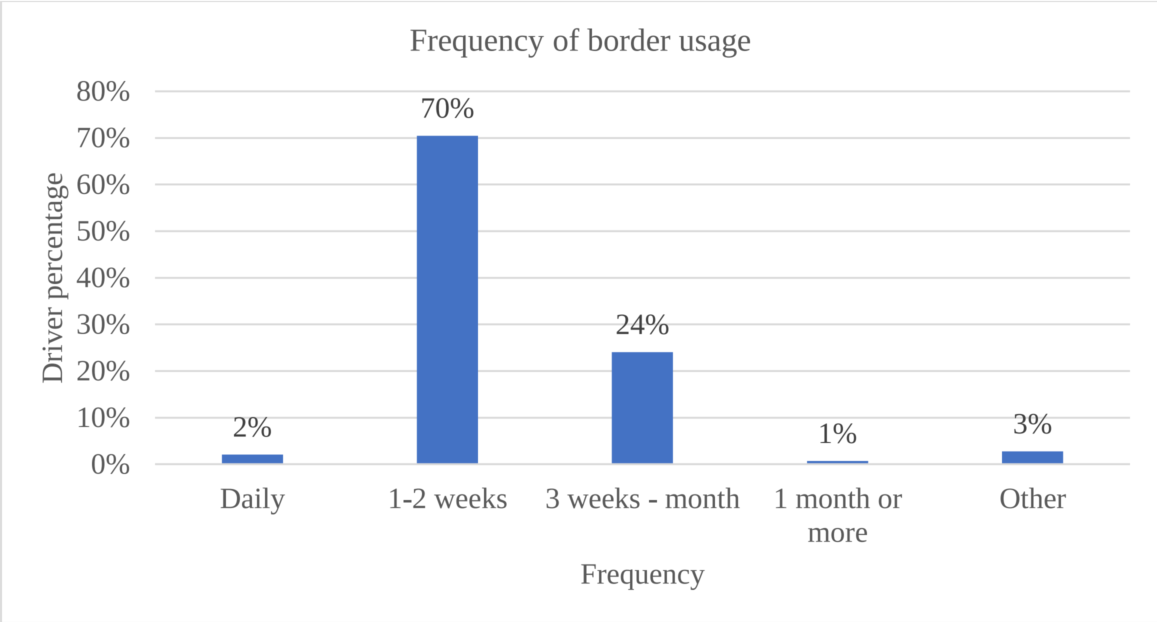

Figure 9: Frequency of border usage

Seventy percent (70%) of drivers pass through Skilpadshek every one to two weeks, 24% of drivers use the border every three weeks and 2% use the border daily. The next section of the survey asked the drivers what their average time spent at the border was. Figure 15 portrays the average time spent at Skilpadshek. A large percentage (37%) of the drivers spent between four to five hours at the border, followed by 30% of the drivers that spent 10-20 hours at the border post.

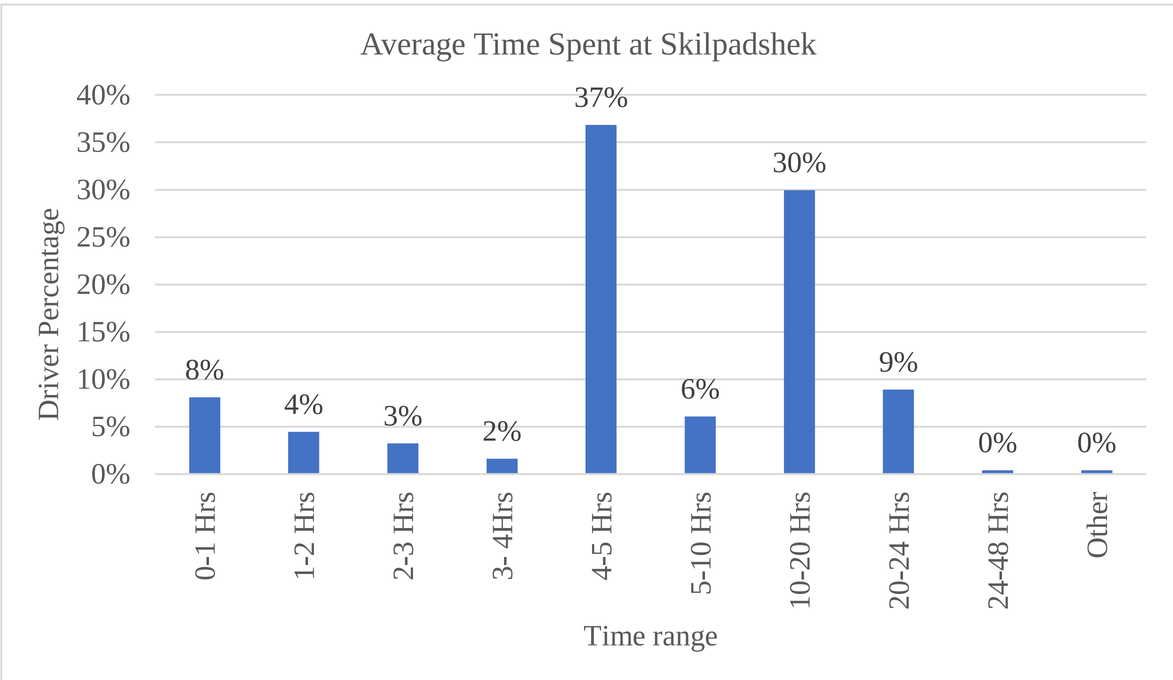

Figure 10: Average time spent at Skilpadshek border

5.6.5 Driver comments at Skilpadshek border post

A research question directed at the truck drivers in the survey was to gain first-hand insight, as to why the drivers were experiencing delays at the borders. The researcher went about cleaning the comments to remove any irrelevant and blank comments. After the cleaning process, a total of 139 comments were stated.

As can be seen in Figure 16, most complaints revolved around administrational challenges faced at Skilpadshek border. The next recurring problem was congestion issues causing traffic to extend at the border. Staff and network signal and facilities were closely grouped together adding to the frustration of the drivers. Infrastructure was brought up six times out of the 139 comments. These answers related to inefficient or lack of parking bays for the drivers to position their stationary vehicles. The fact that administrational challenges were a recurring issue at the Skilpadshek border was reiterated in literature written by Maredi (2014), emphasising the hindrance of administrational challenges.

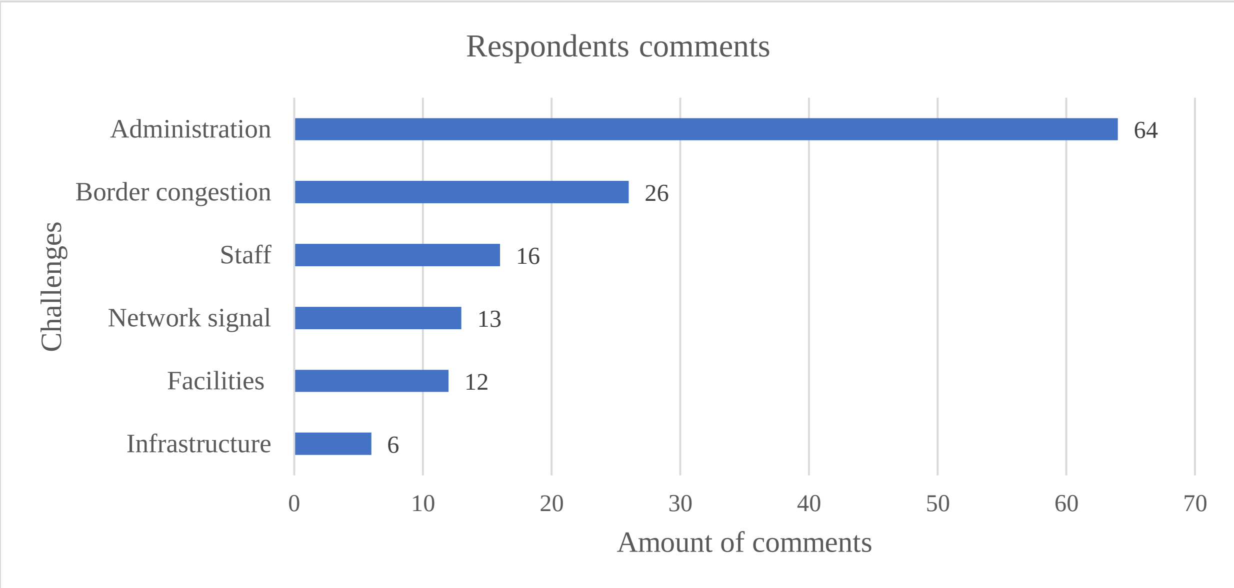

Figure 11: Respondents comments at Skilpadshek

5.7 Freight flows

The Botswana freight flow figures display vital information regarding the most recent volumes of imports and exports that move through the Botswana border. Updated road freight flow data was supplied by Zane Simpson for the purpose of calculating new trade logistics costs affected by time delays at Skilpadshek. Southbound freight movements are imports into South Africa from Botswana and northbound freight movements are exports from South Africa to Botswana. This allows the analysis of freight flows to be divided between northbound and southbound. Table 14 shows that exports to Botswana (77.3%) dominate imports from Botswana (22.7%). This large percentage of freight moving northbound from South Africa to Botswana is matched by a longer transit time delay than the southbound movement. From this pattern, one can infer that with more tons of freight being transported northbound. This would lead to more traffic being created and a longer delay in transit time at the border.

Table 12: Export and import volumes in tons moving through Botswana border in 2018

Sum of Road Tons	Total (2018 volumes)	Percentage of total
Export	3 294 813	77.3%
Import	969 651	22.7%
Grand Total	4 264 464	100%

5.8 Qualitative analysis results

This section will consist of the costs calculated by incorporating the border time delays examined revealing the impact of truck delays on trade logistics costs.

5.8.1 Trade logistics costs

Calculating these news logistics costs affected by lengthy border delays, required updated transit time delays. This research updated the variables, freight volumes and time delays to determine a more accurate logistics cost of border delays at Skilpadshek.

5.8.1.1 Assumptions for freight flow splits

Percentage weights were assigned to both Skilpadshek and Kopfontein to determine the breakdown of how many trucks passed through each border. Skilpadshek and Kopfontein are the two borders that are used, as these are the two most prominent freight clearance borders for Botswana. The percentages in Table 15 are proportional to the vehicle counts that passed through each border. It is also to be assumed that the Zeerust truck stop freight flow percentage is equal in percentage to the Skilpadshek border post.

Table 13: Freight flow percentage split between Skilpadshek and Kopfontein

	Skilpadshek	Kopfontein
Import (*southbound*)	51.21%	48.79%
Export (*northbound)*	43.38%	56.62%

5.8.1.2 Trade Logistics cost for Skilpadshek

The logistics costs as impacted by cross-border delays encountered at Skilpadshek border post in a northbound and southbound direction are displayed in Table 16.

Table 14: Logistics costs for Skilpadshek

	Import (*southbound)*	Export (*northbound)*	Total
Skilpadshek logistics costs	R18 257 887	R78 022 510	R96 280 397

With respect to the Zeerust truck stop, additional costs were calculated solely for the Zeerust truck stop, by looking at the delay times encountered at the truck stop. The following costs resulting from delays at the truck stop were calculated as stated in Table 17. From Table 17 one can infer that the Zeerust truck stop is adding R66 007 290 per annum for trucks passing through Skilpadshek border, due to delays. Skilpadshek border contributes 8.67% to total trade logistics costs. The southbound delay costs (imports) contribute 6.09% and northbound (exports) contribute 9.60% to the greater total of trade logistics costs.

Table 15: Zeerust truck stop delays costs

	Import (*southbound*)	Export (*northbound*)	Total
Zeerust truck stop costs	R11 796 845	R54 210 445	R66 007 290

When analysing the time delay that freight vehicles experience passing through the Skilpadshek border post, it is important to incorporate the delay time experienced when the trucks must pass through the Zeerust truck stop. New trade logistics costs have been calculated by adding the Zeerust truck stop delay time, onto the existing block transit time in both the required northbound and southbound directions. Trade logistics costs encountered at Skilpadshek affected by cross border delays as well as incorporating the Zeerust truck stop are presented in Table 18.

Table 16: Trade logistics costs for Skilpadshek (Including Zeerust truck stop)

	Import (*southbound*)	Export (*northbound*)	Total
Skilpadshek logistics costs	R30 054 732	R132 232 955	R162 287 687

Exports in a northbound movement account for a large portion of the total logistics costs, as the freight flow data was higher for exports as compared to imports. Another factor adding to the significantly large export value was that the total northbound delay was longer in comparison to the southbound delay. Due to unnecessary border delays at Skilpadshek border, a total of R162 287 687 is incurred per annum.

6 CONCLUSIONS

Based on the findings from the study, the following conclusions can be deducted with respect to the research questions that guided the EIA:

Research Question 1: What is the average time it takes for a truck to pass through Skilpadshek border post?

The average transit time through Skilpadshek border post in a northbound direction from South Africa to Botswana was 12 hours 50 minutes. The average transit time through Skilpadshek in a southbound direction from Botswana to South Africa was 8 hours 23 minutes. These times mentioned are exclusively spent waiting at the border post. This has further negative effects on the truck driver's health and wellness due to unfavourable conditions at the border. When incorporating all the delays freight trucks are involved in, the Zeerust truck stop delays need to be included, boosting the true transit time for northbound freight movements to 21 hours 45 minutes and southbound to 13 hours 48 minutes.

Research Question 2 - What is the impact of delays on trade logistics costs at the Skilpadshek border post*?*

The research results have verified that the lengthy time delays experienced at Skilpadshek border post resulted in annual additional logistics costs of R18 257 887 southbound and R78 022 510 northbound. It was found that delays at the Zeerust were responsible for costs of R11 796 845 southbound and R54 210 445 northbound. A more accurate figure is reached once one adds the original delay costs with the costs incurred at the Zeerust truck stop. These costs amounted to R30 054 732 southbound and R132 232 955 northbound.

The supply chain is affected through a multitude of levels by these delays. Senders and receivers of the commodities in transport experience higher transport costs, storage costs, management costs and inventory costs. Unpredictability due to border delays leads to an increase in all these costs and henceforth affects the supply chain. There is a fewer turnaround of trucks and opportunity costs for truck drivers and drivers standing at the border are factored into the overall costs. These costs reflect a loss to the companies involved in the international trade through Skilpadshek, as well as hindering the economy. Improvements in border control systems could bring about cost savings to the economy and lead to more opportunities being created.

Research Question 3 – What are the challenges faced at the Skilpadshek border post?

Passing through a border post in the act of international trade combines several procedures and rules that need to be complied with. Many of these outdated procedures heavily contribute to the delays experienced at Skilpadshek border post. Research has shown that areas that contribute to these inefficiencies include customs control – SARS and BURS. In addition, there is an extensive number of procedures that a truck needs to pass through, because of Covid-

19. This is expected to result in more stops and checks. As emphasised in the research, the most occurring challenge at the border post is related to administrative complications. Within the border clearance procedure, cumbersome document processing, staff shortages, network issues, infrastructure constraints and bureaucracy are experienced, which leads to delays.

Research Question 4 - What is the economic impact of the Zeerust truck stop on trade logistics costs?

The Zeerust truck stop adds an additional R66 007 290 per annum to the total trade logistics costs as affected by cross border delays through Skilpadshek border post. The Zeerust truck stop accounts for 41% of costs in a northbound direction through Skilpadshek and 39.25% of costs in a southbound direction through Skilpadshek. It can be inferred that the Zeerust truck stop is responsible for 40.67% of the total trade logistics costs encountered at Skilpadshek.

7 RECCOMENDATIONS

The research conducted in this study has focused on numerous challenges and areas in need of more efficient practices. These recommendations are discussed within the context of the listed research questions.

- The C-BRTA and stakeholders involved should harness technology for purposes of sustained data gathering and corridor monitoring to overcome some of the limitations highlighted in this report
- Implementation of One Stop Border Posts (OSBP) at both border posts. OSBPs have proven to lessen transit time between borders as part of the procedures can be merged, thus alleviating the issue of duplicated activities
- Harnessing technology and restructuring border procedures to accommodate rising traffic volumes and for future growth in the volume of freight moving through borders. An example of an innovative practice is that of a Single Window System (SWS). Freight transporters will be able to submit all applicable documents required for clearance preceding their arrival at the border, avoiding queues. These documents can be forwarded to an agent via an electronic gateway. This procedure will reduce the number of documents going to different government officials, as all the documents are sent to one person beforehand, resulting in less time spent at the border
- Skilpadshek could see substantial improvements in border clearance procedures, if trade facilitation systems, tools and programmes such as the Authorised Economic Operator Programme are implemented. This allows companies to work in close cooperation with customs authorities and move goods without the inconvenience of detailed customs inspections.

By implementing an OSBP, it would be possible to halve the transit time delay through Skilpadshek border post. Furthermore, replacing the physical truck stop with an online procedure ensuring pre-clearance and pre-booking of vehicles before arriving at the border, it would eliminate the need for the Zeerust truck stop. Considering these assumptions, a 70%

reduction in trade logistics costs through Skilpadshek could be realised, cutting down the total logistics costs from R162 287 687 to R48 140 198 per annum (Simpson, 2020).

Constructing an OSBP might prove to be costly in the short run but cost savings will be realised over the long term. If the recommendations previously stated are implemented, the 8.67% that Skilpadshek contributes to the total trade logistics costs can potentially be reduced by 6.10%. Skilpadshek southbound costs will potentially decrease to 4.24% from 6.09% and Skilpadshek northbound costs will potentially decrease to 6.77% from 9.60%.

Through these recommendations, externalities may also be reduced. The 7.59% that Skilpadshek contributes to total trade logistics costs could potentially decrease by 5.34%. Skilpadshek southbound will potentially decrease by 3.74% from 5.37% and northbound will potentially reduce by 5.90% from 8.37%. This will result in a significant decrease in externality costs.

8 FURTHER RESEARCH

In future, further research should focus on a comprehensive analysis which examines each compulsory stop at the border (for example: immigration, weighbridge, customs etc.) focusing on the length of time vehicles stop at each point. This will result determination of the length of time spent at each point, analysing which stops consume the longest time. In addition, future research could analyse the transit times during peak as well as off-peak months of the year. It is also recommended that future research could look at border processing times and how these times have been impacted by Covid-19 following the new health rules and regulations placed at border posts.