# ASSESSMENT OF THE CZECH REPUBLIC'S CRASH DATA COLLECTION THROUGJ A CASE STUDY

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# ASSESSMENT OF THE CZECH REPUBLIC'S CRASH DATA COLLECTION SYSTEM THROUGH A CASE STUDY

by

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#### THESIS

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# K617 ..... Department of Logistics and Management of Transport

# **MASTER'S THESIS ASSIGNMENT**

(PROJECT, WORK OF ART)

Student's name and surname (including degrees):

# Larisssa L Lara Olivas, B.S.CE

Study programme (field/specialization) of the student:

master's degree – SC – Smart Cities

Theme title (in Czech):

# Theme title (in English): An Assessment of Czech Republic's Crash Data Collection

# **Guidelines for elaboration**

During the elaboration of the master's thesis follow the outline below:

- Apply the U.S methodology of crash data analysis to Vitezne Namasti
- To identify crash patterns at Vitezne Namesti roundabout
- Propose a safety improvement plan
- Evaluate the safety impacts of the improvement plan
- Propose improvement to captuew crash data in the Czech Republic



Graphical work range: -

Accompanying report length: At least 55 pages.

Bibliography:

Ashutosh Arun, Md. Mazharul Haque, Simon Washington, Tarek Sayed, Fred Mannering. (2021). "A systematic review of traffic conflic-based safety measures with a focus on application context"

Mohamed Essa, Tarek Sayed. (2018)"Traffic conflict models to evaluate the safety of signalized intersections

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Date of master's thesis assignment:

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# L. S.

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I confirm assumption of master's thesis assignment.

- student's name from the first page -Student's name and signature

Prague ......June 30, 2022

# June 30, 2022

May 15, 2023

#### Declaration

This report is an output of the International Dual Master Degree Program in Smart Cities Science and Engineering, a collaboration between Czech Technical University, Czech Republic, and the University of Texas at El Paso, USA.

This research is jointly supervised by the following faculty members" Ruey Long Cheu, PhD, The University of Texas at El Paso Jeffrey Weidner, PhD, The University of Texas at El Paso Tomas Horak, PhD, Czech Technical University in Prague I declare that this Master's thesis is my own work and that I list all references in compliance with ethical guidelines on elaboration of Master's thesis.

I have no relevant reason against using this work in the sense of § 60 of Act No. 121/2000, on the copyright law.

Prague, Czech Republic

May 8, 2023

.....

Larissa L Lara Olivas

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I would like to express my sincere gratitude to my family for their constant support and encouragement throughout my academic journey. I would like to give special thanks to my mother for always believing in me and providing me with the motivation to pursue my academic goals. I am also grateful to by brother who introduced me to the field of engineering.

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#### Abstract

Road safety is a crucial issue in the Czech Republic and the United States. This thesis evaluates the crash data collection system in the Czech Republic by conducting a safety analysis on a specific area of Prague. The Vítězné Náměstí Roundabout, a major and complex intersection, was selected as the case study area. Crash data from 2016 to 2022 were collected and analyzed, resulting in a proposed safety improvement for the intersection. A comparative assessment was also conducted, comparing the crash records, forms, databases, crash types and severities, and collision diagrams, between the Czech Republic and Texas. The analysis provides insights into the current state of crash data collection in the Czech Republic and identifies challenges and opportunities for improvement.

**Keywords:** crash data, safety assessment, multi lane roundabout, collision diagrams, cost-benefit analysis, comparative assessment, crash types, crash severities

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#### **Chapter 1: Introduction**

Road safety is a major concern in both the Czech Republic and the United States, with traffic crashes resulting in significant human and economic losses. In order to address this issue, it is essential to have accurate and comprehensive crash data that can be used to identify problem areas, evaluate countermeasures, and monitor progress over time. However, the collection and management of crash data can vary significantly between different countries and jurisdictions. In Prague, the capital city of the Czech Republic, crash data are collected by the police and reported to the Ministry of the Interior, which maintains a national database of all traffic accidents. In contrast, in El Paso, Texas, crash data are collected and managed by the Texas Department of Transportation (TxDOT) in the Texas Crash Records Information System (CRIS). Despite these differences, both Prague and El Paso face similar challenges in collecting and analyzing crash data, including ensuring data quality, improving data sharing among agencies, and addressing privacy concerns related to personal information. This thesis aims to conduct an assessment of the Czech Republic's crash data collection system by performing safety analysis on a specific area of Prague The analysis, which is based on the procedure commonly used in Texas, will provide insights into the safety conditions of the area and identify potential hazards and risk factors. More importantly, the analysis provides insights on the practice of crash data collection in the Czech Republic. By drawing upon previous knowledge and expertise, this thesis compares the states of crash data collection in Czech Republic and in Texas. The analysis will also consider best practices and innovative solutions to purpose targeted improvements that enhance overall safety.

#### **1.1 BACKGROUND**

Roundabouts are a common type of intersection in the Czech Republic. They are circular intersections that allow traffic to flow continuously, without the need for traffic signals. Roundabouts are often used to improve traffic safety and efficient, reduce congestion, and improve overall traffic flow. Most roundabouts are designed with central island, which helps to separate and control the flow of traffic. The design of roundabouts in the Czech Republic varies, depending on the size and location of the intersection, some roundabouts have multiple lanes, while others can have only one. Some are simple and small, while others are large and complex, with multiple exits and access points.

According to the Federal Highway Administration (FHWA), in the United States, a roundabout is a type of intersection with yield control of entering traffic, islands on the approach, and appropriate roadway curvature to reduce vehicles speeds. Figure 1 illustrates a standard roundabout design in the United States, featuring yield signs and designated makings to efficiently achieve its primary goal of traffic calming.



Figure 1: Example of a Multi-Lane Roundabout (FHWA, 2022)

Vítězné Náměstí roundabout is a large, multi-lane roundabout located in the western part of Prague, Czech Republic. It is a key intersection that connects several major roads, including Evropská Street, Bělohorská Street and Vítězné Náměstí (Victory Square). Due to its location near major landmarks and residential areas, the intersection is also popular for public transport and pedestrians. The roundabout has six entry and six exit points, and it is designed to accommodate high volumes of traffic, including busses and trams as shown in Figure 1.1.



Figure 1.1: Google Earth View of Vítězné Náměstí

According to data from the Czech Ministry of Transport from January 1, 2016 to December 31, 2022 there were a total of 311 accidents at Vítězné Náměstí. There were no fatalities reported during this period and the most common type of accident at the roundabout was collisions between vehicles. The Vítězné Náměstí roundabout has been subject to some criticism for its complexity, leading to concerns about the safety of drivers and pedestrians. In this roundabout, the northern entrance poses a significant challenge due to the merging of traffic from two lanes into one lane. This design creates a situation where drivers are required to make sudden lane changes as they attempt to navigate the busy roundabout. Furthermore, the high traffic volume during peak hours is a notable and observable issue. To address these concerns, a safety analysis of the roundabout will be conducted to identify high-risk zones and suggest intersection improvements to increase overall safety.

#### **1.2 THESIS OBJECTIVES**

The objective of this thesis were to evaluate the Czech Republic's crash data collection system. To achieve the objective, the following tasks were performed: (1) apply the Texas methodology of crash data analysis to the Vítězné Náměstí roundabout; (2) Identify crash patterns at Vítězné Náměstí roundabout and based on a proposed improvement plan, estimate the improvement in safety; (3) compare the safety data collection practice between Czech Republic and Texas and make recommendations for improvements in data collection.

The analysis included:

- Vítězné Náměstí roundabout
- Crashes that occurred from January 1, 2016 to December 31, 2022
- Crashes that involved all types of vehicle and modes, including pedestrians and public transportation
- Different manner of crashes: side swipe, rear end, right angle, pedestrians, reversing

#### **1.3 THESIS OUTLINE**

This master thesis is structured into five chapters. The chapters are as follow:

Chapter 1 introduces the background, objectives, and report outline.

Chapter 2 provides a review of the current crash data collection practices in both Texas and the Czech Republic.

Chapter 3 presents a case study of Vítězné Náměstí, including a description of the crash data, data analysis, and safety improvement recommendations, along with a benefit cost analysis.

Chapter 4 offers a comparative assessment of various aspects of crash records, including forms, databases, crash types, crash severities, and collision diagrams.

Chapter 5 provides a summary of the work undertaken in this thesis, including key recommendations, contributions, limitations, and future research directions.

#### **Chapter 2: Review of Existing Crash Data Collection Methods**

Crash data is a crucial tool for improving road safety. By collecting accurate and comprehensive information about road accidents, transportation professionals can identify patterns, trends, crash types and contributing factors to develop targeted interventions that will reduce the frequency and severity of accidents. This chapter reviews the existing crash data collection methods in both Texas and Czech Republic.

#### 2.1 CRASH DATA COLLECTION IN TEXAS

Crash data in Texas is primarily collected by law enforcement officers who respond to the scene of the accident. Officers complete a standardized crash report form, which includes detailed information on the, date, time, and contributing factors of the accident, as well as information on the vehicles and drivers involved. This information is entered into the Crash Report Information System (CRIS), an electronic database managed by the Texas Department of Transportation (TxDOT), which stores and manages detailed information about road accidents. The CRIS includes information on the number of fatalities and injuries resulting from the accident, as well as the severity of the injuries. In addition to law enforcement data, TxDOT also collects crash data from hospitals, emergency medical services, and other sources to ensure that a comprehensive and accurate picture of road safety is available.

The crash data collected Texas is used to identify trends and patterns in road accidents, prioritize safety improvements, and monitor progress towards achieving road safety goals. Overall, the crash data collection process in Texas is comprehensive and detailed, providing valuable information for transportation professionals and stakeholders in the region.

#### **2.2 CRASH DATA COLLECTION IN CZECH REPUBLIC**

The crash data used for this analysis was gather from the website of Traffic Accidents in the Czech Republic (https://nehody.cdv.cz/), which is maintained by the Ministry of interior. Figure 2 is a screenshot of the website's homepage, which illustrates the Czech Republic and its crash data. The website provides access to detailed data on traffic accidents, including their location, type, severity and number of people involved. The information is regularly updated and covers a wide range of accidents, from minor incidents to serious crashes resulting in fatalities.



Figure 2: Traffic Accidents in the Czech Republic website's home page

The website is a user-friendly interface that allows for easy access to a wealth of data on road accidents in the country, however is only available in Czech and not English. Therefore, researchers and stakeholders who do not speak Czech may face challenges in accessing and utilizing the data provided by the website. Despite the language barriers, with the help of translation tools and local collaborators, it is still possible to extract valuable insights from the data and use it to inform road safety polices and initiatives.

The Traffic Accidents website in the Czech Republic offers users the ability to set various parameters to filter and analyze crash data. This feature allows users to tailor their analysis to specific regions, time periods, and type of accidents. One important feature of this website is the legend that accompanies the map as shown in Figure 2.1. This legend provides key information

about the colors, symbols, and data points used to represent different types of crashes and their severity.



Figure 2.1: Traffic Accidents in the Czech Republic

Understanding the website and its legend is crucial for accurately interpreting the data presented on the website and drawing meaningful conclusions about road safety in the country. The legend and tabs of the website were translated to English using a translation tool as shown in Figure 2.3. While Google Translate provides an option to translate the webpage, it only translates the main tabs and not the crash data. Additionally, the translation may not always be completely accurate, which poses a significant challenge for those collecting or analyzing data from this website. Table 1 displays the key terms that were manually translated to obtain a more appropriate terminology than that provided by Google Translate.



Figure 2.3: Traffic Accidents in the Czech Republic (English Version)

By utilizing the various filter options, users can gain a more comprehensive understanding of road safety in the Czech Republic. Table 2.1 displays the icons featured on the map and their corresponding functions.

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|--|-------------------------------|--|--|--|--|--|--|
| Icon   | Function                      |  |  |  |  |  |  |
|  | Display entire Czech Republic |  |  |  |  |  |  |
| A  | Filter Area                   |  |  |  |  |  |  |
|  | Map Key                       |  |  |  |  |  |  |
| S  | Create Link                   |  |  |  |  |  |  |

Table 2.1: Traffic Accidents in the Czech Republic Maps Icon and Function

By utilizing this data source, the necessary crash data was obtained to conduct a safety analysis of the selected location in Prague. The aim of this analysis is to identify the primary causes of accidents, and the first step towards achieving this objective is to analyze the crash data. Processing the crash data might involve several steps, particularly if the data is only available in a foreign language. The subsequent chapter will detail the steps taken to examine the available public crash data.

Collision data in Prague is primarily collected by the Prague City Police. When a crash occurs, the police officer who responds to the scene is responsible for completing a paper form documenting the details of the crash, including the date, time, location, and description of the incident. The form also includes details about the involved vehicles, drivers, and nature of the accident. Once the paper form is completed, the police enter the information into their computer system. This data is then utilized to generate statistical reports on traffic accidents not just in Prague, but also throughout the country. Researchers and the public can access the data for analysis and research purposes. While statistical reports on traffic accidents are produced using the data collected by the police, the police report themselves are not generally available to the public. Some information, such as the number of injuries, fatalities, and type of accidents, is made public through the Traffic Accidents website, but more detailed information may only be accessible to authorized personnel. The analysis presented in this thesis relied solely on crash data that has been made available to the public at Traffic Accidents in the Czech Republic website shown in Figure 2.4, which will be fully described in Chapter 3. Utilizing this data, the study aimed to obtain valuable insights into the primary causes of accidents and identify areas that require the most attention for improving safety.



Vítejte na stránkách Dopravních nehod v ČR. Aplikace je určena odborné i široké veřejnosti a nabízí statistické vyhodnocení dopravních nehod od roku 2006. V sekci Statistiky si uživatel může sám filtrovat nehody na základě časové či prostorové lokalizace a podle 64 parametrů, které Policie ČR eviduje. Výsledek lze exportovat do pdf. K aktualizaci dat dochází jednou měsíčně.

Poslední aktualizace dat: 31. 3. 2023

Interaktivní grafika níže na této stránce poskytuje základní statistické údaje o dopravních nehodách na území ČR od roku 2011. V levé části jsou k dispozici filtry, po jejichž označení se grafy přizpůsobí zvoleným filtrům. Je možné označit libovolné množství filtrů i v jedné kategorii (např. označit více krajů).



#### **Chapter 3: Case Study**

This chapter seeks to understand the crash data collection in the Czech Republic by performing a case study at a site in Prague.

#### **3.1 SITE DESCRIPTION**

Roundabouts have become increasingly popular in the Czech Republic as a means of improving traffic flow and reducing the number of accidents at intersections. The basic principle behind a roundabout is that traffic moves counterclockwise around a central island, with vehicles entering and exiting at designated points. This study focuses on Vítězné Náměstí roundabout, a significant roundabout with three lanes and six entry and exit points. Figure 3 illustrates the current

design and lane measurements of Vítězné Náměstí roundabout. Additionally, there are surrounding streets with parking areas and bus stop station located on the north-western side of the roundabout. The presence of a tram line passing through the roundabout further complicates the traffic flow. This roundabout experiences high volumes of public transportation, pedestrian, and vehicular traffic, making it a particularly busy intersection.



Figure 3: Current Design of Vítězné Náměstí

#### **3.2 CRASH DATA SET**

All the data analyzed in this study was obtained from the Traffic Accidents website, and it covers the period 2016 to 2022. To process this data, several steps were taken, which are described below for better understanding. The purpose of these steps was to filter the crash data and focus solely on the desired area, which is the roundabout.

#### **Step 1: Filter Area of Interest**

This step removed records of all the crashes that did not occur at the Vítězné Náměstí roundabout. To do this the pencil icon on the map was used, and with it a polygon was drawn to include the entire roundabout and some of the small streets that surround it as shown in Figure 3.1. The picture below shows how the interest area was selected and it includes crash accidents from January 1, 2016 to December 3, 2022.



Figure 3.1: Study Area for Crash Analysis

#### Step 2: Filter Crash Data by Year

In this step crash data is filtered by year on the previously selected area. The desired start and end dates are entered next to the calendar icons highlighted in Figure 3.4. As a result, only corresponding crash data is displayed on the map. The start date for this analysis is January 1, 2016 and the end date is December 31, 2016.



Figure 3.4: Crash Data in 2016

#### Step 3: Present data in table

For this step the "Tabulka" icon, which is highlighted in Figure 3.4, will be selected. This icon displays the crash data in a table format as shown in Figure 3.5. This format makes it easier to go through the crash data since its sorted by date and it is easy to keep track on which crashes have been already reviewed.

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| 210    | 0161810  | 3.2.2016<br>(středa)   |          | 8:02         |          | Praha |          | Hlavní<br>Praha | město      | srážka s chodcem                         |          | nezavině               | ná řidičem                   |          | 0   |          | 0   |          | 1  |          |       |
| 210    | 0161877  | 4.2.2016<br>(čtvrtek)  |          | 9:53         |          | Praha |          | Hlavní<br>Praha | město      | srážka s jedoucím<br>nekolejovým vozidle | em       | při přejížo<br>druhého | dění z jednoho jízdního      | pruhu do | 0   |          | 0   |          | 0  |          |       |
| 210    | 0162687  | 18.2.2016<br>(čtvrtek) | 6        | 7:10         |          | Praha |          | Hlavní<br>Praha | město      | srážka s jedoucím<br>nekolejovým vozidle | em       | nedodrže<br>vozidlem   | ní bezpečné vzdálenos        | sti za   | 0   |          | 0   |          | 1  |          |       |
| 210    | 0163008  | 23.2.2016<br>(úterý)   | 6        | 9:20         |          | Praha |          | Hlavní<br>Praha | město      | srážka s jedoucím<br>nekolejovým vozidle | em       | proti příka<br>PŘEDNO  | azu dopravní značky D<br>OST | EJ       | 0   |          | 0   |          | 0  |          |       |

Figure 3.5: Crash data in Table Format

#### Step 4: Analyze each individual crash case

In this step, each individual crash record was reviewed. Each accident has an individual and unique crash ID number. After selecting the Crash ID, which are the blue numbers in Figure 3.5, the website opens a new tab with detailed information on the accident selected as illustrated in Figure 3.6. It is important to mention that all detailed information is provided only in Czech. After using reliable translation resources and help from advisors, the important information for this analysis was identified. For this analysis it was important to identify date, time, location type of accident and severity. The date and time are stated below the case ID, the exact location is displayed on the map, and the type of accident is on the second column next to "Hlavni pricina nehody", highlighted in Figure 3.6, which translates to main cause of accident. There is more information available like information on the cars and persons involved but that information was

not necessary in this analysis. Once the necessary information was localized, google translate was used to translate in order to determine the type of accident of each crash.

| · · · · ·   | 0 N                                    |                  | · · · · · · · · · · · · · · · · · · ·                    |
|-------------|--|------------------|--|
| ID nehody   | 2100161103                             | Obec             | Praha (Hlavní město Praha)                               |
| Datum       | 20.1.2016 (středa), 22:20              | Druh komunikace  | komunikace sledovaná (ve vybraných městech) (do 12/2022) |
| Druh nehody | srážka s jedoucím nekolejovým vozidlem | Číslo komunikace |  |
|             |  |                  |  |
| OSM N       | Aap Satellite ZM Mapy.cz               |                  |  |

# NEHODA 2100161103

| Druh srážky jedoucích vozidel          | zezadu  | Povětrnostní podmínky v době<br>nehody       | neztížené  |
|--|---|--|--|
| Druh pevné překážky                    | nepřichází v úvahu, nejedná se o srážku s<br>pevnou překážkou | ViditeInost                                  | v noci - s veřejným osvětlením, viditelnost nezhoršená vlivem<br>povětrnostních podmínek |
| Charakter nehody                       | nehoda pouze s hmotnou škodou                                 | Rozhledové poměry                            | dobré  |
| Zavinění nehody                        | řidičem motorového vozidla                                    | Dělení komunikace                            | třípruhová   |
| Přítomnost alkoholu u viníka<br>nehody | ne  | Situování nehody na komunikaci               | na jízdním pruhu   |
| Hlavní příčina nehody                  | nedodržení bezpečné vzdálenosti za vozidlem                   | Řízení provozu v době nehody                 | žádný způsob řízení provozu  |
| Usmrceno osob                          | 0   | Místní úprava přednosti v jízdě              | žádná místní úprava  |
| Těžce zraněno osob                     | 0   | Specifická místa a objekty v místě<br>nehody | žádné nebo žádné z uvedených   |
| Lehce zraněno osob                     | 0   | Směrové poměry                               | přímý úsek   |
| Celková hmotná škoda (Kč)              | 90000   | Počet zúčastněných vozidel                   | 2  |
| Druh povrchu vozovky                   | živice  | Misto dopravní nehody                        | mimo křižovatku  |
| Stav povrchu vozovky v době<br>nehody  | na vozovce je náledí, ujetý sníh - posypané                   | Druh křižující komunikace                    |  |
| Stav komunikace                        | dobrý, bez závad  |  |  |

| Figure | 3.6: | Individual | Crash | Report |
|--------|------|------------|-------|--------|
|--------|------|------------|-------|--------|

Once the main cause of accident was known, each crash was drawn in auto cad to create the crash diagrams that will be explain in detailed in the next chapter. Figure 3.7 illustrates how a crash and its corresponding data its translated into the collision diagram. Since the collision diagrams were drawn per year, only the month and day are shown, and since the crash ID's all start with the same five digits only the last six digits are displayed on the crash diagrams.



Figure 3.7: AutoCAD crash drawing

### **Step 5: Repeat the previous steps**

The previous steps need to be repeated until all crashes in the selected area, from

2016 to 22, are analyzed.

#### **3.3 CRASH ANALYSIS**

The present study analyzed 311 crashes occurring over a period of seven years (2016 to 2022); however, only 253 of them were included in the analysis due to issues with data accuracy. The excluded 58 crashes were not reflected in the crash diagrams because they lacked information on the type of collision, which is a critical factor in identifying high-risk areas. To provide a comprehensive understanding, Table 3.3 summarizes the number and types of collisions that occurred during the seven-year window. The unspecified crashes were categorized as "other" due to their unknown cause, leaving a total of 253 crashes.

|       |            |          | 14010 5.5. | i otar i tannoer | or recracints |             |       | i i   |
|-------|------------|----------|------------|------------------|---------------|-------------|-------|-------|
| Year  | Side Swipe | Rear End | Reversing  | Fixed Object     | Pedestrians   | Right Angle | Other | Total |
| 2016  | 28         | 20       | 3          | 0                | 1             | 2           | 16    | 70    |
| 2017  | 27         | 8        | 2          | 0                | 4             | 2           | 10    | 53    |
| 2018  | 21         | 11       | 1          | 0                | 2             | 0           | 4     | 39    |
| 2019  | 28         | 16       | 1          | 0                | 1             | 1           | 5     | 52    |
| 2020  | 14         | 6        | 3          | 0                | 0             | 0           | 9     | 32    |
| 2021  | 17         | 3        | 5          | 3                | 0             | 1           | 6     | 35    |
| 2022  | 10         | 9        | 0          | 1                | 2             | 0           | 8     | 30    |
| Total | 146        | 74       | 14         | 4                | 10            | 5           | 58    | 311   |

Table 3.3: Total Number of Accidents

To enhance the visibility and comprehensively of the crash diagrams, the roundabout was divided into four quadrants for the safety analysis. The quadrants are numbered in counterclockwise direction starting from the North East side of the roundabout. The individual crash diagrams, included in the appendix, have been summarized on the following pages (Figures 3.8 - 3.11), revealing that Quadrants 2 and 3 have reported more accidents. The distribution of accidents per quadrant is presented in the subsequent table, Table 3.3.1, with the sideswipe being the most frequent type of accident, particularly in Quadrant 2. This high number of sideswipe accidents in Quadrant 2 (North East approach) may be attributed to the roundabout design, as discussed in Section 1,1, which involves two lanes merging into one to access the roundabout. The majority of these accidents occurred in the North East part of the roundabout, where drivers

frequently change lanes as they enter or exit the roundabout. The second most frequent type of crash is rear-end collision, which could be attributed to the significant volume of traffic at the roundabout, resulting in drivers' inability to maintain a safe following distance. This type of collision is also observed to be most prevalent in Quadrant 2.

|            | Side Swipe | Rear End | Reversing | Fixed Object | Pedestrian | Right Angle | Total |  |
|------------|------------|----------|-----------|--------------|------------|-------------|-------|--|
| Quadrant 1 | 15         | 17       | 4         | 2            | 7          | 6           | 51    |  |
| Quadrant 2 | 54         | 19       | 1         | 2            | 3          | 0           | 79    |  |
| Quadrant 3 | 45         | 30       | 3         | 1            | 2          | 3           | 84    |  |
| Quadrant 4 | 12         | 7        | 7         | 1            | 5          | 0           | 32    |  |

Table 3.3.1: Number of Accidents per Quadrant


Figure 3.8: Quadrant 1 Crash Diagram Summary



Figure 3.9: Quadrant 2 Crash Diagram Summary



Figure 3.10: Quadrant 3 Crash Diagram Summary



Figure 3.11: Quadrant 4 Crash Diagram Summary

#### **3.4 BENEFIT-COST ANALYSIS AND SAFETY IMPROVEMENTS**

### **Cost-Analysis**

For the purpose of calculating the cost per crash, this study only considered crash data from 2016 to 2021. This is because the cost per crash data for the year 2022 has not yet been released. It is important to note that the next step in the analysis was to categorize the data by severity. Table 3.4 provides a summary of the number of crashes and their severity levels, while the detailed information for each year is included in the appendix. As a result of excluding the crash data from 2022 for the cost benefit analysis, the total number of crashes considered in this study was reduced to 231.

|                 | Side  | Rear |           | Fixed  |             |                    |       |
|-----------------|-------|------|-----------|--------|-------------|--------------------|-------|
|                 | Swipe | End  | Reversing | Object | Pedestrians | <b>Right Angle</b> | Total |
| Fatalities      | 0     | 0    | 0         | 0      | 0           | 0                  | 0     |
| Severe Injuries | 0     | 0    | 0         | 0      | 1           | 1                  | 2     |
| Minor Injuries  | 0     | 2    | 0         | 0      | 12          | 0                  | 14    |
| Material Damage | 123   | 62   | 15        | 5      | 3           | 7                  | 215   |
| TOTAL           |       |      |           |        |             |                    | 231   |

Table 3.4: Number of Crashes per Severity

After the severity of the crashes was determined, the analysis proceeded to calculate the cost per crash. The cost per crash data used in this study was obtained from Dr. Josef Kocourek, who used the "Updated Methodology for calculating Losses from Road Traffic Accidents" to provide this information. The given costs per accidents are displayed in Table 3.4.1.

|      | Fatal      | ities     | Severe Ir  | njuries | Minor Ir | njuries | Material Damage |        |  |  |
|------|------------|-----------|------------|---------|----------|---------|-----------------|--------|--|--|
|      | Кс         | USD       | Кс         | USD     | Кс       | USD     | Кс              | USD    |  |  |
| 2016 | 19,411,000 | 860,989   | 5,094,200  | 225,957 | 668,500  | 29,652  | 364,500         | 16,168 |  |  |
| 2017 | 19,784,000 | 877,534   | 5,097,500  | 226,103 | 716,700  | 31,790  | 386,400         | 17,139 |  |  |
| 2018 | 22,534,000 | 999,512   | 5,983,000  | 265,380 | 739,700  | 32,810  | 389,800         | 17,290 |  |  |
| 2019 | 25,041,000 | 1,110,712 | 5,567,000  | 246,928 | 809,000  | 35,884  | 405,000         | 17,964 |  |  |
| 2020 | 35,021,000 | 1,553,382 | 5,800,000  | 257,263 | 603,300  | 26,760  | 415,800         | 18,443 |  |  |
| 2021 | 58,235,000 | 2,583,056 | 12,211,000 | 541,628 | 713,500  | 31,648  | 474,800         | 21,060 |  |  |

Table 3.4.1: Cost per Accident

To determine the cost per accident in US dollars, the exchange rate between Czech Crowns and US Dollars was obtained from the website (<u>https://www.kurzy.cz/kurzy-</u><u>men/kurzy.asp?a=X&mena1=CZK&mena2=USD&c=1&d=17.3.2023&convert=P%F8eve%EF+m%</u> <u>ECnu</u>) and used for conversion. Based on this calculation, the cost per accident for each year was determined and is presented in Table 3.4.2 through Table 3.4.7.

|                 | Number of | Cost Per Accident | Cost Per Accident |            |             |
|-----------------|-----------|-------------------|-------------------|------------|-------------|
| Severity        | Accidents | (Kc)              | (USD)             | Total (Kc) | Total (USD) |
| Fatalities      | 0         | 19,411,000        | 860,989           | 0          | 0           |
| Severe Injuries | 0         | 5,094,200         | 225,957           | 0          | 0           |
| Minor Injuries  | 2         | 668,500           | 29,652            | 1,337,000  | 59,304      |
| Material Damage | 52        | 364,500           | 16,168            | 18,954,000 | 840,719     |
| TOTAL           |           |                   |                   | 20,291,000 | 900,022     |

Table 3.4.2: 2016-Cost per Accident

|                 | Number of | Cost Per Accident | Cost Per Accident |            |             |
|-----------------|-----------|-------------------|-------------------|------------|-------------|
| Severity        | Accidents | (Кс)              | (USD)             | Total (Kc) | Total (USD) |
| Fatalities      | 0         | 19,784,000        | 877,534           | 0          | 0           |
| Severe Injuries | 0         | 5,097,500         | 226,103           | 0          | 0           |
| Minor Injuries  | 4         | 716,700           | 31,790            | 2,866,800  | 127,159     |
| Material Damage | 39        | 386,400           | 17,139            | 15,069,600 | 668,423     |
| TOTAL           |           |                   |                   | 17,936,400 | 795,582     |

# Table 3.4.3: 2017-Cost per Accident

# Table 3.4.4: 2018-Cost per Accident

|                 | Number of | Cost Per Accident | Cost Per Accident |            |             |
|-----------------|-----------|-------------------|-------------------|------------|-------------|
| Severity        | Accidents | (Kc)              | (USD)             | Total (Kc) | Total (USD) |
| Fatalities      | 0         | 22,534,000        | 999,512           | 0          | 0           |
| Severe Injuries | 0         | 5,938,000         | 265,380           | 0          | 0           |
| Minor Injuries  | 4         | 739,700           | 32,810            | 2,958,800  | 131,240     |
| Material Damage | 29        | 389,800           | 17,290            | 11,304,200 | 501,406     |
| TOTAL           |           |                   |                   | 14,263,000 | 632,646     |

## Table 3.4.5: 2019-Cost per Accident

|                 | Number of | Cost Per Accident | Cost Per Accident |            |             |
|-----------------|-----------|-------------------|-------------------|------------|-------------|
| Severity        | Accidents | (Кс)              | (USD)             | Total (Kc) | Total (USD) |
| Fatalities      | 0         | 25,041,000        | 1,110,712         | 0          | 0           |
| Severe Injuries | 0         | 5,567,000         | 246,928           | 0          | 0           |
| Minor Injuries  | 3         | 809,000           | 35,884            | 2,427,000  | 107,651     |
| Material Damage | 45        | 405,000           | 17,964            | 18,225,000 | 808,383     |
| TOTAL           |           |                   |                   | 20,652,000 | 916,035     |

#### Table 3.4.6: 2020-Cost per Accident

|                 | Number of | Cost Per Accident | Cost Per Accident |            |             |
|-----------------|-----------|-------------------|-------------------|------------|-------------|
| Severity        | Accidents | (Kc)              | (USD)             | Total (Kc) | Total (USD) |
| Fatalities      | 0         | 35,021,000        | 1,553,382         | 0          | 0           |
| Severe Injuries | 0         | 5,800,000         | 257,263           | 0          | 0           |
| Minor Injuries  | 1         | 603,300           | 26,760            | 603,300    | 26,760      |
| Material Damage | 22        | 415,800           | 18,443            | 9,147,600  | 405,749     |
| TOTAL           |           |                   |                   | 9,750,900  | 432,508     |

## Table 3.4.7: 2021-Cost per Accident

|                 | Number of | Cost Per Accident | Cost Per Accident |            |             |
|-----------------|-----------|-------------------|-------------------|------------|-------------|
| Severity        | Accidents | (Кс)              | (USD)             | Total (Kc) | Total (USD) |
| Fatalities      | 0         | 58,235,000        | 2,583,056         | 0          | 0           |
| Severe Injuries | 2         | 12,211,000        | 541,628           | 24,422,000 | 1,083,256   |
| Minor Injuries  | 0         | 713,500           | 31,648            | 0          | 0           |
| Material Damage | 28        | 474,800           | 21,060            | 13,294,400 | 589,683     |
| TOTAL           |           |                   |                   | 37,716,400 | 1,672,939   |

A summary of the cost per accident is presented in Table 3.4.8, which displays the total cost per accident in the six -year period, accounting for the variation in cost per accident over the years.

## Table 3.4.8: 2016-2022 Cost Per Accident

| Severity        | Number of Accidents | Total (Kc)  | Total (USD) |
|-----------------|---------------------|-------------|-------------|
| Fatalities      | 0                   | 0           | 0           |
| Severe Injuries | 2                   | 24,422,000  | 1,083,256   |
| Minor Injuries  | 14                  | 10,192,900  | 452,114     |
| Material Damage | 215                 | 85,994,800  | 3,814,362   |
| TOTAL           | 231                 | 120,609,700 | 5,349,732   |

#### **Safety Improvements**

Upon completion of the crash diagrams and cost-per-accident calculations, the next step was to propose improvements to enhance safety. In collaboration with Lauren Brown, a colleague working on Traffic Analysis and Operational Improvements for Vítězné Náměstí in Prague, it was suggested that Vítězné Náměstí be transformed into a two-lane roundabout based on U.S guidelines. The objective of this proposal is to address the main conflict area at the North Entrance where vehicles merge into a single lane to enter the roundabout, resulting in side swipe accidents. This improvement aims to mitigate such incidents by allowing users to enter and maintain the desired lane without having to change lanes within the roundabout. However, the southern entrance and exit would remain a single lane due to the tram stop that limits the available space for a two-lane entrance or exit. An AutoCAD drawing of the suggested safety improvement design is illustrated in Figure 3.12.



Figure 3.12: Proposed Improvement

After the improvement suggestion was chosen and the cost per accident was calculated, the subsequent step is to conduct a cost-benefit analysis. In order to execute this analysis, it was essential to determine which accidents could potentially be reduced by implementing the selected improvement. To provide better visualization 3.12 (Quadrant 1), Figure 3.14 (Quadrant 2) and Figure 3.15 (Quadrant 4) are included in the report. It is worth noting that the proposed improvement, a conversion to a two-lane roundabout, does not affect quadrant 3. This is due to the fact that the southern exit of the roundabout cannot be modified to accommodate a two-lane configuration. These figures show a crash summary for the years 2016-20221, which serves as the basis for the benefit-cost analysis. The potential prevented accidents are highlighted in green in these figures to make them easily identifiable.

A total of 61 sideswipe accidents have the potential to be reduced by the proposed improvement. Detailed tables for each year are listed in the appendix, but Table 3.4.9 provides a summary of the potential prevented accidents by quadrant including their associated costs accounting for variations in cost per accident over the years.

| Location   | Provable Prevented Accidents | Cost of Accidents (Kc) | Cost of Accidents (USD) |
|------------|------------------------------|------------------------|-------------------------|
| Quadrant 1 | 11                           | 4,464,300              | 198,017                 |
| Quadrant 2 | 46                           | 17,898,700             | 793,910                 |
| Quadrant 3 | 0                            | 0                      | 0                       |
| Quadrant 4 | 4                            | 1,579,500              | 70,060                  |
| Total      | 61                           | 23,942,500             | 1,061,987               |

Table 3.4.9: Potential Prevented Accidents (2016-2021)



Figure 3.13: Potential Prevented Accidents (Quadrant 1)



Figure 3.14: Potential Prevented Accidents (Quadrant 2)



Figure 3.15: Potential Prevented Accidents (Quadrant 4)

#### **Chapter 4: Comparative Assessment**

This chapter outlines the steps taken to process the crash data, including filtering, and the tools and techniques used to analyze and visualize the data.

#### 4.1 CRASH RECORD FORMS

In accordance with Texas Law (TxDOT, 2013), Texas crash reports are not publicly available for online viewing due to their confidential nature. The Texas Peace Officers Crash Report (CR-3) serves as a vital document that contains comprehensive information about the crash such as the date, time, and location, as well as the type of crash It also includes a section dedicated to vehicle information, including the make and model of the vehicles, license plate numbers, and the names and addresses of drivers. To aid comprehension, visual representation of the CR-3 form has been included in this report. These can be found in Figures 4.2 through 4.4. Based on prior experience with safety analysis and exposure to CR-3 forms the clarity of the diagram is evident in its ability to effectively illustrate the details of the crash scene. However, due to confidentiality, a completed CR-3 form cannot be provided. Nevertheless, a screenshot of one of the CR-3 diagram and its corresponding narrative description, prepared by peace officer is shown in Figure 4 and Figure 4.1.

|     | Investigator's Narrative Opinion of What Happened<br>(Attach Additional Sheets if Necessary) |
|-----|--|
|     | The 1100 block of Robert E. Lee is a two lane two way roadway                                |
|     | that runs north and south. The 6600 block of Gateway West is a                               |
|     | two lane one way roadway that runs west and intersects with the                              |
|     | 1100 block of Robert E. Lee. The intersection is controlled by                               |
|     | 2 stop signs for the north and south bound traffic on Robert E.                              |
|     | Lee. Unit 1 was traveling north bound on the 1100 block of                                   |
|     | Robert E. Lee and came to the intersection with gateway West.                                |
|     | The driver of Unit 1 stopped and then proceeded through the                                  |
|     | intersection. Unit 1 drove into the path of Unit 2 who was                                   |
| AM  | traveling in the left lane on 6600 Gateway West. Unit 2 struck                               |
| ទ   | Unit 1 in the intersection. The driver of Unit 1 advised that                                |
| DIA | she checked the roadway before she went but did not see Unit 2.                              |
| ē   | The driver of Unit 2 has the right of way due to Unit 1 having a                             |
| A   | stop sign. The driver of Unit 1 is at fault for the collision.                               |
| Ň   | The driver of Unit 2 complained of pain to his left arm and                                  |
| 8A7 | shoulder but refused medical transport. The driver of Unit 1                                 |
| A R | complained of pain from her mid back to her lower back (right                                |
| Ż   | side) but refused medical treatment. There were no reported                                  |
|     | witnesses to this collision. The Officer cited the driver of                                 |
|     | Unit 1 for causing the collision. The Officer exchanged the                                  |
|     | drivers information and advised them. Both vehicles had to be                                |
|     | towed from the scene due to damage. The scene was cleared.                                   |
|     |  |
|     |  |
|     |  |

Figure 4: Narrative Description Example (CR-3)



Figure 4.1: Field Diagram Example (CR-3)

|         |   | reement o                              | and To             |                    | ie ONL'             | Y                  |                   | ROAD                |                  |                   |                    | EVEN     | <b>π</b> 1     | ACT<br>SCH     |            | L              |                  | To           | tal<br>Im.        |               |                 | To             | tal<br>Im.   | ī                 |                | D                      | DOT<br>ash ID                                |                              |                            |               |
|---------|---|--|--------------------|--------------------|---------------------|--------------------|-------------------|---------------------|------------------|-------------------|--------------------|----------|----------------|----------------|------------|----------------|------------------|--------------|-------------------|---------------|-----------------|----------------|--------------|-------------------|----------------|------------------------|--|------------------------------|----------------------------|---------------|
| 5       |   | -                                      | 8                  |                    | nooc                | 000                |                   | LINGHD              |                  | Texa              | s Peac             | e Offi   | icer           | s Cra          | sh I       | Report         | (Form            | CR-          | 3 4/1             | 2023          |                 | 100            | 10.1         |                   | -              |                        |  |                              |                            |               |
|         | Ding<br>of Tes                                    | inua<br>artewn<br>naportation          |                    |                    | Refe<br>Thes        | r to th<br>e field | e attac<br>is are | hed coo             | de she<br>d on a | eet fo<br>all add | r numb<br>litional | sheet    | field<br>ts su | s<br>Ibmitte   | ed fo      | or this c      | rash (e          | ex.: a       | dditio            | nal v         | Ques            | tions<br>s, oc | ? Ca<br>cupa | ll 844<br>nts, ir | 274-<br>njurec | 7457<br>I, etc.        | ).   | P                            | ige_                       | of            |
| Γ       | *Crash Date Case (MM/DD/YYY) (24HRMM) [ ] ] ] ] ] |  |                    |                    |                     |                    |                   |                     |                  |                   |                    |          |                | ocal<br>Ise    |            |                |                  |              |                   |               |                 |                |              |                   |                |                        |  |                              |                            |               |
|         | *Cou<br>Nam                                       | nty<br>e                               |                    |                    |                     |                    |                   |                     |                  |                   |                    |          |                | City<br>lame   |            |                |                  |              |                   |               |                 |                |              |                   |                |                        |  |                              | Out<br>City                | side<br>Limit |
| ATION   | In yo<br>\$100                                    | ur opinio<br>0 damao                   | on, dia<br>ge to a | this on<br>any one | ash res             | ult in a           | t least           | Yes I               | atitude          | e                 |                    |          |                |                |            |                |                  |              | Lor               | gitude        |                 |                |              |                   |                |                        |  |                              |                            |               |
| \$100   | ROA   | D ON W                                 | нісн               | CRAS               | носо                | URRE               | D                 |                     | _                |                   | _                  | _        | -              | _              | _          |                | _                |              | -                 |               |                 | -              |              | _                 | -              | _                      |  | _                            | _                          |               |
| TION    | Sys.  | twy.                                   |                    | Nu                 | ey.<br>m.           | _                  |                   | 2 Rdwy<br>Part      | ·                |                   | Block<br>Num       | _        |                |                | 3 S<br>Pre | treet<br>fix   |                  | Nam          | eet<br>xe         |               |                 |                |              |                   |                |                        | 4 Str<br>Sufft                               | eet<br>K                     |                            |               |
| TIFICA  |   | htvate Dri<br>htvate Pro<br>harking Lo | operty,<br>t       | load,              | 3 Dir. o<br>Traffic | x                  |                   | Toll Ro<br>Toll La  | ad/ ine          | Speed<br>Limit    |                    | Zor      | nst. [         | Yes<br>No      | Wo<br>Pre  | rkers          | Yes Se<br>No Cri | conda<br>ash | "8                | res 8<br>No 1 | Street<br>Desc. |                |              |                   |                |                        |  |                              |                            |               |
| IDEMT   | INTE  | RSECT                                  |                    | OAD, O             | OR IF C             | RASH               | NOTA              | T INTER             | ECTIO            | ON, NE            | AREST              | INTER    | RSEC           | TING R         | IOAC       | O OR RE        | FEREN            | CE MA        | RKER              | 2             |                 |                |              |                   |                |                        | 4.5%   |                              |                            |               |
| Γ       | Int   | No                                     | Sys                | awy.               |                     | Nu                 | im.               |                     | Part             | iy.               |                    | Num.     | _              |                |            | Prefix         | _                |              | Name              |               |                 |                |              |                   |                |                        | Suff   | K                            |                            |               |
| L       | Dista<br>or Re                                    | nce from<br>f. Marke                   | n Int.<br>Ir       |                    |                     |                    | 3 Dir.<br>or Ref. | from Int.<br>Marker |                  |                   | Ref.<br>Marker     |          |                | Speed<br>Limit |            |                | Street<br>Desc.  |              |                   |               |                 |                |              | R<br>N            | IRX<br>Ium.    | 1                      |  |                              | 1                          | ī.            |
|         | Unit<br>Num                                       |  | 5 U<br>De          | init<br>sc.        |                     |                    | arked<br>ehicle   | Hit ar<br>Run       | d Li<br>S        | P                 |                    | LP<br>Nu | m.             |                |            |                | VIN              |              | 1                 | ī.            |                 | T              | L            |                   |                | T                      | 1.1  | 1                            | ī                          | L             |
| L       | Veh<br>Year                                       | 1.1                                    | 1                  | 1                  | 6 Ve<br>Colo        | h.<br>r            |                   |                     | Veh<br>Mai       | h.<br>ke          |                    |          |                |                |            | Ve<br>Mo       | h.<br>del        |              |                   |               |                 |                | 7<br>S       | Body<br>tyle      |                |                        |  |                              |                            |               |
| L       |   | Respond<br>Explain                     | ler Str<br>in Na   | uck<br>rrative i   | fcheck              | ed) 8              | Autono            | mous Un             |                  |                   |                    |          |                |                | 9 A.       | utonomou       | s Level          | Enga         | ged               |               |                 |                |              |                   |                | Polic<br>(Exp          | e, Fire, E<br>lain in N                      | MS on<br>mative              | Emerg                      | pency<br>ked) |
| L       | 10 D<br>Type                                      | L/ID                                   |                    | DL/I<br>Stat       | De                  |                    | DL/ID<br>Num.     |                     |                  |                   |                    | 1<br>C   | 1 DL           |                |            | 12 CDL<br>End. |                  |              | 13 DL<br>Rest.    |               |                 | 00             | B            |                   |                |                        |  |                              |                            |               |
| XV      | Addr<br>City,                                     | ess (Stre<br>State, Z                  | et,<br>IP)         |                    |                     |                    | -                 |                     |                  |                   |                    | _        |                |                | _          |                |                  |              |                   |               |                 |                |              |                   | -              |                        |  |                              | -                          | -             |
| PERSC   | 8 e   | Prsn                                   | li di              |                    |                     |                    |                   | Nam                 | e: La            | ast, Fir          | rst, Midd          | dle      |                |                |            |                | Alua             |              | Voi               | ×             | ijoct.          | bestr.         | Virbag       | het               |                | و ق                    | ij   | 9                            | din 1                      | on A          |
| FR &    | e z   | 14.<br>Typ                             | 155<br>Pos         |                    |                     | Ente               | er Drive          | er or Prin          | nary F           | Persor            | n for this         | s Unit   | on fi          | irst line      | •          |                | 28               | Age          | ÷#                | 18.5          | 19 6            | 8              | 21           | 호<br>S<br>S       | 88             | 8 54 V                 | Alc:<br>Res                                  | 88.<br>887                   | 88                         | 270           |
| DRIV    | _   |  | _                  |                    |                     |                    |                   |                     |                  |                   |                    |          |                |                |            |                |                  |              |                   |               |                 |                |              |                   |                | Not                    | Acolicab                                     | le - Ak                      |                            |               |
| HICLE   |   | $\vdash$                               | _                  |                    |                     |                    |                   |                     |                  |                   |                    |          |                |                | _          |                | $\left  \right $ | _            | -                 | _             |                 | _              | -            |                   | -              | Drug<br>for D          | Results                                      | are of<br>mary P             | nly rep<br>Person          | orted         |
| 2V      |   | Owner                                  | 0                  | nerles             | see                 | _                  |                   |                     |                  |                   |                    |          |                |                | -          |                |                  |              |                   |               |                 |                |              |                   |                | for e                  | ach Unit                                     |                              |                            | _             |
|         |   | essee                                  | Nar                | ne & Ad            | idress              | En                 |                   |                     | En 1             | Pasa              |                    |          |                |                |            |                | E                | Res          | 0                 |               |                 |                |              |                   |                |                        |  |                              |                            |               |
|         | Fin. I  | Nesp.                                  | No                 | Exe                | mpt R               | esp. Ty            | pe                |                     | Nam              | e                 |                    |          |                |                |            |                | Nu               | m.           | ~                 |               |                 |                |              |                   |                | _                      |  |                              | _                          | Mar           |
|         | Fin.<br>Phor                                      | Resp.<br>ie Num.                       |                    |                    |                     |                    |                   |                     | 29<br>Da         | Vehici<br>amage l | e<br>Rating 1      |          |                | - 1            | I          |                | -                | 29<br>Dan    | Vehicle<br>nage R | ating         | 2 ]             | 1              | Ċ.           | 1                 | 1              | Ľ.                     | In   | ventori                      |                            | No            |
| L       | Towe<br>By  | d                                      |                    |                    |                     |                    |                   |                     |                  |                   | Towed<br>To        | 1        |                |                |            |                |                  |              |                   |               |                 |                |              |                   |                |                        |  |                              |                            |               |
| Γ       | Unit<br>Num                                       |  | 5 U<br>De          | init<br>sc.        |                     |                    | nked              | Hit ar<br>Run       | id Li<br>S       | P                 |                    | LP       | m.             |                |            |                | VIN              |              | 1                 | ī.            |                 |                | T            |                   |                | 1                      |  |                              |                            |               |
|         | Veh   |  |                    |                    | 6 Ve                | h.                 |                   |                     | Vet              | h.<br>ke          |                    |          |                |                |            | Ve             | h.<br>del        | -            |                   |               |                 |                | 7            | Body              |                |                        |  |                              |                            |               |
|         |   | Respond                                | er Str             | uck                | chack               | 8                  | Autono            | mous Uni            | 1                |                   |                    |          |                |                | 9 Au       | tonomou        | s Level          | Engag        | ged               |               |                 |                |              | ,-                |                | Polic                  | e, Fire, E<br>Iain in Na                     | MS on                        | Emerg                      | ency<br>kert) |
|         | 10 D  | L/ID                                   |                    | DLA                | D                   |                    | DL/ID             |                     | -                |                   |                    | 11       | 1 DL           |                | 1          | 12 CDL         |                  |              | 13 DL<br>Rest     |               |                 | 00             | B            |                   |                |                        |  |                              |                            |               |
| ×       | Addr  | ess (Stre<br>State 7                   | et,                | U.M.               | -                   |                    | riant.            |                     |                  |                   |                    |          |                |                | _          | Line.          |                  |              | T VILLES.         |               |                 | (141           |              |                   | -              | 1                      | /  |                              | -                          | -             |
| PERSO   | 5   | ç                                      | ¥ 8                |                    |                     |                    |                   | Nam                 | e: La            | ast, Fir          | st, Midd           | dle      |                |                | _          |                | 24               |              | Ap                | ×             | 멍               | str.           | theg         | 5                 |                | a .                    |  | <b>8</b> .                   | 3-                         | 38            |
| 28.8.9  | Pers  | 14 Pr                                  | 15 St<br>Posti     |                    |                     | Ente               | er Drive          | r or Prin           | nary F           | Persor            | n for this         | s Unit   | on fi          | irst line      | •          |                | 16 Inj           | 904          | 17<br>Etho        | 18 Se         | 19 日            | 20 Ri          | 21 A         | Helm<br>Helm      | 80             | 24 AJ                  | Ac.<br>Resu                                  | 25. D<br>Spec                | 26 Dr                      | 0.0           |
| DRIVI   |   |  |                    |                    |                     |                    |                   |                     |                  |                   |                    |          |                |                |            |                |                  |              |                   |               |                 |                |              |                   |                |                        |  |                              |                            |               |
| FHICLE. |   | $\left  \right $                       |                    |                    |                     |                    |                   |                     |                  |                   |                    |          |                |                |            |                | $\left  \right $ |              |                   |               |                 |                | _            |                   |                | Not /<br>Drug<br>for D | Applicab<br>Results<br>river/Pri<br>ach Unit | le - Alc<br>are or<br>mary P | ohol a<br>Ny rep<br>Yerson | nd<br>orted   |
| ſ       |   | Owner                                  | Own                | er/Less            | iee<br>tress        |                    |                   |                     |                  |                   |                    |          |                |                |            |                |                  |              |                   |               |                 |                | _            |                   |                |                        |  |                              |                            |               |
|         | Proof   | of                                     | Yes                | Expi               | red 21              | 8 Fin.             |                   |                     | Fin              | Resp              |                    | _        | _              |                | _          |                | Fir              | . Res        | p.                | _             | _               | _              | _            | _                 | _              | _                      |  | _                            | _                          | _             |
|         | Fin.  | Resp.                                  | JNO                | L EXAM             | mpt R               | esp. Ty            | pe                |                     | 29               | ) Vehid           | e                  | _        |                |                |            |                | Nu               | 29           | Vehick            |               |                 | _              |              |                   |                |                        | V  | ahicle                       |                            | Yes           |
|         | Phor  | e Num.                                 |                    |                    |                     |                    |                   |                     | Da               | amage             | Rating 1           | 1        |                | <u> </u>       | 1          |                | -                | Dar          | mage F            | Rating        | 2               |                | Ľ.           |                   | 1              | Ē                      | Inv  | entorie                      | ≤ [                        | No            |
| L       | By  | -                                      |                    |                    |                     |                    |                   |                     |                  |                   | То                 |          |                |                |            |                |                  |              |                   |               |                 |                |              |                   |                |                        |  |                              |                            |               |

Figure 4.2: CR-3's First Page

| La<br>Fo | Law Enforcement and TxDOT Use ONLY. Dase TxDOT Crash ID Contact/Help |                 |                 |           |                         |                   |         |                  |                  | elp Pag      | e_of             |                  |            |         |                    |                 |                       |            |         |                         |                         |              |                            |                      |           |
|----------|--|-----------------|-----------------|-----------|-------------------------|-------------------|---------|------------------|------------------|--------------|------------------|------------------|------------|---------|--------------------|-----------------|-----------------------|------------|---------|-------------------------|-------------------------|--------------|----------------------------|----------------------|-----------|
| Γ        | ,  | Unit            | Prsi<br>Nun     | n.<br>n.  |                         |                   | т       | aken 1           | То               |              |                  |                  |            |         | Taken By           |                 |                       |            |         | Date of<br>(MM/DD       | Death                   |              | Time o<br>(24H             | f Death<br>RMM)      |           |
| NOF      |  |                 |                 |           |                         |                   |         |                  |                  |              |                  |                  |            |         |                    |                 |                       |            |         |                         |                         |              | 1                          |                      |           |
| OSITIC   |  |                 |                 |           |                         |                   |         |                  |                  |              |                  |                  |            |         |                    |                 |                       |            |         |                         |                         |              |                            |                      |           |
| DISP     | 3  |                 | +               | +         |                         |                   |         |                  |                  |              |                  | -                |            |         |                    |                 |                       |            |         |                         |                         |              |                            |                      |           |
| ┝        | Un   |                 | Prsn.           |           |                         |                   |         |                  |                  |              |                  |                  |            |         |                    |                 |                       |            |         |                         |                         |              |                            |                      |           |
| s        | Nur  | m.              | Num.            |           |                         |                   |         |                  |                  |              |                  |                  | Charge     |         |                    |                 |                       |            |         |                         |                         | Citation     | reference                  | Num.                 | _         |
| HARGE    |  | +               | _               |           |                         |                   |         |                  |                  |              |                  |                  |            |         |                    |                 |                       |            |         |                         |                         |              |                            |                      | _         |
| σ        |  | 1               |                 |           |                         |                   |         |                  |                  |              |                  |                  |            |         |                    |                 |                       |            |         |                         |                         |              |                            |                      | _         |
| ЗE       |  |                 | D               | amage     | d Property              | y Other           | Than V  | /ehicle          | 8                |              |                  |                  | c          | wne     | r's Name           |                 |                       |            |         |                         | Own                     | er's Address |                            |                      | _         |
| DAMA     |  |                 |                 |           |                         |                   |         |                  |                  |              |                  |                  |            |         |                    |                 |                       | _          |         |                         |                         |              |                            |                      |           |
| -        | Unit   |                 |                 | 10        | 0,001+                  |                   | fransor | rtina            |                  |              |                  | CMV              | Disabling  | П       | es 30 Vel          | h.              | 31 G                  | arrier     |         |                         | Carrier                 |              |                            |                      | _         |
|          | Num  | n.<br>rier's    |                 | μ         | 35.                     | ju ;              | lazardo | xus Ma           | terial<br>Can    | tier's       | Capacity         | Dam              | age?       |         | o Oper.            |                 | ID T)                 | ype        |         |                         | ID Num                  |              | 32 Veh.                    |                      |           |
| 2        | Corp<br>33 B   | p. Na<br>Ius    | me              |           | RGVW                    |                   |         |                  | Prin             | hary Add     | r.<br>15 34 Hazl | Mat              | HazMat     |         |                    |                 | 34 Hazi               | Mat        | Haz     | zMat                    |                         |              | Type<br>35 Cargo           |                      | _         |
| ຽ        | Type   | e               |                 | −₽        | RGVWR                   |                   |         | -                | Release<br>36 Tr | ed No<br>ir. | Class N<br>CM    | lum.<br>V Disabl | ID Num     | l<br>Ur |                    |                 | Class N<br>RGVW       | um.        | ID I    | Num.                    | 36 Trir.                |              | Body Type<br>MV Disabilin  |                      | es        |
|          | Sequ   | ueno            | e 37 s          | Seq. 1    | GVWR                    | 37                | Seq. 2  |                  | Type             | 37 Sec       | 0an              | nage?            | 37 Seq. 4  | 1       |                    | Intermo         | GVWR<br>dal Shipping  | Ye         | s Act   | ual<br>xss              | Туре                    |              | Total Num.                 |                      | <u> </u>  |
|          | 8  | venic           | 38 Co           | ntributi  | ing Facto               | rs (Inv           | estigat | or's O           | pinion)          |              | 39 Vet           | hicle De         | fects (Inv | estig   | ator's Op          | inion)          |                       |            | Envir   | onmental                | and Road                | tway Condit  | tions                      |                      | _         |
| TORS     |  | Unit            | -               |           | Contribute              | 1                 |         | May              | Have Co          | ntrib.       |                  | Contribut        | ing        | +       | May Have           | Contrib.        | 40<br>Weather<br>Cond | Lig<br>Cor | 1<br>ht | 42<br>Entering<br>Roads | 43<br>Roadway<br>Type   | Alcoment     | 45<br>Surface<br>Condition | 46<br>Traff<br>Contr | ic<br>Iol |
| FAC      | Š,   |                 | +               |           |                         | +                 |         |                  | +                | -            |                  |                  | +          | +       |                    |                 | Conta.                |            | -       |                         | .,,,~                   |              | Consider                   | Com                  |           |
| F        |  |                 |                 |           | Investi                 | gator's<br>Attach | Narrati | ve Opi<br>nal Sh | inion of l       | What Ha      | ppened           |                  |            |         | Indicate           |                 |                       | Fie        | id Diag | gram - Not              | to Scale                |              |                            |                      | _         |
|          |  |                 |                 |           |                         |                   |         |                  |                  | ,            | "                |                  |            |         | North              |                 |                       |            |         |                         |                         |              |                            |                      |           |
|          |  |                 |                 |           |                         |                   |         |                  |                  |              |                  |                  |            |         |                    |                 |                       |            |         |                         |                         |              |                            |                      |           |
|          |  |                 |                 |           |                         |                   |         |                  |                  |              |                  |                  |            |         |                    |                 |                       |            |         |                         |                         |              |                            |                      |           |
|          |  |                 |                 |           |                         |                   |         |                  |                  |              |                  |                  |            |         |                    |                 |                       |            |         |                         |                         |              |                            |                      |           |
| W        |  |                 |                 |           |                         |                   |         |                  |                  |              |                  |                  |            |         |                    |                 |                       |            |         |                         |                         |              |                            |                      |           |
| AGRA     |  |                 |                 |           |                         |                   |         |                  |                  |              |                  |                  |            |         |                    |                 |                       |            |         |                         |                         |              |                            |                      |           |
| ND DI    |  |                 |                 |           |                         |                   |         |                  |                  |              |                  |                  |            |         |                    |                 |                       |            |         |                         |                         |              |                            |                      |           |
| TIVEA    |  |                 |                 |           |                         |                   |         |                  |                  |              |                  |                  |            |         |                    |                 |                       |            |         |                         |                         |              |                            |                      |           |
| IARRA    |  |                 |                 |           |                         |                   |         |                  |                  |              |                  |                  |            |         |                    |                 |                       |            |         |                         |                         |              |                            |                      |           |
|          |  |                 |                 |           |                         |                   |         |                  |                  |              |                  |                  |            |         |                    |                 |                       |            |         |                         |                         |              |                            |                      |           |
|          |  |                 |                 |           |                         |                   |         |                  |                  |              |                  |                  |            |         |                    |                 |                       |            |         |                         |                         |              |                            |                      |           |
|          |  |                 |                 |           |                         |                   |         |                  |                  |              |                  |                  |            |         |                    |                 |                       |            |         |                         |                         |              |                            |                      |           |
|          |  |                 |                 |           |                         |                   |         |                  |                  |              |                  |                  |            |         |                    |                 |                       |            |         |                         |                         |              |                            |                      |           |
|          |  |                 |                 |           |                         |                   |         |                  |                  |              |                  |                  |            |         |                    |                 |                       |            |         |                         |                         |              |                            |                      |           |
| $\vdash$ | Der  | a bir           | lifed           |           |                         | _                 |         |                  |                  |              |                  | _                |            | Te      | ne Notified        |                 |                       | He         |         |                         |                         |              |                            |                      |           |
|          | (MA  | WDD             | mm              |           | _                       |                   |         |                  |                  |              |                  |                  |            | (24     | HRMM)              |                 | 1 1                   | No         | tfied   |                         |                         |              |                            |                      | _         |
| TOR      | (M)  | M/DD            | Amm             | )         |                         |                   |         |                  |                  |              |                  |                  | (24)       | HRM     | M)                 | T T             | I Ó                   | MMD        | DAT     | ŋ                       |                         |              |                            |                      |           |
| STIGA    | Cles   | e Ro<br>ared    | adway<br>(MM/DI | m         | n                       |                   |         |                  | Ck               | ared (24     | HRMM)            | 1                |            |         | Date So<br>Cleared | ine<br>(MM/DD/Y | m)                    |            |         |                         | Time Soer<br>Cleared (2 | e<br>4HRMM)  |                            | 1                    |           |
| INVE     | Con  | estiga<br>nplet | e               | Yes<br>No | Investigat<br>Name (Pri | tor<br>inted)     |         |                  |                  |              |                  |                  |            |         |                    |                 |                       |            |         |                         | ID<br>Num.              |              |                            |                      |           |
|          | ORI  | n. j            | 1               | 1 1       | 1.1                     |                   | 1       |                  | *Agency          | ,            |                  |                  |            |         |                    |                 |                       |            |         |                         | Service/<br>Region/     | DA           | 1                          |                      |           |

Figure 4.3: CR-3's Second Page

| Law Enforcement and TxDOT Use ONLY. Case<br>Form CR-3 (Rev. 4/1/2023) ID       |          |                |                |                   |  | TxD0F<br>Gash ID |         |   |       |         |              |   | Contact/Help Page of |  |              |                    |     |        |            |        |        |              |             |       |
|--|----------|----------------|----------------|-------------------|--|------------------|---------|---|-------|---------|--------------|---|----------------------|--|--------------|--------------------|-----|--------|------------|--------|--------|--------------|-------------|-------|
| "Crash Date     "Crash Time     "County     (MM/DD/YYYY)     (24HRMM)     Name |          |                |                |                   |  |                  |         |   |       |         |              |   |                      |  |              |                    |     |        |            |        |        |              |             |       |
|  | *City    |                |                |                   |  |                  |         |   | -     |         |              |   | *1 Rdwy.             |  | "Hwy.<br>Num |                    |     |        |            |        |        |              |             | _     |
|  | *Stre    | et             |                |                   |  |                  |         |   |       |         |              |   | 372                  |  |              |                    |     |        |            |        |        |              |             |       |
|  | OR       |                |                |                   |  |                  | 'Agency |   |       |         |              |   |                      |  |              |                    |     | Servic | 08/<br>00/ |        | 1      |              | 1           |       |
|  | S        | L.             | ć              | # 5               |  |                  |         |   |       |         |              |   |                      |  |              | ŠΖ                 |     | ity a  |            | ಕ      | ι,     |              | Ŧ           |       |
|  | Unit N   | Persot<br>Num. | 14 Prs<br>Type | 15 Sev<br>Positik |  |                  |         |   | Name: | Last, F | First, Middl | e |                      |  |              | 16 Inju<br>Serveri | Age | Ethnic | 18 Se      | 10 Eje | 20 Res | 21<br>Airbag | 22<br>Helme | 23 50 |
|  |          |                |                |                   |  |                  |         |   |       |         |              |   |                      |  |              |                    |     |        |            |        |        |              |             |       |
|  |          |                |                |                   |  |                  |         |   |       |         |              |   |                      |  |              |                    |     |        |            |        |        |              |             |       |
|  |          |                |                |                   |  |                  |         |   |       |         |              |   |                      |  |              |                    |     |        |            |        |        |              |             |       |
|  |          |                |                |                   |  |                  |         |   |       |         |              |   |                      |  |              |                    |     |        |            |        |        |              |             |       |
|  |          | -              | -              | -                 |  |                  |         |   |       |         |              |   |                      |  |              | -                  |     |        | -          |        |        |              |             |       |
|  | -        | -              | -              |                   |  |                  |         |   |       |         |              |   |                      |  |              | -                  |     |        |            |        |        | _            |             | -     |
|  |          |                |                |                   |  |                  |         |   |       |         |              |   |                      |  |              |                    |     |        |            |        |        |              |             | -     |
|  |          | -              | -              |                   |  |                  |         |   |       |         | _            |   | _                    |  |              |                    |     |        |            | -      |        | _            | _           | -     |
|  |          |                |                |                   |  |                  | _       | _ | _     | _       |              | _ |                      |  |              |                    |     |        |            |        |        |              |             | -     |
|  |          |                |                |                   |  |                  |         |   |       |         |              |   |                      |  |              |                    |     |        |            |        |        |              |             |       |
|  |          |                |                |                   |  |                  |         |   |       |         |              |   |                      |  |              |                    |     |        |            |        |        |              |             |       |
|  |          |                |                |                   |  |                  |         |   |       |         |              |   |                      |  |              |                    |     |        |            |        |        |              |             |       |
| ×  |          |                |                |                   |  |                  |         |   |       |         |              |   |                      |  |              |                    |     |        |            |        |        |              |             |       |
| 10203  |          |                |                |                   |  |                  |         |   |       |         |              |   |                      |  |              |                    |     |        |            |        |        |              |             |       |
| NAL P  |          |                |                |                   |  |                  |         |   |       |         |              |   |                      |  |              |                    |     |        |            |        |        |              |             |       |
| OTTO   |          | -              | -              | -                 |  |                  |         |   |       |         |              |   |                      |  |              | -                  |     | _      |            | _      |        |              | _           | -     |
| 4  | <u>ا</u> | -              | -              |                   |  |                  |         |   |       |         |              |   |                      |  |              | -                  |     |        |            | _      |        |              | _           |       |
|  | -        | -              | -              |                   |  |                  |         |   |       |         |              |   |                      |  |              | -                  |     |        |            | _      |        | -            | _           | -     |
|  |          | -              |                |                   |  |                  |         |   |       |         |              |   |                      |  |              | -                  |     |        |            |        |        |              | _           | -     |
|  |          | -              |                | -                 |  |                  |         |   |       |         |              |   |                      |  |              |                    |     |        |            |        |        |              |             |       |
|  |          |                |                |                   |  |                  |         |   |       |         |              |   |                      |  |              |                    |     |        |            |        |        |              |             |       |
|  |          |                |                |                   |  |                  |         |   |       |         |              |   |                      |  |              |                    |     |        |            |        |        |              |             |       |
|  |          |                |                |                   |  |                  |         |   |       |         |              |   |                      |  |              |                    |     |        |            |        |        |              |             |       |
|  |          |                |                |                   |  |                  |         |   |       |         |              |   |                      |  |              |                    |     |        |            |        |        |              |             |       |
|  |          |                |                |                   |  |                  |         |   |       |         |              |   |                      |  |              |                    |     |        |            |        |        |              |             |       |
|  |          |                |                |                   |  |                  |         |   |       |         |              |   |                      |  |              |                    |     |        |            |        |        |              |             |       |
|  |          | -              |                |                   |  |                  |         |   |       |         |              |   |                      |  |              | -                  |     |        |            |        |        |              |             |       |
|  |          |                | -              |                   |  |                  |         |   |       |         |              |   |                      |  |              | -                  |     |        |            | _      |        | _            |             |       |
|  |          |                | -              | -                 |  |                  |         |   |       |         |              |   |                      |  |              | -                  |     |        |            |        |        | _            |             |       |
|  |          |                | -              | -                 |  |                  |         |   | _     |         |              | _ |                      |  |              |                    |     |        |            | -      |        |              |             | -     |
|  |          |                |                |                   |  |                  |         |   |       |         |              |   |                      |  |              |                    |     |        |            |        |        |              |             | -     |
|  |          |                |                |                   |  |                  |         |   |       |         |              |   |                      |  |              |                    |     |        |            |        |        |              |             |       |
|  |          |                |                |                   |  |                  |         |   |       |         |              |   |                      |  |              |                    |     |        |            |        |        |              |             |       |
|  |          |                |                |                   |  |                  |         |   |       |         |              |   |                      |  |              |                    |     |        |            |        |        |              |             |       |
|  |          |                |                |                   |  |                  |         |   |       |         |              |   |                      |  |              |                    |     |        |            |        |        |              |             |       |

Figure 4.4: CR-3's Third Page

Finding the Czech crash report form proved to be more challenging, as the form was not readily available on the Ministry of Transport's website, even though crash data in the Czech Republic is publicly accessible. A through internet search revealed that Figure 4.5 is likely the accident report form used by insurance agencies.

The form bears similarity to the CR-3 forms in terms of its content. It includes personal information on the individuals involved in the accident, as well as basic information on the vehicles and details such as the date, time, location, and circumstances of the accident. Additionally, it includes insurance information and a designated section for a sketch of the accident. Determining the clarity of these drawings in comparison to the CR-3 diagrams is challenging due to the lack of prior experience with this form.

Table 4 presents a comparative analysis of the selected items included in the CR-3 crash report form used in Texas and the Czech accident report form. The purpose of this table is to highlight similarities and differences between the two forms.

| Item   | CR-3 Form | Czech Accident Report Form |
|--|-----------|----------------------------|
| Crash ID   | Yes       | No                         |
| Case ID  | Yes       | No                         |
| Date & Time  | Yes       | Yes                        |
| Location (Streets Names)   | Yes       | Yes                        |
| Latitude & Longitude   | Yes       | No                         |
| Injuries   | Yes       | Yes                        |
| Witness  | Yes       | Yes                        |
| Speed Limit  | Yes       | No                         |
| Circumstances (what happen?)   | Yes       | Yes                        |
| Number of vehicles involved  | Yes       | Yes                        |
| Vehicle identification number  | Yes       | Yes                        |
| Vehicle color & model  | Yes       | No                         |
| Vehicle Make   | Yes       | Yes                        |
| Name of persons involved   | Yes       | Yes                        |
| Age of persons involved  | Yes       | No                         |
| Phone/email of persons involved  | Yes       | Yes                        |
| Driver license   | Yes       | Yes                        |
| Insurance Information  | No        | Yes                        |
| Charges  | Yes       | No                         |
| Damage   | Yes       | Yes                        |
| Narrative  | Yes       | No                         |
| Diagram  | Yes       | Yes                        |
| Investigators' information:<br>• Date & time notified<br>• Date & time arrived | Yes       | No                         |

Table 4: CR-3 vs. the Czech Accident report form

#### Does not constitute an admission of liability, just Accidentsketch.com Accident Report Form 1 Date of accident 2 Locality - Country - Place 3 Injuries even if slight Time no 🔲 yes 🗌 4 Material damage 3 ..... objects other than vehicle other than to vehicles A and B: I по 🗌 уня 🗌 ∾ □ y== 🗌 Vehicle A Circumstances Vehicle B 12 Loss (married 6 Insured policyholder\* 6 Insuredipolicyholder\* Sumame ..... Put a cross in each of the relevant boxes to help Sumame ..... First name explain the drawing -\* delete where appropriate: First name ..... Address ..... Address ..... ZIP code ......Country ..... Zip code ......Country..... What happened? A • Tel. or e-mail Tel. or e-mail .... ..... 1 \* parked / stopped 1 7 Vehicle leaving a parking space / opening a vehicle door Vehicle 2 2 Trailer: Motor: Trailer: 3 3 entering a parking space Make, type Make, type emerging from a parking space, from private premiaes, from a track 4 4 Registration No. Registration No. Registration No. Registration No. \*entering a parking space, private premises, a track 5 5 Country of registration Country of registration Country of registration Country of registration 6 entering a roundabout 7 circulating a roundabout 7 E Insurance company surance company striking the near of the other vehicle in the sam line of traffic and traveling in the same direction 8 8 Sumarne Sumame going in the same direction but in a different line of traffic Policy No. Policy No. 9 9 10 Insurance Certificate changing lines of traffic 10 Insurance Certificate valid from ..... valid from ..... overtaking 11 11 to ..... 10 ..... 12 turning to the right 12 Agency (or bureau, or broker) Agency (or bureau, or broker) 13 turning to the left 13 Address ..... Address ..... 14 14 reversing Country Country ..... Tel. or e-mail Tel. or e-mail changing to a lane reserved for traffic in 15 the opposite direction Does the policy cover material damage to the Does the policy cover material damage to the no 🗌 no 🗌 ym 🗌 vehicle? yes 🗌 16 coming from the right (at a junction) 16 vehicle? 17 had not observed a priority sign or a red light 17 2 Driver (making to Driver (see dhing loance) Sumame ..... Sumane ..... ← State the number of → First name First name ...... Date of birth .... Date of birth .... Address ..... 13 Address ..... Sketch of accident when impact occurred Country ..... Country ..... Co siete vour sketch later, www.AccidentSketch.com Tel. or email Tel. or email indicate 1, the layout of the road 2, by arrows the direction Driving licence No..... of the vehicles A, B 3. their position at the time of impact Driving licence No Category Calegory 4. the road signs 5. names of the streets or roads Driving licence valid untit . Driving licence valid until: 10 Indicate the point of initial impact to vehicle B by an Indicate the point of initial impact to vehicle A by an arrow IP Your Sketch of the accident: - w Visible damage to faible damage to le B: 14 My remarks: .... Signatures of the drivers 15 в А

AccidentSketch.com | Provided by ClaimMS GmbH | PO Box 111248 | D-57258 Freudenberg | www.Claim.MS Infoline: +49 271 222 9 222 | eMail: Info@Claim.MS | www.Accidentsketch.com

Figure 4.5: Czech Crash Report Form

### **4.2 DATABASES**

The Crash Record Information System (CRIS) website in Texas is an online platform that provides access to crash data, crash reports and crash statistics. It is operated by the Texas Department of Transportation (TxDOT) and is designed to be a comprehensive tool for analyzing and understanding crashes that occur on Texas roadways. Authorized users can search for and download crash reports and view crash statistics and trends. Although the CRIS is a publicly available online, access to the database is restricted to registered users or organizations with authorized permission to view the information. Previous experience with the City of El Paso on Safety Analysis provided familiarity with the CRIS database and its functionality. A screenshot of the CRIS database homepage, depicted in Figure 4.6, displays a prompt for user information to confirm authorization to access the database. The CRIS Launch interface is presented in Figure 4.7, which provides users with the ability to search for reports. Figure 4.8 displays the available filtering fields to narrow down the data search. Finally, Figure 4.9 shows the results of the search criteria entered, and from this screen, users can view or download the CR-3 forms.

| Crash Records Information System  |  |             |
|---|--|-------------|
| Q Looking for a copy of your Texa   | is Peace Officer's Crash Report (CR-3)? Purchase one he    | re.         |
| Please select your Age  | ncy  |             |
| The Application or Service you are trying to re   | ach requires you to authenticate with your ho              | ome Agency. |
| <ul> <li>I use CRIS to enter Crash Reports, and I am a member</li> </ul>  | of the following Agency:                                   |             |
| Enter your organization's name  | Dentinue   |             |
| Allow me to pick from a list  |  |             |
| » I use CRIS to enter Crash Reports (law enforcement) o<br>etc. governmental entity), but My Agency is not shown al | r analyze data (City, MPO, Federal,<br>bove                |             |
| » I only use CRIS to download Interface Requests  |  |             |
| Need assistance? Chat with a support  | t technician! The help desk can also be reached at (844) ( | CRIS-HLP.   |



| Welcome to CRIS Launch              |        |  |  |  |  |  |  |  |  |
|-------------------------------------|--------|--|--|--|--|--|--|--|--|
| Today is Sunday, November 28, 2021. |        |  |  |  |  |  |  |  |  |
| General Information My CRIS Apps    |        |  |  |  |  |  |  |  |  |
| FAQ                                 |        |  |  |  |  |  |  |  |  |
| Help                                |        |  |  |  |  |  |  |  |  |
| Crash Instructions (CR100)          |        |  |  |  |  |  |  |  |  |
| Classification Manual (CR102)       | Search |  |  |  |  |  |  |  |  |
| Vehicle Damage (CR80)               |        |  |  |  |  |  |  |  |  |

Figure 4.7: CRIS Launch Interface

| Search Cra                   | sh Reports                            |                |                          |                             |  |  |  |  |  |
|------------------------------|---------------------------------------|----------------|--------------------------|-----------------------------|--|--|--|--|--|
| Please complete some         | e or all of the following fields to f | find ma        | tching Crash Reports     |                             |  |  |  |  |  |
| City                         |                                       |                | County                   |                             |  |  |  |  |  |
| Type to Filter               |                                       | Type to Filter | *                        |                             |  |  |  |  |  |
| Crash ID Web Crash ID        |                                       |                | Crash Number             | Agency Case ID<br>17-023205 |  |  |  |  |  |
| Crash Date                   |                                       |                |                          |                             |  |  |  |  |  |
| Select a Date                |                                       | =              |                          |                             |  |  |  |  |  |
| Use MM/DD/YYYY format such a | as 09/01/2020 for September 1, 2020   |                |                          |                             |  |  |  |  |  |
| Involved Party First Name    |                                       |                | Involved Party Last Name |                             |  |  |  |  |  |
|                              |                                       |                |                          |                             |  |  |  |  |  |
| Officer First Name           |                                       |                | Officer Last Name        |                             |  |  |  |  |  |
|                              |                                       |                |                          |                             |  |  |  |  |  |
| Crash Severity               |                                       |                |                          |                             |  |  |  |  |  |
| Type to Filter               |                                       | *              |                          |                             |  |  |  |  |  |
| Show Advanced Fiel           | lds                                   |                |                          |                             |  |  |  |  |  |
| Search Reset                 |                                       |                |                          |                             |  |  |  |  |  |

Figure 4.8: CRIS Search Criteria

| Search Results (2 Cr | ashes)   |       |     | Edi        | t Approve | Supplement | Correct   | View PDF | Export |
|----------------------|----------|-------|-----|------------|-----------|------------|-----------|----------|--------|
| Web Crash ID         | Crash ID | Fatal | сму | Crash Date | City      | County     | Case ID   | Source   |        |
| 9                    | 15965185 | No    | No  | 09/14/2017 | LAREDO    | WEBB       | 17-023205 | XML      |        |
| 9                    | 15562654 | No    | No  | 01/23/2017 | EL PASO   | EL PASO    | 17-023205 | WEB      |        |

Figure 4.9: CRIS Results

The crash database in the Czech Republic operates differently from that in Texas. As mentioned in Section 3.2, the Traffic Accidents in the Czech Republic website (https://nehody.cdv.cz/) is a public database managed by the Ministry of Transport of the Czech Republic. It provides statistical data on traffic accidents that occur in the country, and users can filter data by location, date, time or even type of accident. Figure 4.10 depicts the homepage of the Traffic Accidents in the Czech Republic website, which provides access to crash data from the entire country. However, as shown in another screenshot of the same website (4.11), all data is provided solely in the Czech language, which may present challenges for non-Czech speakers seeking to use or analyze the data.



Welcome to the website of Traffic accidents in the Czech Republic. The application is intended for professionals and the general public and offers a statistical evaluation of traffic accidents since 2006. In the Statistics section, the user can filter accidents on the basis of temporal or spatial location and according to 64 parameters recorded by the Police of the Czech Republic. The result can be exported to pdf. The data is updated once a month.

#### Last data update: 31/03/2023

The interactive graphic below on this page provides basic statistical data on traffic accidents in the Czech Republic since 2011. Filters are available in the left part, after marking which the graphs will adapt to the selected filters. It is possible to mark any number of filters even in one category (e.g. mark several regions).



Figure 4.10: Traffic Accidents in the Czech Republic Website



Figure 4.11: Traffic Accidents in the Czech Republic Website Data

Both the CRIS and Traffic Accidents in the Czech Republic website serve information sources on crash data, and allow users to filter and download data. However, the restrictions on the CRIS database are imposed to safeguard the personal and detailed information on the CR-3 forms, which are not publicly available. Conversely, the Traffic of Accidents in the Czech Republic website is a public platform that provides access to statistical data on traffic accidents, but in some cases may lack important detailed information on the type of accident and fault attribution.

## 4.3 CRASH TYPES, CRASH SEVERITIES, COLLISION DIAGRAMS

The frequency of crash types may vary depending on the location of analysis; never the less, the classification of crashes in both Texas and the Czech Republic is comparable. The crashes are classified as follows:

- Side Swipe
- Rear End
- Reversing
- Fixed Object
- Pedestrians
- Right Angle
- Head On
- Out of Control
- Left Turn
- Pedestrian
- Cyclist

Moreover, the Vítězné Náměstí Roundabout, which is a major public transportation hub,

adds two unique types of collisions to the analysis involving:

- Tram and Vehicles
- Tram and Pedestrians

Both the Czech Republic and Texas classify their crash data by severity, but they differ in the levels of severity. In the Czech Republic, severities are categorized as follow:

- Fatalities
- Severe Injuries
- Minor Injuries
- Material Damage

On the other hand, Texas categorizes accident severities in the following levels:

- Fatal Injury
- Suspected Serious Injury
- Possible Injury
- Suspected Minor Injury
- Not Injured
- Unknown

Collision diagrams may differ depending on the practices and regulations in each location. For this analysis, the crash diagram template used is based on a Texas template provided by the City of El Paso. This template includes a designated key section that describes the meaning of the symbols used in the drawing for better understanding. Additionally, this template includes the date, time and case ID next to the drawing, as shown in Figure 4.13 to ensure easy identification of each crash. A visual representation of this template can be found in Figure 4.12 on the following page.



Figure 4.12: Collision Diagram Template (Texas)



Figure 4.13: Data information on collision diagram

To obtain information on Czech collision diagrams for this master thesis, an example of a conflict diagram was provided as there was no access to any Czech collision diagrams. Conflict diagrams are similar to collision diagrams, but instead of depicting actual crashes, they display conflict areas. The diagram (Figure 4.14) depicts a roundabout with various connected streets and used arrows to indicate the type of accidents similar to the Texas template. However, the presentation of information in the Czech collision diagram is different. The diagram displays the number of accidents categorized by levels.



Figure 4.14: Example of Conflict Drawing (Kocourek, 2023)

Dr. Josef Kocourek introduced the concept of conflict severity used in Figure 4.14, which

includes the following examples as shown in Figure 4.15:

- Level 0: This involves a minor conflict, such as a car occupying the cyclist lane or a truck not opening enough for a turn.
- Level 1: This occurs when cars obstruct a sidewalk, but the pedestrian still manages to cross the street
- Level 2: This includes a car scraping another car
- Level 3: This refers to a near accident situation in which the car was able to stop.
- Level 4: This is an actual crash





Figure 4.15: Levels of Severity (Kocourek, 2023)

## 4.4 Cost of Crashes

During the cost analysis conducted in this thesis, a significant difference between Texas and the Czech Republic's crash data analysis was observed. Texas has a feature known as the reduction factor, which was identified due to previous experience in analyzing Texas crash data. The reduction factor is a percentage of crashes that can be avoided by implementing a countermeasures. The reduction factor varies depending on the safety improvement. Table 4.4 presents a list of crash countermeasures along with their corresponding reduction factors, which were collected from the Highway Safety Improvement Program Guidelines published by the Texas Department of Transportation in 2021. In contrast, the Czech Republic does not have an equivalent feature to the reduction factor.

| Crash Countermeasures                | <b>Reduction Factor</b> |
|--------------------------------------|-------------------------|
| Install Pedestrian Crosswalk         | 10%                     |
| Construct Pedestrian Over/Under Pass | 95%                     |
| Increase Turning Radius              | 10%                     |
| Add Right Turn Lane                  | 25%                     |
| Lengthen Left Turn Lane              | 40%                     |
| Widen Lane(s)                        | 30%                     |
| Construct a Roundabout               | 62%                     |

#### Table 4.4: Reduction Factor Example (TxDOT, 2021)

#### **Chapter 5: Conclusion**

#### 5.1 SUMMARY OF WORK

This thesis presents an evaluation of the crash data collection system in the Czech Republic, with a specific case study conducted in Prague. A comprehensive review of crash data collection was conducted, comparing the approaches taken by both Texas and the Czech Republic. The Vítězné Náměstí Roundabout was selected as the case study area due to its complexity and unique design. Traffic accident data from 2016 to 2022 was collected and analyzed, resulting in a proposed safety improvement in collaboration with Lauren Brown, who specialized in traffic analysis at Vítězné Náměstí. The proposed improvement is the implementation of a two-lane roundabout based on U.S design guidelines, and a benefit cost analysis was performed to assess its potential impact. A comparative assessment was also conducted, comparing crash records forms, databases, crash types and severities, and collision diagrams. Notably, the Czech Republic lacks a reduction factor which is an important factor in the benefit-cost analyses in the United States.

#### **5.2 RECOMMENDATIONS**

The availability of publicly crash data is a notable advantage of the Czech Republic's data collection system compared to Texas. However, the efficacy of Texas' method, which employs the CR-3 form, is noteworthy. Thus, a recommendation would be to introduce a similar form in the Czech Republic, with a clear narrative description from police officers to ensure the accuracy of crash data. Furthermore, it is recommended to incorporate reduction factors in the analysis, as their inclusion can enhance the precision of benefit cost analysis.

#### **5.3 CONTRIBUTIONS**

This master thesis makes important contributions to the field of traffic safety by providing a comprehensive assessment of the Czech Republic's crash data collection system and proposing improvement plan for a high-risk traffic area in Prague. By comparing the Czech Republic's crash data collection method to Texas, this study offers valuable insights into how the collection method can be improved in the Czech Republic. These contributions have significant implications for improving the overall accuracy and efficiency of crash data collection, which in turn can help inform evidence-based traffic safety policies and interventions

#### 5.4 LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

Although this study has contributed significantly to the understanding of the crash data collection system in the Czech Republic, it is important to acknowledge its limitations. One major challenge was the language barrier, as the crash data was only available in Czech and the use of machine translation tools like Google Translate did not always provide accurate translations, hindering proper data analysis. Additionally, the lack of precision in the crash data posed a
challenge in categorizing accidents by type, and some crashes could not be clearly categorized, making them unsuitable for further analysis.

The findings of this study open several avenues for future research. One possible direction could be to evaluate the effectiveness of the proposed safety improvement at Vítězné Náměstí and to further refine it based on the results. Additionally, future studies could focus on investigating the benefits and challenges of adopting a reduction factor in the Czech Republic's benefit-cost analyses. Another possible future study could focus on the development of a standardized crash data collection system. Furthermore, there is a potential for future research to investigate the benefits of incorporating emerging technologies such as artificial intelligence and machine learning into crash data analysis to improve accuracy and efficiency. Such studies could help to advance the understanding of crash data collection and improve road safety in the Czech Republic and beyond.

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### Appendix A

This appendix lists collision diagrams for Vitezne Namesti Roundabout. Each year has 4 collision diagrams, arranged in the following order:

- Quadrant 1: North East (crashes that occur from January 1 to December 31)
- Quadrant 2 North West (crashes that occur from January 1 to December 31)
- Quadrant 3 South West (crashes that occur from January 1 to December 31)
- Quadrant 4 South East (crashes that occur from January 1 to December 31)

#### A.1 2016 COLLISION DIAGRAM









#### A.2 2017 COLLISION DIAGRAM









#### A.3 2018 COLLISION DIAGRAM









#### A.4 2019 COLLISION DIAGRAM









#### A.5 2020 COLLISION DIAGRAM









#### A.6 2021 COLLISION DIAGRAM









### A.7 2022 COLLISION DIAGRAM









# Appendix B

This appendix list screenshots of the excel used for all the calculations performed in this analysis.

### B.1 CRASH DATA BY ACCIDENT TYPE AND SEVERITY

| 2010   |  |  |   |  |   |   |   |
|--|--|--|---|--|---|---|---|
|  | Side Swipe   | Rear End   | Reversing   | Fixed Object   | Pedestrians   | Right Angle   | Total   |
| Fatalities   | 0  | 0  | 0   | 0  | 0   | 0   | 0   |
| Severe Injuries  | 0  | 0  | 0   | 0  | 0   | 0   | 0   |
| Minor Injuries   | 0  | 1  | 0   | 0  | 1   | 0   | 2   |
| Material Damage  | 28   | 19   | 3   | 0  | 0   | 2   | 52  |
| TOTAL  |  |  |   |  |   |   | 54  |
|  |  |  |   |  |   |   |   |
| 2017   |  |  |   |  |   |   |   |
|  | Side Swipe   | Rear End   | Reversing   | Fixed Object   | Pedestrians   | Right Angle   | Total   |
| Fatalities   | 0  | 0  | 0   | 0  | 0   | 0   | 0   |
| Severe Injuries  | 0  | 0  | 0   | 0  | 0   | 0   | 0   |
| Minor Injuries   | 0  | 0  | 0   | 0  | 4   | 0   | 4   |
| Material Damage  | 27   | 8  | 2   | 0  | 0   | 2   | 39  |
| TOTAL  |  |  |   |  |   |   | 43  |
|  |  |  |   |  |   |   |   |
| 2018   |  |  |   |  |   |   |   |
|  | Side Swipe   | Rear End   | Reversing   | Fixed Object   | Pedestrians   | Right Angle   | Total   |
| Fatalities   | 0  | 0  | 0   | 0  | 0   | 0   | 0   |
| Severe Injuries  | 0  | 0  | 0   | 0  | 0   | 0   | 0   |
| Minor Injuries   | 0  | 0  | 0   | 0  | 4   | 0   | 4   |
| Material Damage  | 14   | 11   | 2   | 0  | 2   | 0   | 29  |
| TOTAL  |  |  |   |  |   |   | 33  |
|  |  |  |   |  |   |   |   |
| 2019   |  |  |   |  |   |   |   |
|  | Side Swipe   | Rear End   | Reversing   | Fixed Object   | Pedestrians   | Right Angle   | Total   |
|  | · · · · · · · · · · · · · · · · · · ·  |  | -   | -  |   |   |   |
| Fatalities   | 0  | 0  | 0   | 0  | 0   | 0   | 0   |
| Severe Injuries  | 0  | 0  | 0   | 0  | 0   | 0   | 0   |
| Severe Injuries<br>Minor Injuries  | 0<br>0<br>0  | 0  | 0   | 0<br>0<br>0  | 0<br>0<br>2   | 0   | 0<br>0<br>3   |
| Severe Injuries<br>Minor Injuries<br>Material Damage   | 0<br>0<br>0<br>23  | 0<br>0<br>1<br>16  | 0<br>0<br>0   | 0<br>0<br>0<br>2   | 0<br>0<br>2<br>1  | 0<br>0<br>0<br>0<br>0<br>2  | 0<br>0<br>3<br>45   |
| Severe Injuries<br>Minor Injuries<br>Material Damage<br>TOTAL  | 0<br>0<br>0<br>23  | 0<br>0<br>1<br>16  | 0<br>0<br>0<br>1  | 0<br>0<br>0<br>2   | 0<br>0<br>2<br>1  | 0<br>0<br>0<br>0<br>2   | 0<br>0<br>3<br>45<br>48   |
| Severe Injuries<br>Minor Injuries<br>Material Damage<br>TOTAL  | 0<br>0<br>23   | 0<br>0<br>1<br>16  | 0<br>0<br>0<br>1  | 0<br>0<br>0<br>2   | 0<br>0<br>2<br>1  | 0<br>0<br>0<br>0<br>2   | 0<br>0<br>3<br>45<br>48   |
| Severe Injuries<br>Minor Injuries<br>Material Damage<br>TOTAL<br>2020  | 0<br>0<br>23   | 0<br>0<br>1<br>16  | 0<br>0<br>0<br>1  | 0<br>0<br>0<br>2   | 0<br>0<br>2<br>1  | 0   | 0<br>0<br>3<br>45<br>48   |
| Severe Injuries<br>Minor Injuries<br>Material Damage<br>TOTAL<br>2020  | 0<br>0<br>23<br>Side Swipe   | 0<br>0<br>1<br>16<br>Rear End  | 0<br>0<br>1<br>Reversing  | 0<br>0<br>2<br>Fixed Object  | 0<br>0<br>2<br>1<br>Pedestrians   | 0<br>0<br>0<br>2<br>Right Angle   | 0<br>0<br>3<br>45<br>48<br>Total  |
| Severe Injuries<br>Minor Injuries<br>Material Damage<br>TOTAL<br>2020<br>Fatalities  | 0<br>0<br>23<br>Side Swipe<br>0  | 0<br>0<br>1<br>16<br>  | 0<br>0<br>1<br>Reversing<br>0   | 0<br>0<br>2<br>Fixed Object<br>0   | 0<br>0<br>2<br>1<br>Pedestrians<br>0  | 0<br>0<br>0<br>0<br>2<br>Right Angle<br>0   | 0<br>0<br>3<br>45<br>48<br>Total<br>0   |
| Severe Injuries<br>Minor Injuries<br>Material Damage<br>TOTAL<br>2020<br>Fatalities<br>Severe Injuries   | 0<br>0<br>23<br>Side Swipe<br>0<br>0   | 0<br>0<br>1<br>16<br>  | 0<br>0<br>1<br>Reversing<br>0<br>0  | 0<br>0<br>2<br>Fixed Object<br>0<br>0  | 0<br>0<br>2<br>1<br>9<br>Pedestrians<br>0<br>0  | 0<br>0<br>0<br>0<br>2<br>Right Angle<br>0<br>0  | 0<br>0<br>3<br>45<br>48<br>Total<br>0<br>0  |
| Severe Injuries<br>Minor Injuries<br>Material Damage<br>TOTAL<br>2020<br>Fatalities<br>Severe Injuries<br>Minor Injuries   | 0<br>0<br>23<br>Side Swipe<br>0<br>0<br>0  | 0<br>0<br>1<br>16<br>  | 0<br>0<br>1<br>Reversing<br>0<br>0<br>0   | 0<br>0<br>2<br>Fixed Object<br>0<br>0<br>0   | 0<br>0<br>2<br>1<br>9<br>Pedestrians<br>0<br>0<br>0<br>0  | 0<br>0<br>0<br>0<br>2<br>Right Angle<br>0<br>0<br>0<br>0  | 0<br>0<br>3<br>45<br>48<br>Total<br>0<br>0<br>1   |
| Fatalities   Severe Injuries   Minor Injuries   Material Damage   TOTAL   2020   Fatalities   Severe Injuries   Minor Injuries   Minor Injuries   Material Damage  | 0<br>0<br>23<br>Side Swipe<br>0<br>0<br>0<br>14  | 0<br>0<br>1<br>16<br>  | 0<br>0<br>1<br>1<br>Reversing<br>0<br>0<br>0<br>3   | 0<br>0<br>2<br>Fixed Object<br>0<br>0<br>0<br>0  | 0<br>0<br>2<br>1<br>9<br>Pedestrians<br>0<br>0<br>0<br>0<br>0   | 0<br>0<br>0<br>0<br>2<br>2<br>Right Angle<br>0<br>0<br>0<br>0<br>0  | 0<br>0<br>3<br>45<br>48<br>Total<br>0<br>0<br>1<br>1<br>22  |
| Fatalities<br>Severe Injuries<br>Material Damage<br>TOTAL<br>2020<br>Fatalities<br>Severe Injuries<br>Minor Injuries<br>Material Damage<br>TOTAL   | 0<br>0<br>23<br>Side Swipe<br>0<br>0<br>0<br>14  | 0<br>0<br>1<br>16<br>  | 0<br>0<br>1<br>Reversing<br>0<br>0<br>0<br>3  | 0<br>0<br>2<br>Fixed Object<br>0<br>0<br>0<br>0  | 0<br>0<br>2<br>1<br>9<br>Pedestrians<br>0<br>0<br>0<br>0<br>0<br>0  | 0<br>0<br>0<br>0<br>2<br>2<br>Right Angle<br>0<br>0<br>0<br>0<br>0  | 0<br>0<br>3<br>45<br>48<br>Total<br>0<br>0<br>0<br>1<br>22<br>23  |
| Severe Injuries<br>Minor Injuries<br>Material Damage<br>TOTAL<br>2020<br>Fatalities<br>Severe Injuries<br>Minor Injuries<br>Material Damage<br>TOTAL   | 0<br>0<br>23<br>Side Swipe<br>0<br>0<br>0<br>14  | 0<br>0<br>1<br>16<br>  | 0<br>0<br>1<br>Reversing<br>0<br>0<br>0<br>3<br>3   | 0<br>0<br>2<br>Fixed Object<br>0<br>0<br>0<br>0  | 0<br>0<br>2<br>1<br>9<br>Pedestrians<br>0<br>0<br>0<br>0<br>0   | 0<br>0<br>0<br>0<br>2<br>2<br>Right Angle<br>0<br>0<br>0<br>0   | 0<br>0<br>3<br>45<br>48<br>Total<br>0<br>0<br>0<br>1<br>22<br>23  |
| Severe Injuries<br>Minor Injuries<br>Material Damage<br>TOTAL<br>2020<br>Fatalities<br>Severe Injuries<br>Minor Injuries<br>Material Damage<br>TOTAL<br>2021   | 0<br>0<br>23<br>Side Swipe<br>0<br>0<br>0<br>14  | 0<br>0<br>1<br>16<br>8<br>8<br>8<br>8<br>7<br>8<br>7<br>7<br>7<br>7<br>7<br>7<br>7<br>7<br>7<br>7<br>7<br>7<br>7                               | 0<br>0<br>1<br>Reversing<br>0<br>0<br>0<br>3<br>3   | 0<br>0<br>2<br>Fixed Object<br>0<br>0<br>0<br>0  | 0<br>0<br>2<br>1<br>9<br>Pedestrians<br>0<br>0<br>0<br>0<br>0   | 0<br>0<br>0<br>0<br>2<br>2<br>Right Angle<br>0<br>0<br>0<br>0   | 0<br>0<br>3<br>45<br>48<br>Total<br>0<br>0<br>0<br>1<br>1<br>22<br>23   |
| Severe Injuries<br>Minor Injuries<br>Material Damage<br>TOTAL<br>2020<br>Fatalities<br>Severe Injuries<br>Minor Injuries<br>Material Damage<br>TOTAL<br>2021   | 0<br>0<br>23<br>Side Swipe<br>0<br>0<br>0<br>14<br>Side Swipe                          | 0<br>0<br>1<br>16<br>7<br>8ear End<br>0<br>0<br>0<br>1<br>1<br>5<br>7<br>8ear End  | 0<br>0<br>1<br>1<br>Reversing<br>0<br>0<br>0<br>0<br>3<br>3<br>Reversing                          | 0<br>0<br>0<br>2<br>Fixed Object<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0  | 0<br>0<br>2<br>1<br>Pedestrians<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0   | Right Angle   | 0<br>0<br>3<br>45<br>48<br>Total<br>0<br>0<br>1<br>1<br>22<br>23<br>7<br>0tal                                 |
| Fatalities<br>Severe Injuries<br>Material Damage<br>TOTAL<br>2020<br>Fatalities<br>Severe Injuries<br>Minor Injuries<br>Material Damage<br>TOTAL<br>2021<br>Fatalities   | 0<br>0<br>23<br>Side Swipe<br>0<br>0<br>0<br>14<br>Side Swipe<br>0                     | 0<br>0<br>1<br>16<br>  | 0<br>0<br>1<br>1<br>Reversing<br>0<br>0<br>0<br>0<br>3<br>3<br>Reversing<br>0                     | 0<br>0<br>2<br>7<br>7<br>7<br>7<br>7<br>7<br>7<br>7<br>7<br>7<br>7<br>7<br>7<br>7<br>7<br>7<br>7   | 0<br>0<br>2<br>1<br>1<br>Pedestrians<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0 | 0<br>0<br>0<br>0<br>2<br>2<br>Right Angle<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0  | 0<br>0<br>3<br>45<br>48<br>Total<br>0<br>0<br>1<br>1<br>22<br>23<br>23<br>Total<br>0                          |
| Severe Injuries<br>Material Damage<br>TOTAL<br>2020<br>Fatalities<br>Severe Injuries<br>Minor Injuries<br>Material Damage<br>TOTAL<br>2021<br>Fatalities<br>Severe Injuries  | 0<br>0<br>23<br>Side Swipe<br>0<br>0<br>0<br>14<br>Side Swipe<br>0<br>0                | 0<br>0<br>1<br>16<br>  | 0<br>0<br>1<br>1<br>Reversing<br>0<br>0<br>0<br>0<br>3<br>3<br>Reversing<br>0<br>0<br>0<br>0      | 0<br>0<br>2<br>7<br>7<br>7<br>7<br>7<br>7<br>7<br>7<br>7<br>7<br>7<br>7<br>7<br>7<br>7<br>7<br>7   | 0<br>0<br>2<br>1<br>1<br>Pedestrians<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0 | 0   0     0   0     0   0     2   0     Right Angle   0     0   0     0   0     0   0     0   0     0   0     0   0     0   0     0   0     0   0     0   0     0   0     1   0 | 0<br>0<br>3<br>45<br>48<br>7<br>0<br>0<br>0<br>1<br>1<br>22<br>23<br>23<br>7<br>0<br>0<br>2                   |
| Severe Injuries<br>Minor Injuries<br>Material Damage<br>TOTAL<br>2020<br>Fatalities<br>Severe Injuries<br>Material Damage<br>TOTAL<br>2021<br>Fatalities<br>Severe Injuries<br>Material Damage<br>TOTAL<br>2021<br>Fatalities<br>Severe Injuries<br>Minor Injuries   | 0<br>0<br>23<br>Side Swipe<br>0<br>0<br>0<br>14<br>Side Swipe<br>0<br>0<br>0<br>0<br>0 | 0<br>0<br>1<br>16<br>  | 0<br>0<br>1<br>1<br>Reversing<br>0<br>0<br>0<br>3<br>3<br>Reversing<br>0<br>0<br>0<br>0<br>0<br>0 | 0<br>0<br>2<br>2<br>Fixed Object<br>0<br>0<br>0<br>0<br>5<br>Fixed Object<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0 | 0<br>0<br>2<br>1<br>1<br>Pedestrians<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0 | 0   0     0   0     0   0     2   0     Right Angle   0     0   0     0   0     0   0     0   0     0   0     0   0     0   0     0   0     0   0     1   0                     | 0<br>0<br>3<br>45<br>48<br>Total<br>0<br>0<br>1<br>1<br>22<br>23<br>7<br>0<br>7<br>0<br>1<br>0<br>0<br>2<br>0 |
| Fatalities   Severe Injuries   Minor Injuries   Material Damage   TOTAL   2020   Fatalities   Severe Injuries   Minor Injuries   Material Damage   TOTAL   2020   Fatalities   Severe Injuries   Material Damage   TOTAL   2021   Fatalities   Severe Injuries   Minor Injuries   Minor Injuries   Minor Injuries   Minor Injuries   Material Damage | 0<br>0<br>23<br>Side Swipe<br>0<br>0<br>0<br>14<br>Side Swipe<br>0<br>0<br>0<br>17     | 0<br>0<br>1<br>16<br>0<br>0<br>0<br>0<br>1<br>1<br>5<br>5<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>7<br>8<br>9<br>0<br>0<br>0<br>0<br>0<br>0<br>3 | 0<br>0<br>1<br>1<br>Reversing<br>0<br>0<br>0<br>3<br>3<br>Reversing<br>0<br>0<br>0<br>0<br>4      | 0<br>0<br>0<br>2<br>7<br>Fixed Object<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0                                     | 0<br>0<br>2<br>1<br>1<br>Pedestrians<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0 | 0   0     0   0     0   0     2   0     Right Angle   0     0   0     0   0     0   0     0   0     0   0     0   0     0   0     0   0     0   0     1   0     1   0           | 0<br>0<br>3<br>45<br>48<br>Total<br>0<br>0<br>1<br>1<br>22<br>23<br>7<br>0<br>1<br>0<br>2<br>0<br>0<br>28     |

| ES |
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|    |

| 2016        |                |              |               |                  |                 |                 |
|-------------|----------------|--------------|---------------|------------------|-----------------|-----------------|
|             | Side Swipe (%) | Rear End (%) | Reversing (%) | Fixed Object (%) | Pedestrians (%) | Right Angle (%) |
| Fatalities  | 0              | 0            | 0             | 0                | 0               | 0               |
| Severe Inju | 0              | 0            | 0             | 0                | 0               | 0               |
| Minor Inju  | 0.00           | 1.85         | 0             | 0                | 1.85            | 0               |
| Material D  | 51.85          | 35.19        | 5.56          | 0                | 0               | 3.70            |
|             |                |              |               |                  |                 |                 |
|             |                |              |               |                  |                 |                 |
| 2017        |                |              |               |                  |                 |                 |
|             | Side Swipe (%) | Rear End (%) | Reversing (%) | Fixed Object (%) | Pedestrians (%) | Right Angle (%) |
| Fatalities  | 0              | 0            | 0             | 0                | 0               | 0               |
| Severe Inju | 0              | 0            | 0             | 0                | 0               | 0               |
| Minor Inju  | 0              | 0            | 0             | 0                | 9.30            | 0               |
| Material D  | 62.79          | 18.60        | 4.65          | 0                | 0               | 4.65            |
|             |                |              |               |                  |                 |                 |
|             |                |              |               |                  |                 |                 |
| 2018        |                |              |               |                  |                 |                 |
|             | Side Swipe (%) | Rear End (%) | Reversing (%) | Fixed Object (%) | Pedestrians (%) | Right Angle (%) |
| Fatalities  | 0              | 0            | 0             | 0                | 0               | 0               |
| Severe Inju | 0              | 0            | 0             | 0                | 0               | 0               |
| Minor Inju  | 0              | 0            | 0             | 0                | 12.12           | 0               |
| Material D  | 42.42          | 33.33        | 6.06          | 0                | 6.06            | 0               |
|             |                |              |               |                  |                 |                 |
|             |                |              |               |                  |                 |                 |
| 2019        |                |              |               |                  |                 |                 |
|             | Side Swipe (%) | Rear End (%) | Reversing (%) | Fixed Object (%) | Pedestrians (%) | Right Angle (%) |
| Fatalities  | 0              | 0            | 0             | 0                | 0               | 0               |
| Severe Inju | 0              | 0            | 0             | 0                | 0               | 0               |
| Minor Inju  | 0              | 2.08         | 0             | 0                | 4.17            | 0               |
| Material D  | 47.92          | 33.33        | 2.08          | 4.17             | 2.08            | 4.17            |
|             |                |              |               |                  |                 |                 |
|             |                |              |               |                  |                 |                 |
| 2020        |                |              |               |                  |                 |                 |
|             | Side Swipe (%) | Rear End (%) | Reversing (%) | Fixed Object (%) | Pedestrians (%) | Right Angle (%) |
| Fatalities  | 0              | 0            | 0             | 0                | 0               | 0               |
| Severe Inju | 0              | 0            | 0             | 0                | 0               | 0               |
| Minor Inju  | 0              | 4.35         | 0             | 0                | 0               | 0               |
| Material D  | 60.87          | 21.74        | 13.04         | 0                | 0               | 0               |
|             |                |              |               |                  |                 |                 |
|             |                |              |               |                  |                 |                 |
| 2021        |                |              |               |                  |                 |                 |
|             | Side Swipe (%) | Rear End (%) | Reversing (%) | Fixed Object (%) | Pedestrians (%) | Right Angle (%) |
| Fatalities  | 0              | 0            | 0             | 0                | 0               | 0               |
| Severe Inju | 0              | 0            | 0             | 0                | 1               | 3.33            |
| Minor Inju  | 0              | 0            | 0             | 0                | 0               | 0               |
| Material D  | 56.67          | 10.00        | 13.33         | 10.00            | 0               | 3.33            |

### **B.3** COST PER ACCIDENT

| 2016             |                     |                        |                         |               |                       |
|------------------|---------------------|------------------------|-------------------------|---------------|-----------------------|
| Severity         | Number of Accidents | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc)    | Total (USD)           |
| Fatalities       | 0                   | 19,411,000             | 860,989                 | 0             | 0                     |
| Severe Injuries  | 0                   | 5,094,200              | 225,957                 | 0             | 0                     |
| Minor Injuries   | 2                   | 668,500                | 29,652                  | 1,337,000     | 59,304                |
| Material Damage  | 52                  | 364,500                | 16,168                  | 18,954,000    | 840,719               |
| TOTAL            |                     |                        |                         | 20,291,000.00 | 900,022               |
|                  |                     |                        |                         |               |                       |
| 2017             |                     |                        |                         |               |                       |
| Severity         | Number of Accidents | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc)    | Total (USD)           |
| Fatalities       | 0                   | 19,784,000             | 877,534                 | 0             | 0                     |
| Severe Injuries  | 0                   | 5,097,500              | 226,103                 | 0             | 0                     |
| Minor Injuries   | 4                   | 716,700                | 31,790                  | 2,866,800.00  | 127,159               |
| Material Damage  | 39                  | 386,400                | 17,139                  | 15,069,600.00 | 668,423               |
| TOTAL            |                     |                        |                         | 17,936,400.00 | 795,582               |
|                  |                     |                        |                         |               |                       |
| 2018             |                     |                        |                         |               |                       |
| Severity         | Number of Accidents | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc)    | Total (USD)           |
| Fatalities       | 0                   | 22,534,000             | 999,512                 | 0             | 0                     |
| Severe Injuries  | 0                   | 5,983,000              | 265,380                 | 0             | 0                     |
| Minor Injuries   | 4                   | 739,700                | 32,810                  | 2,958,800     | 131,240               |
| Material Damage  | 29                  | 389,800                | 17,290                  | 11,304,200    | 501,406               |
| TOTAL            |                     |                        |                         | 14,263,000    | 632,646               |
|                  |                     |                        |                         |               |                       |
| 2019             |                     |                        |                         |               |                       |
| Severity         | Number of Accidents | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc)    | Total (USD)           |
| Fatalities       | 0                   | 25,041,000             | 1,110,712               | 0             | 0                     |
| Severe Injuries  | 0                   | 5,567,000              | 246,928                 | 0             | 0                     |
| Minor Injuries   | 3                   | 809,000                | 35,884                  | 2,427,000     | 107,651               |
| Material Damage  | 45                  | 405,000                | 17,964                  | 18,225,000    | 808,383               |
| TOTAL            |                     |                        |                         | 20,652,000    | 916,035               |
|                  |                     |                        |                         |               |                       |
| 2020             |                     |                        |                         |               |                       |
| Severity         | Number of Accidents | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc)    | Total (USD)           |
| Fatalities       | 0                   | 35,021,000             | 1,553,382               | 0             | 0                     |
| Severe Injuries  | 0                   | 5,800,000              | 257,263                 | 0             | 0                     |
| Minor Injuries   | 1                   | 603,300                | 26,760                  | 603,300       | 26,760                |
| Material Damage  | 22                  | 415,800                | 18,443                  | 9,147,600     | 405,749               |
| TOTAL            |                     |                        |                         | 9,750,900     | 432,508               |
| 2021             |                     |                        |                         |               |                       |
| 2021<br>Covority | Number of Accidents | Cost Per Accident (Ka) | Cost Per Accident (USD) | Total (Kc)    |                       |
| Fatalitios       |                     | 58 235 000             | 2 583 056               |               |                       |
|                  | 2                   | 12 211 000             | 541 678                 | 24 422 000    | 1 083 256             |
| Minor Injuries   | 0                   | 713 500                | 31 648                  | Ω             | <u>1,003,230</u><br>Λ |
| Material Damage  | 28                  | 474 800                | 21,040                  | 13 294 400    | 589 683               |
|                  | 20                  | טטט,דיד                | 21,000                  | 37 716 400    | 1 672 939             |
| TOTAL            |                     |                        |                         | 57,710,400    | 1,072,535             |

## **B.4** COST PER ACCIDENT (SIDE SWIPE)

| 2016            |            |                        |                         |            |             |
|-----------------|------------|------------------------|-------------------------|------------|-------------|
|                 | Side Swipe | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0          | 19,411,000             | 860,989                 | 0          | 0           |
| Severe Injuries | 0          | 5,094,200              | 225,957                 | 0          | 0           |
| Minor Injuries  | 0          | 668,500                | 29,652                  | 0          | 0           |
| Material Damage | 28         | 364,500                | 16,168                  | 10,206,000 | 452,695     |
| Total           |            |                        |                         | 10,206,000 | 452,695     |
|                 |            |                        |                         |            |             |
| 2017            |            |                        |                         |            |             |
|                 | Side Swipe | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0          | 19,784,000             | 877,534                 | 0          | 0           |
| Severe Injuries | 0          | 5,097,500              | 226,103                 | 0          | 0           |
| Minor Injuries  | 0          | 716,700                | 31,790                  | 0          | 0           |
| Material Damage | 27         | 386,400                | 17,139                  | 10,432,800 | 462,754     |
| TOTAL           |            |                        |                         | 10,432,800 | 462,754     |
|                 |            |                        |                         |            |             |
| 2018            |            |                        |                         |            |             |
|                 | Side Swipe | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0          | 22,534,000             | 999,512                 | 0          | 0           |
| Severe Injuries | 0          | 5,983,000              | 265,380                 | 0          | 0           |
| Minor Injuries  | 0          | 739,700                | 32,810                  | 0          | 0           |
| Material Damage | 14         | 389,800                | 17,290                  | 5,457,200  | 242,058     |
| TOTAL           |            |                        |                         | 5,457,200  | 242,058     |
|                 |            |                        |                         |            |             |
| 2019            |            |                        |                         |            |             |
|                 | Side Swipe | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0          | 25,041,000             | 1,110,712               | 0          | 0           |
| Severe Injuries | 0          | 5,567,000              | 246,928                 | 0          | 0           |
| Minor Injuries  | 0          | 809,000                | 35,884                  | 0          | 0           |
| Material Damage | 23         | 405,000                | 17,964                  | 9,315,000  | 413,174     |
| TOTAL           |            |                        |                         | 9,315,000  | 413,174     |
|                 |            |                        |                         |            |             |
| 2020            |            |                        |                         |            |             |
|                 | Side Swipe | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0          | 35,021,000             | 1,553,382               | 0          | 0           |
| Severe Injuries | 0          | 5,800,000              | 257,263                 | 0          | 0           |
| Minor Injuries  | 0          | 603,300                | 26,760                  | 0          | 0           |
| Material Damage | 14         | 415,800                | 18,443                  | 5,821,200  | 258,204     |
| TOTAL           |            |                        |                         | 5,821,200  | 258,204     |
|                 |            |                        |                         |            |             |
| 2021            |            |                        |                         |            |             |
|                 | Side Swipe | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0          | 58,235,000             | 2,583,056               | 0          | 0           |
| Severe Injuries | 0          | 12,211,000             | 541,628                 | 0          | 0           |
| Minor Injuries  | 0          | 713,500                | 31,648                  | 0          | 0           |
| Material Damage | 17         | 474,800                | 21,060                  | 8,071,600  | 358,022     |
| TOTAL           |            |                        |                         | 8,071,600  | 358,022     |
## **B.5** Cost per Accident (Rear End)

| 2016            |          |                        |                         |            |             |
|-----------------|----------|------------------------|-------------------------|------------|-------------|
|                 | Rear End | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0        | 19,411,000             | 860,989                 | 0          | 0           |
| Severe Injuries | 0        | 5,094,200              | 225,957                 | 0          | 0           |
| Minor Injuries  | 1        | 668,500                | 29,652                  | 668,500    | 29,652      |
| Material Damage | 19       | 364,500                | 16,168                  | 6,925,500  | 307,186     |
| Total           |          |                        |                         | 7,594,000  | 336,837     |
|                 |          |                        |                         |            |             |
| 2017            |          |                        |                         |            |             |
|                 | Rear End | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0        | 19,784,000             | 877,534                 | 0          | 0           |
| Severe Injuries | 0        | 5,097,500              | 226,103                 | 0          | 0           |
| Minor Injuries  | 0        | 716,700                | 31,790                  | 0          | 0           |
| Material Damage | 8        | 386,400                | 17,139                  | 3,091,200  | 137,112     |
| TOTAL           |          |                        |                         | 3,091,200  | 137,112     |
|                 |          |                        |                         |            |             |
| 2018            |          |                        |                         |            |             |
|                 | Rear End | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0        | 22,534,000             | 999,512                 | 0          | 0           |
| Severe Injuries | 0        | 5,983,000              | 265,380                 | 0          | 0           |
| Minor Injuries  | 0        | 739,700                | 32,810                  | 0          | 0           |
| Material Damage | 11       | 389,800                | 17,290                  | 4,287,800  | 190,189     |
| TOTAL           |          |                        |                         | 4,287,800  | 190,189     |
|                 |          |                        |                         |            |             |
| 2019            |          |                        |                         |            |             |
|                 | Rear End | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0        | 25,041,000             | 1,110,712               | 0          | 0           |
| Severe Injuries | 0        | 5,567,000              | 246,928                 | 0          | 0           |
| Minor Injuries  | 1        | 809,000                | 35,884                  | 809,000    | 35,884      |
| Material Damage | 16       | 405,000                | 17,964                  | 6,480,000  | 287,425     |
| TOTAL           |          |                        |                         | 7,289,000  | 323,309     |
|                 |          |                        |                         |            |             |
| 2020            |          |                        |                         |            |             |
|                 | Rear End | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0        | 35,021,000             | 1,553,382               | 0          | 0           |
| Severe Injuries | 0        | 5,800,000              | 257,263                 | 0          | 0           |
| Minor Injuries  | 1        | 603,300                | 26,760                  | 603,300    | 26,760      |
| Material Damage | 5        | 415,800                | 18,443                  | 2,079,000  | 92,216      |
| TOTAL           |          |                        |                         | 2,682,300  | 118,975     |
|                 |          |                        |                         |            |             |
| 2021            |          |                        |                         |            |             |
|                 | Rear End | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0        | 58,235,000             | 2,583,056               | 0          | 0           |
| Severe Injuries | 0        | 12,211,000             | 541,628                 | 0          | 0           |
| Minor Injuries  | 0        | 713,500                | 31,648                  | 0          | 0           |
| Material Damage | 3        | 474,800                | 21,060                  | 1,424,400  | 63,180      |
| TOTAL           |          |                        |                         | 1,424,400  | 63,180      |

## **B.6** COST PER ACCIDENT (REVERSING)

| 2016            |           |                        |                         |            |             |
|-----------------|-----------|------------------------|-------------------------|------------|-------------|
|                 | Reversing | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0         | 19,411,000             | 860,989                 | 0          | 0           |
| Severe Injuries | 0         | 5,094,200              | 225,957                 | 0          | 0           |
| Minor Injuries  | 0         | 668,500                | 29,652                  | 0          | 0           |
| Material Damage | 3         | 364,500                | 16,168                  | 1,093,500  | 48,503      |
| Total           |           |                        |                         | 1,093,500  | 48,503      |
|                 |           |                        |                         |            |             |
| 2017            |           |                        |                         |            |             |
|                 | Reversing | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0         | 19,784,000             | 877,534                 | 0          | 0           |
| Severe Injuries | 0         | 5,097,500              | 226,103                 | 0          | 0           |
| Minor Injuries  | 0         | 716,700                | 31,790                  | 0          | 0           |
| Material Damage | 2         | 386,400                | 17,139                  | 772,800    | 34,278      |
| TOTAL           |           |                        |                         | 772,800    | 34,278      |
|                 |           |                        |                         |            |             |
| 2018            |           |                        |                         |            |             |
|                 | Reversing | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0         | 22,534,000             | 999,512                 | 0          | 0           |
| Severe Injuries | 0         | 5,983,000              | 265,380                 | 0          | 0           |
| Minor Injuries  | 0         | 739,700                | 32,810                  | 0          | 0           |
| Material Damage | 2         | 389,800                | 17,290                  | 779,600    | 34,580      |
| TOTAL           |           |                        |                         | 779,600    | 34,580      |
|                 |           |                        |                         |            |             |
| 2019            |           |                        |                         |            |             |
|                 | Reversing | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0         | 25,041,000             | 1,110,712               | 0          | 0           |
| Severe Injuries | 0         | 5,567,000              | 246,928                 | 0          | 0           |
| Minor Injuries  | 0         | 809,000                | 35,884                  | 0          | 0           |
| Material Damage | 1         | 405,000                | 17,964                  | 405000     | 17964.07186 |
| TOTAL           |           |                        |                         | 405000     | 17964.07186 |
|                 |           |                        |                         |            |             |
| 2020            |           |                        |                         |            |             |
|                 | Reversing | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0         | 35,021,000             | 1,553,382               | 0          | 0           |
| Severe Injuries | 0         | 5,800,000              | 257,263                 | 0          | 0           |
| Minor Injuries  | 0         | 603,300                | 26,760                  | 0          | 0           |
| Material Damage | 3         | 415,800                | 18,443                  | 1,247,400  | 55,329      |
| TOTAL           |           |                        |                         | 1,247,400  | 55,329      |
|                 |           |                        |                         |            |             |
| 2021            |           |                        |                         |            |             |
|                 | Reversing | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0         | 58,235,000             | 2,583,056               | 0          | 0           |
| Severe Injuries | 0         | 12,211,000             | 541,628                 | 0          | 0           |
| Minor Injuries  | 0         | 713,500                | 31,648                  | 0          | 0           |
| Material Damage | 4         | 474,800                | 21,060                  | 1,899,200  | 84,240      |
| TOTAL           |           |                        |                         | 1,899,200  | 84,240      |

# **B.7** COST PER ACCIDENT (FIXED OBJECT)

| 2016              |              |                        |                         |             |             |
|-------------------|--------------|------------------------|-------------------------|-------------|-------------|
|                   | Fixed Object | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc)  | Total (USD) |
| Fatalities        | 0            | 19,411,000             | 860,989                 | 0           | 0           |
| Severe Injuries   | 0            | 5,094,200              | 225,957                 | 0           | 0           |
| Minor Injuries    | 0            | 668,500                | 29,652                  | 0           | 0           |
| Material Damage   | 0            | 364,500                | 16,168                  | 0           | 0           |
| Total             |              |                        |                         | 0           | 0           |
|                   |              |                        |                         |             |             |
| 2017              |              |                        |                         |             |             |
|                   | Fixed Object | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc)  | Total (USD) |
| Fatalities        | 0            | 19,784,000             | 877,534                 | 0           | 0           |
| Severe Injuries   | 0            | 5,097,500              | 226,103                 | 0           | 0           |
| Minor Injuries    | 0            | 716,700                | 31,790                  | 0           | 0           |
| Material Damage   | 0            | 386,400                | 17,139                  | 0           | 0           |
| TOTAL             |              |                        |                         | 0           | 0           |
|                   |              |                        |                         |             |             |
| 2018              |              |                        |                         |             |             |
|                   | Fixed Object | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc)  | Total (USD) |
| Fatalities        | 0            | 22,534,000             | 999,512                 | 0           | 0           |
| Severe Injuries   | 0            | 5,983,000              | 265,380                 | 0           | 0           |
| Minor Injuries    | 0            | 739,700                | 32,810                  | 0           | 0           |
| Material Damage   | 0            | 389,800                | 17,290                  | 0           | 0           |
| TOTAL             |              |                        |                         | 0           | 0           |
|                   |              |                        |                         |             |             |
| 2019              |              |                        |                         |             |             |
|                   | Fixed Object | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc)  | Total (USD) |
| Fatalities        | 0            | 25,041,000             | 1,110,712               | 0           | 0           |
| Severe Injuries   | 0            | 5,567,000              | 246,928                 | 0           | 0           |
| Minor Injuries    | 0            | 809,000                | 35,884                  | 0           | 0           |
| Material Damage   | 2            | 405,000                | 17,964                  | 810,000     | 35,928      |
| TOTAL             |              |                        |                         | 810,000     | 35,928      |
|                   |              |                        |                         |             |             |
| 2020              |              |                        |                         |             |             |
|                   | Fixed Object | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc)  | Total (USD) |
| Fatalities        | 0            | 35,021,000             | 1,553,382               | 0           | 0           |
| Severe Injuries   | 0            | 5,800,000              | 257,263                 | 0           | 0           |
| Minor Injuries    | 0            | 603,300                | 26,760                  | 0           | 0           |
| Material Damage   | 0            | 415,800                | 18,443                  | 0           | 0           |
| TOTAL             |              |                        |                         | 0           | 0           |
|                   |              |                        |                         |             |             |
| 2021              |              |                        |                         |             | T (1.10D)   |
| Catalities        | Fixed Object | Cost Per Accident (Kc) | Cost Per Accident (USD) | i otal (Kc) | iotai (USD) |
|                   | 0            | 58,235,000             | 2,583,056               | 0           | 0           |
| Severe injuries   | 0            | 12,211,000             | 541,628                 | 0           | 0           |
| Ivinor injuries   | 0            | /13,500                | 31,648                  | 0           | 0           |
| Iviaterial Damage | 3            | 474,800                | 21,060                  | 1,424,400   | 63,180      |
|                   |              |                        |                         | 1,424,400   | 63,180      |

## **B.8** COST PER ACCIDENT (PEDESTRIANS)

| 2016            |             |                        |                         |            |             |
|-----------------|-------------|------------------------|-------------------------|------------|-------------|
|                 | Pedestrians | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0           | 19,411,000             | 860,989                 | 0          | 0           |
| Severe Injuries | 0           | 5,094,200              | 225,957                 | 0          | 0           |
| Minor Injuries  | 1           | 668,500                | 29,652                  | 668,500    | 29,652      |
| Material Damage | 0           | 364,500                | 16,168                  | 0          | 0           |
| Total           |             |                        |                         | 668,500    | 29,652      |
|                 |             |                        |                         |            |             |
| 2017            |             |                        |                         |            |             |
|                 | Pedestrians | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0           | 19,784,000             | 877,534                 | 0          | 0           |
| Severe Injuries | 0           | 5,097,500              | 226,103                 | 0          | 0           |
| Minor Injuries  | 4           | 716,700                | 31,790                  | 2,866,800  | 127,159     |
| Material Damage | 0           | 386,400                | 17,139                  | 0          | 0           |
| TOTAL           |             |                        |                         | 2,866,800  | 127,159     |
|                 |             |                        |                         |            |             |
| 2018            |             |                        |                         |            |             |
|                 | Pedestrians | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0           | 22,534,000             | 999,512                 | 0          | 0           |
| Severe Injuries | 0           | 5,983,000              | 265,380                 | 0          | 0           |
| Minor Injuries  | 4           | 739,700                | 32,810                  | 2,958,800  | 131,240     |
| Material Damage | 2           | 389,800                | 17,290                  | 779,600    | 34,580      |
| TOTAL           |             |                        |                         | 3,738,400  | 165,819     |
|                 |             |                        |                         |            |             |
| 2019            |             |                        |                         |            |             |
|                 | Pedestrians | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0           | 25,041,000             | 1,110,712               | 0          | 0           |
| Severe Injuries | 0           | 5,567,000              | 246,928                 | 0          | 0           |
| Minor Injuries  | 2           | 809,000                | 35,884                  | 1,618,000  | 71,768      |
| Material Damage | 1           | 405,000                | 17,964                  | 405,000    | 17,964      |
| TOTAL           |             |                        |                         | 2,023,000  | 89,732      |
|                 |             |                        |                         |            |             |
| 2020            |             |                        |                         |            |             |
|                 | Pedestrians | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0           | 35,021,000             | 1,553,382               | 0          | 0           |
| Severe Injuries | 0           | 5,800,000              | 257,263                 | 0          | 0           |
| Minor Injuries  | 0           | 603,300                | 26,760                  | 0          | 0           |
| Material Damage | 0           | 415,800                | 18,443                  | 0          | 0           |
| TOTAL           |             |                        |                         | 0          | 0           |
|                 |             |                        |                         |            |             |
| 2021            |             |                        |                         |            |             |
|                 | Pedestrians | Cost Per Accident (Kc) | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0           | 58,235,000             | 2,583,056               | 0          | 0           |
| Severe Injuries | 1           | 12,211,000             | 541,628                 | 12,211,000 | 541,628     |
| Minor Injuries  | 0           | 713,500                | 31,648                  | 0          | 0           |
| Material Damage | 0           | 474,800                | 21,060                  | 0          | 0           |
| TOTAL           |             |                        |                         | 12,211,000 | 541,628     |

## **B.9** COST PER ACCIDENT (RIGHT ANGLE)

| 2016            |             |   |                         |            |             |
|-----------------|-------------|---|-------------------------|------------|-------------|
|                 | Right Angle | Cost Per Accident (Kc)                  | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0           | 19,411,000                              | 860,989                 | 0          | 0           |
| Severe Injuries | 0           | 5,094,200                               | 225,957                 | 0          | 0           |
| Minor Injuries  | 0           | 668,500                                 | 29,652                  | 0          | 0           |
| Material Damage | 2           | 364,500                                 | 16,168                  | 729,000    | 32,335      |
| TOTAL           |             |   |                         | 729,000    | 32,335      |
|                 |             |   |                         |            |             |
| 2017            | ,           |   |                         |            |             |
|                 | Right Angle | Cost Per Accident (Kc)                  | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0           | 19,784,000                              | 877,534                 | 0          | 0           |
| Severe Injuries | 0           | 5,097,500                               | 226,103                 | 0          | 0           |
| Minor Injuries  | 0           | 716,700                                 | 31,790                  | 0          | 0           |
| Material Damage | 2           | 386,400                                 | 17,139                  | 772,800    | 34,278      |
| TOTAL           |             |   |                         | 772,800    | 34,278      |
|                 |             |   |                         |            |             |
| 2018            |             |   |                         |            |             |
|                 | Right Angle | Cost Per Accident (Kc)                  | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0           | 22,534,000                              | 999,512                 | 0          | 0           |
| Severe Injuries | 0           | 5,983,000                               | 265,380                 | 0          | 0           |
| Minor Injuries  | 0           | 739,700                                 | 32,810                  | 0          | 0           |
| Material Damage | 0           | 389,800                                 | 17,290                  | 0          | 0           |
| TOTAL           |             | , |                         | 0          | 0           |
|                 |             |   |                         |            |             |
| 2019            | )           |   |                         |            |             |
|                 | Right Angle | Cost Per Accident (Kc)                  | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0           | 25,041,000                              | 1,110,712               | 0          | 0           |
| Severe Injuries | 0           | 5,567,000                               | 246,928                 | 0          | 0           |
| Minor Injuries  | 0           | 809,000                                 | 35,884                  | 0          | 0           |
| Material Damage | 2           | 405,000                                 | 17,964                  | 810,000    | 35,928      |
| TOTAL           |             | · · · ·                                 |                         | 810,000    | 35,928      |
|                 |             |   |                         |            |             |
| 2020            |             |   |                         |            |             |
|                 | Right Angle | Cost Per Accident (Kc)                  | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0           | 35,021,000                              | 1,553,382               | 0          | 0           |
| Severe Injuries | 0           | 5,800,000                               | 257,263                 | 0          | 0           |
| Minor Injuries  | 0           | 603,300                                 | 26,760                  | 0          | 0           |
| Material Damage | 0           | 415,800                                 | 18,443                  | 0          | 0           |
| TOTAL           |             |   |                         | 0          | 0           |
|                 |             |   |                         |            |             |
| 2021            |             |   |                         |            |             |
|                 | Right Angle | Cost Per Accident (Kc)                  | Cost Per Accident (USD) | Total (Kc) | Total (USD) |
| Fatalities      | 0           | 58,235,000                              | 2,583,056               | 0          | 0           |
| Severe Injuries | 1           | 12,211,000                              | 541,628                 | 12,211,000 | 541,628     |
| Minor Injuries  | 0           | 713,500                                 | 31,648                  | 0          | 0           |
| Material Damage | 1           | 474,800                                 | 21,060                  | 474,800    | 21,060      |
| TOTAL           |             |   |                         | 12,685,800 | 562,688     |

#### **B.10 EXPECTED COST SAVINGS**

| 2016       |                              |                            |                             |
|------------|------------------------------|----------------------------|-----------------------------|
| Location   | Expected Reduction of Crases | Expected Cost Savings (Kc) | Expected Cost Savings (USD) |
| Quadrant 1 | 3                            | 1,093,500                  | 48,503                      |
| Quadrant 2 | 15                           | 5,467,500                  | 242,515                     |
| Quadrant 3 | 0                            | 0                          | 0                           |
| Quadrant 4 | 1                            | 364,500                    | 16,168                      |
|            |                              | 6,925,500                  | 307,186                     |
|            |                              |                            |                             |
| 2017       |                              |                            |                             |
| Location   | Expected Reduction of Crases | Expected Cost Savings (Kc) | Expected Cost Savings (USD) |
| Quadrant 1 | 0                            | 0                          | 0                           |
| Quadrant 2 | 11                           | 4,250,400                  | 188,530                     |
| Quadrant 3 | 0                            | 0                          | 0                           |
| Quadrant 4 | 0                            | 0                          | 0                           |
|            |                              | 4,250,400                  | 188,530                     |
|            |                              |                            |                             |
| 2018       |                              |                            |                             |
| Location   | Expected Reduction of Crases | Expected Cost Savings (Kc) | Expected Cost Savings (USD) |
| Quadrant 1 | 2                            | 779,600                    | 34,580                      |
| Quadrant 2 | 6                            | 2,338,800                  | 103,739                     |
| Quadrant 3 | 0                            | 0                          | 0                           |
| Quadrant 4 | 0                            | 0                          | 0                           |
|            |                              | 3,118,400                  | 138,319                     |
|            |                              |                            |                             |
| 2019       |                              |                            |                             |
| Location   | Expected Reduction of Crases | Expected Cost Savings (Kc) | Expected Cost Savings (USD) |
| Quadrant 1 | 2                            | 810,000                    | 35,928                      |
| Quadrant 2 | 9                            | 3,645,000                  | 161,677                     |
| Quadrant 3 | 0                            | 0                          | 0                           |
| Quadrant 4 | 3                            | 1,215,000                  | 53,892                      |
|            |                              | 5,670,000                  | 251,497                     |
|            |                              |                            |                             |
| 2020       |                              |                            |                             |
| Location   | Expected Reduction of Crases | Expected Cost Savings (Kc) | Expected Cost Savings (USD) |
| Quadrant 1 | 2                            | 831,600                    | 36,886                      |
| Quadrant 2 | 3                            | 1,247,400                  | 55,329                      |
| Quadrant 3 | 0                            | 0                          | 0                           |
| Quadrant 4 | 0                            | 0                          | 0                           |
|            |                              | 2,079,000                  | 92,216                      |
|            |                              |                            |                             |
| 2021       |                              |                            |                             |
| Location   | Expected Reduction of Crases | Expected Cost Savings (Kc) | Expected Cost Savings (USD) |
| Quadrant 1 | 2                            | 949,600                    | 42,120                      |
| Quadrant 2 | 2                            | 949,600                    | 42,120                      |
| Quadrant 3 | 0                            | 0                          | 0                           |
|            | 0                            | 0                          | 0                           |
|            |                              | 1,899,200                  | 84,240                      |

#### VITA

Larissa L Lara Olivas was born in Camargo Chihuahua, Mexico in 1998, and grew up in El Paso, Texas. She pursued a career in civil engineering, eventually earning a Bachelor of Science in Civil Engineering from the University of Texas at El Paso (UTEP) in 2021.

After completing her undergraduate degree, Larissa enrolled in the Dual Master Degree Program in Smart Cities, a collaborative effort between Czech Technical University (CTU) and the University of Texas at El Paso. In the program, Larissa spent the first year at UTEP and then continued her studies at CTU.

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This thesis was typed by Larissa L Lara Olivas