Undertaking #24

Reference:
CMMG (MPI) 1- 12

MPI to file the costing analysis with regard to distracted driving that forms the basis for the Corporation's estimate of that range of 69 million to 92 million.

RESPONSE:

The Cost of Distracted Driving Crashes to Manitoba Public Insurance (June, 2016) is filed as *Appendix 1*.

Cost of Distracted Driving-Related Crashes to Manitoba Public Insurance

Final Report

June 2016

Research Note:
It is generally accepted that the existence of systematic biases in the official identification and reporting of distracted driving-related crashes has led to an underreporting of the extent of the problem. These biases are noted in the report. Further, it is possible that the magnitude of the problem could vary in the future solely because of changes in the collection and reporting of the base data, regardless of and perhaps despite the impact of specific interventions.

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1.0 Executive Summary

This report presents the results of a direct costing analysis of distracted driving-related crashes to Manitoba Public Insurance based on data for the period 2012 to 2014. Also included are the results of the estimated number of people killed or injured, and the number of vehicles involved as a result of distracted driving-related crashes. The details of the study methodology and literature review are included in the Appendices. This is the first costing analysis of distracted driving-related crashes completed by Manitoba Public Insurance.

Distracted Driving has been defined in a number of different ways, however one of the most widely accepted definitions in Canada and acknowledged by Traffic Injury Research Foundation is as follows (TIRF, 2010):

> "Distraction involves a diversion of attention from driving, because the driver is temporarily focused on an object, person, task, or event not related to driving, which reduces the driver's awareness, decision-making, and/or performance, leading to an increased risk of corrective actions, near-crashes or crashes"(Hedlund 2006; p.2). This definition incorporates three important aspects of the problem – the source, the effects, and the consequences.

Distracted driving behaviours may include a broad spectrum of activities:

- using electronic devices such as (global positioning system) GPS systems, CD and DVD players, radios, cell phones, laptops, (personal digital assistant) PDAs and MP3 players;
- reading maps, directions or other material;
- grooming (e.g. combing hair, putting on make-up or shaving);
- eating or drinking;
- talking with passengers or tending to children or pets;
- visual distractions outside the vehicle, such as collisions, police activity, or looking at street signs or billboards.

Research about the consequences of distracted driving show that driver behaviour may include a variety of driving errors including but not limited to (TIRF, 2010):

- following too close;
- failing to maintain lane position;
- red light running; and
- irregular speed.

While the spectrum of behaviours that constitute distracted driving is broad, the scope must be defined in order to analyze the magnitude of the distracted driving issue. For the purpose of this study, distracted driving as it relates to collisions will be defined as two major contributing factors, *careless driving* and/or *distraction/inattention*. In selecting data for this study, the crash will be defined as distracted driving related if either of these contributing factors is recorded: *careless driving* or *distraction/inattention*. Further to these, those crashes will be included if conviction data shows that there was a traffic conviction for *use of a hand-operated electronic device while driving* or for *careless driving*. Other types of collisions related to distracted driving such as red-light running and rear-ending will be examined in addition the base magnitude.

It is possible that distracted driving along with other contributing factors be recorded as being responsible for a crash. As long as those indicators selected to represent distracted driving is one of the contributing factors in a crash, that record is selected for this study. Therefore, the distracted driving-related crashes and cost estimates in this study are based on records where distracted driving is recorded as one of the contributing factors in a crash. The study does not attempt to divide or separate the costs between the various contributing factors. It is important to note that the costs of distracted driving-related crashes calculated in this study are not additive to other cost estimates, such as the cost of alcohol-related crashes.

Three theoretical approaches are considered in this study: Real Dollar Estimates, Discounted Future Earnings, and Willingness to Pay. Each of these approaches is discussed in greater detail in Section 4.0. The Real Dollar Estimates (RDE) approach is selected for this study because it addresses the costs that have a direct financial impact on Manitoba Public Insurance.

Using a direct costing approach (RDE), three steps were applied to estimate the cost of distracted driving-related crashes to Manitoba Public Insurance.

1. MPI claims data from 2012 to 2014 was used to determine the average costs of crashes for each crash type[1] for all crashes.
2. The contributing factors in Traffic Accident Report (TAR) data and the convictions data during the period 2012 to 2014 were used to calculate the average number

[1] The terms "crash type" and "accident severity" are used interchangeably in this report to indicate crashes of differing severity and/or outcome.

distracted driving-related crashes per year, and then multiplied by the average costs in Step 1 to determine the average annual cost of distracted driving-related crashes.

3. Additional costs of distraction related rear-end and red-light running crashes were examined and added to the cost in Step 2.

Step 2 and Step 3 were also applied to estimate the number of people killed or injured, and the number of vehicles involved as a result of distracted driving-related crashes.

In summary, it is estimated that distracted driving-related crashes annually cost Manitoba Public Insurance between **$69.4 million (**based on the contributing factors and convictions) and **$92.4 million (**including the additional cost of distraction related rear-end and red-light running crashes)**.** The lower bound provides the base cost magnitude of distracted driving-related crashes. The upper bound adjusts for under-reporting of distracted driving-related crashes in TAR. Therefore, the cost of distracted driving-related crashes to Manitoba Public Insurance can range from **$69.4 million** to **$92.4 million** per year.

In addition to the costs, distracted driving-related crashes based on the contributing factors and convictions are responsible for **31** people killed, **1,805** people injured, and involve **10,530** vehicles annually. When including distraction related rear-end and red-light running crashes, it is estimated that **31** people are killed, **2,611** people are injured, and **13,704** vehicles are involved in these crashes annually.

2.0 Introduction

Manitoba Public Insurance strives to develop driver and vehicle safety programming initiatives to reduce risk on the road and protect Manitobans. To support these initiatives, information is required to identify and prioritize road safety issues by researching the factors that contribute to crashes. This report presents the results of a direct costing analysis of distracted driving as a contributing factor in traffic collisions; it also includes results of the number of people killed or injured as a result of distracted driving-related collisions. The details of the study methodology and literature for this topic are included in the Appendices.

Distracted driving is becoming an increasing focus of many road safety initiatives. This issue has not been as extensively documented or studied in comparison to other factors, due to the broad spectrum of what is considered distracted driving. As a road safety initiative, it is more difficult to address due to the complexity and diversity of the behaviours that are associated with distraction. This is a main reason why many studies have focused on distracted driving as represented by cell phone use (TIRF, 2011). The scope of the Manitoba Public Insurance costing study about distracted driving will also include distracted driving as defined by the use of hand-operated electronic device while driving. The definition of the scope of distracted driving behaviours for the purposes of this study will be explored in greater detail in the body of the report.

A detailed literature review is presented to provide relevant and timely research related to distracted driving-related traffic crashes (see Appendix B). The type of information collected includes research that: presents various definitions of distracted driving; establishes distracted driving as a contributing factor in crashes; statistics of accident counts and severities; profile and demographic information associated with distracted driving; studies that attempt to measure the cost of a crash to society; and research based cost models applied to estimate the contribution of distracted driving to insurance claims costs.

3.0 Objectives

The objectives of this study are to:

i. Determine the number of people killed or injured and the number of vehicles involved as a result of distracted driving-related crashes;
ii. Determine the direct financial costs incurred by Manitoba Public Insurance from distracted driving-related crashes.

In this study, Manitoba Public Insurance claims financial data, Traffic Accident Report (TAR) data, and convictions data are used to estimate the costs and impact of distracted driving-related crashes. The steps associated with the estimation and the relevant data are presented in this report.

4.0 Theoretical Costing Approaches

In general, there are three basic costing models that may be applied to estimate the costs of a distracted driving-related crash. Each model has different assumptions and definitions which lead to different calculations and results.

1. Real Dollar Estimates (RDE): How much will this cost in real dollars spent?
2. Discounted Future Earnings (DFE): How much will this cost in terms of lost goods, opportunity, or productivity?
3. Willingness to Pay (WTP): How much would I pay for this not to have happened?

4.1 Real Dollar Estimates

This approach involves the calculation of the dollars spent by an insurance company on various accident related expenses such as vehicle repairs, medical costs, and other types of insurance payouts. The resulting figure also represents the amount of money that would be saved (or simply not spent) had the crash been prevented. This approach does not take into account the broader harm to the society resulting from a crash such as lives made less productive, reduced quality of lives, emotional distress caused by the accident, etc. Consequently, the Real Dollar Estimates approach only estimates the direct financial costs associated with the crash, not other societal costs.

In Manitoba, individuals are compensated for the loss of income that results from traffic crashes through the Income Replacement Indemnity (IRI) under the Personal Injury

Protection Plan (PIPP). Within the PIPP program, compensation for financial loss (including Income Replacement) is based on the person's actual situation at the time of loss. Some benefits are indexed to account for inflation. While the RDE method does not estimate societal costs, it provides an estimate that is applicable to Manitoba Public Insurance.

4.2 Discounted Future Earnings

"Discounted Future Earnings" estimates the cost of a crash by calculating both the immediate dollars spent, and the productivity that society loses from lost days at work, reduced employment opportunity, or a life shortened. This approach results in larger costs than the RDE model, but is not a realistic estimate of actual dollar savings had the crash not occurred, as it deals with theoretical savings. This approach uses the discounted present value of a victim's future earnings as a proxy for the cost of death or injury. Some of the disadvantages of this model are that it may provide misleading results in an economy with less than full employment; and it may not fully address the issue of quality of life, pain, suffering and grief, due to actuarial uncertainties regarding life expectancy and earnings (BTE, 2000).

4.3 Willingness to Pay

The "Willingness to Pay" (WTP) approach provides the most comprehensive estimate of the cost of a crash to society. The WTP estimates the value of life in terms of the amounts that individuals are prepared to pay to reduce risks to their lives. It is a comprehensive approach that reflects individual preferences and incorporates subjective welfare costs. It is the most widely accepted approach to date for calculating total societal costs. A main disadvantage of this method is that it depends on peoples' perception of the benefit of avoiding the accident and, therefore, may change based on time or under various circumstances. The WTP value can also be based on peoples' perception of their ability to pay, the likelihood of their loved ones being involved in a crash, or the perceived risk of a serious injury or death as a result of an accident. The latter two may be affected by awareness campaigns or past experiences.

4.4 Approach Selected

For the purpose of this study, the Real Dollar Estimates approach will be used to estimate the cost of distracted driving-related crashes, as it focuses on the direct financial impact of crashes to Manitoba Public Insurance.

5.0 Definition of Distracted Driving

Distracted Driving has been defined in a number of different ways, however one of the most widely accepted definitions in Canada and acknowledged by Traffic Injury Research Foundation is as follows (TIRF, 2010):

> "Distraction involves a diversion of attention from driving, because the driver is temporarily focused on an object, person, task, or event not related to driving, which reduces the driver's awareness, decision-making, and/or performance, leading to an increased risk of corrective actions, near-crashes or crashes"(Hedlund 2006; p.2). This definition incorporates three important aspects of the problem – the source, the effects, and the consequences.

Distracted driving behaviours may include a broad spectrum of activities:

- using electronic devices such as (global positioning system) GPS systems, CD and DVD players, radios, cell phones, laptops, (personal digital assistant) PDAs and MP3 players;
- reading maps, directions or other material;
- grooming (e.g. combing hair, putting on make-up or shaving);
- eating or drinking;
- talking with passengers or tending to children or pets;
- visual distractions outside the vehicle, such as collisions, police activity, or looking at street signs or billboards.

Research about the consequences of distracted driving show that driver behaviour may include a variety of driving errors including but not limited to (TIRF, 2010):

- following too close;
- failing to maintain lane position;
- red light running; and
- irregular speed.

While the spectrum of behaviours that constitute distracted driving is broad, the scope must be defined in order to analyze the magnitude of the distracted driving issue. For the purpose of this study, distracted driving as it relates to collisions will be defined as two major contributing factors, *careless driving* and/or *distraction/inattention*. Based on the data available at Manitoba Public Insurance, the crash will be defined as distracted driving related if either of these contributing factors is recorded: *careless driving* or *distraction/inattention*. Distracted driving has also commonly been measured by convictions for *using a hand-operated electronic device while driving* in Manitoba since 2010.

These convictions will also be used to define distracted driving-related crashes. In recording details of a collision, police may record up to three contributory factors for each driver or vehicle involved. For example, police may record *exceeding speed limit*, *careless driving* and *impaired by alcohol* as contributing factors in a collision. For the purpose of this study, if any of the contributing factors recorded by the police for any driver or vehicle involved are *careless driving*, *distraction/inattention,* or there is a traffic conviction for *use of a hand-operated electronic device while driving* or for *careless driving,* that crash will be considered to be a distracted driving-related collision. The study does not attempt to divide the costs between the various contributing factors because drivers can have various different contributing factors recorded for a collision[2].

6.0 Data

There are three types of data available at Manitoba Public Insurance for the purpose of this study.

1. Manitoba Public Insurance claims data;
2. Traffic Accident Report (TAR) data; and
3. Convictions data.

6.1 MPI Claims Data

Claims data includes information pertaining to a collision such as persons involved, number of occupants killed or injured, type of injuries sustained, type of collision, vehicle description, driver information, and amount paid out in claims. Claims data contains financial information of a crash.

6.1.1 Development Factors

The estimation method proposed in this study (i.e., RDE) involves using the claims incurred costs to estimate the direct financial impact of distracted driving-related crashes to the Manitoba Public Insurance. As noted earlier in this report, claims information is the best source for obtaining financial information on traffic crashes in Manitoba. Since injury claims may take a long time to be completely paid, development factors provided by the Corporation's Pricing and Economics Department will be used to convert the incurred-to-date claims costs to ultimate claims costs (i.e., the estimated final cost when all the claims are closed). The newer the claim, the larger the

[2] Up to three factors can be recorded for each driver or vehicle involved, which include a wide range of factors that can be broadly grouped as driver actions, human condition, vehicle defect, and environmental condition.

development factor. As the claim nears its end, the development factor decreases to account for the greater stability and less likeliness that additional costs will be incurred.

Table 1 shows the development factors that will be applied to bring reported incurred amounts to ultimate costs. For each year, the average of *Set 1* and *Set 2* development factors will be applied to injury claims. *Set 3* development factors will be applied to fatal claims.

Table 1: Cover Codes and Development Factors

Coverage Type	**Set Number**
Death Benefits (DB)	Set 3
PIPP-related Expenses (Exp)	Set 2
Income Replacement Indemnity (IRI)	Set 1
Personal Care (PC)	Set 2
Permanent Impairment (PI)	Set 3
Rehabilitation (REHAB)	Set 2
Pre-PIPP Medical Expenses (TREAT)	Set 2

Set Definition

The definition of set numbers is as follows:

Set 1 refers to Accident Benefits Weekly Indemnity.
Set 2 refers to Accident Benefits Other Indexed.
Set 3 refers to Accident Benefits Other Non-Indexed.

Development Factors to Ultimate[1]

Year	**Set 1**	**Set 2**	**Set 3**
2012	1.4489	1.1377	1.0448
2013	1.8807	1.2185	1.1426
2014	3.3563	1.4052	1.4881

[1] For the respective loss year, these factors represent the development to ultimate costs based on losses reported/incurred up to and including Feb 28, 2015.

6.2 Traffic Accident Report (TAR) Data

The Traffic Accident Report (TAR) data is taken from Traffic Accident Reports generated by Manitoba Public Insurance and law enforcement agencies. It includes information pertaining to a collision such as contributing factors, accident severity[3] (fatal, injury or physical damage only), number of people killed or injured, and number of vehicles involved. While TAR data has detailed information on the crash characteristics, there is no information pertaining to how much was paid out for the accident. In addition, TAR data only includes collisions that occur on public roadways. Although TAR data represents only a subset of all crashes recorded in the Manitoba

[3] The terms "accident severity" and "crash type" are used interchangeably in this report to indicate crashes of differing severity and/or outcome.

Public Insurance data warehouse, it can be used to establish the basis and magnitude to estimate the cost of distracted driving-related crashes.

6.3 Convictions Data

Convictions data is taken from reports generated by Manitoba Justice and the court system. It includes information such as driver's licence number, conviction code, occurrence date (i.e. date of the violation), and date of conviction. Since it can take up to two years to convict a driver for driving violations due to court process, the date of the violation is used for this study instead of the actual conviction date. Convictions data is merged with TAR data to create a comprehensive picture of crashes.

7.0 Estimation of Distracted Driving-Related Crashes and Costs to Manitoba Public Insurance

This section details the steps involved in estimating the direct financial cost to Manitoba Public Insurance from distracted driving-related crashes using the Real Dollar Estimates approach. A discussion of the limitations associated with the estimation of distracted driving-related crashes is included in Appendix A.

At a broad level, the steps involved are:

1. MPI claims data from 2012 to 2014 was used to determine the average costs of crashes for each crash type[4] for all crashes.
2. The contributing factors in Traffic Accident Report (TAR) data and the convictions data during the period 2012 to 2014 were used to calculate the average number of distracted driving-related crashes per year, and then multiplied by the average costs in Step 1 to determine the average annual cost of distracted driving-related crashes.
3. Additional costs of distraction related rear-end and red-light running crashes were examined and added to the cost in Step 2.

7.1 Average Costs of All Crashes in Claims Data for Each Crash Type

This step calculates the average costs of all crashes in claims data for each crash type. For example, the average cost of fatal crashes in claims data was calculated in the following way:

$$C_{tf} = \textit{cost of fatal crashes in claims data/Number of fatal crashes in claims data}$$

[4] The terms "crash type" and "accident severity" are used interchangeably in this report to indicate crashes of differing severity and/or outcome.

The same procedure was used to calculate average costs per crash for injury and PDO (property damage only) crashes. Table 2 presents the results of these computations.

Table 2: Collision Claims Data (All Crashes)

Accident Severity	Year	Crashes [a]	$ Incurred [b]	Cost per Crash [b/a]
Fatal	2012	111	$33,511,446.50	$301,904.92
	2013	82	$27,584,030.80	$336,390.62
	2014	87	$32,652,884.70	$375,320.51
	Average 2012-2014	**93**	**$31,249,454.00**	**$334,815.58**
Injury	2012	9,001	$241,877,431.00	$26,872.28
	2013	9,434	$254,428,714.00	$26,969.34
	2014	8,414	$270,872,208.00	$32,193.04
	Average 2012-2014	**8,950**	**$255,726,117.67**	**$28,573.81**
PDO	2012	82,899	$312,363,507.00	$3,768.00
	2013	89,554	$360,451,932.00	$4,024.97
	2014	85,125	$350,641,311.00	$4,119.13
	Average 2012-2014	**85,859**	**$341,152,250.00**	**$3,973.39**

Source: Crash counts are based on the Claims and Collisions Statistics Report. Costs incurred are based on Claims data.

7.2 Cost of Distracted Driving-Related Crashes Based on Contributing Factors and Convictions

If any of the contributing factors recorded for any driver/vehicle involved in a crash were *careless driving* or *distraction/inattention,* that crash was flagged as a distracted driving-related collision. Between 2012 and 2014, there were 19,947 distracted driving-related crashes in the TAR database based on these contributing factors.

In addition, if a driver was convicted for *use of a hand-operated electronic device while driving* or for *careless driving* at the time of the crash, it was flagged as a distracted driving-related collision. Between 2012 and 2014, there were 180 distracted driving-related crashes in the TAR database based on these convictions. Fifty-four of those have already been captured as distracted driving based on contributing factors. Therefore, there were an additional 126 distracted driving-related crashes in the TAR database based on convictions.

Table 3 shows the number of distracted driving-related crashes by year and by accident severity in TAR.

Table 3: Distracted Driving-Related Crashes Based on Contributing Factors in TAR Data and Convictions

Accident Severity	Year	Based on Contributing Factors	Based on Convictions	Total
Fatal	2012	35	2	37
	2013	18	3	21
	2014	17	3	20
	Average 2012-2014	**23**	**3**	**26**
Injury	2012	948	31	979
	2013	1,357	15	1,372
	2014	1,810	16	1,826
	Average 2012-2014	**1,372**	**21**	**1,392**
PDO	2012	3,794	21	3,815
	2013	5,334	17	5,351
	2014	6,634	18	6,652
	Average 2012-2014	**5,254**	**19**	**5,273**
Total Distracted Driving-Related Crashes (All Severity Types)	2012	4,777	54	4,831
	2013	6,709	35	6,744
	2014	8,461	37	8,498
	Average 2012-2014	**6,649**	**42**	**6,691**

In order to determine the cost of distracted driving-related crashes, the annual average counts of fatal, injury, and PDO collisions caused by distracted driving (Table 3) were multiplied by the average costs per crash from Table 2, and summing the results. The computation is summarized in Table 4.

Table 4: Computation of the Costs of Distracted Driving-Related Crashes by Crash Type

Accident Severity	Annual Average Number of Distracted Driving-Related Crashes in TAR [a]	Average Cost per Crash (Claims Data) [b]	Cost of Distracted Driving-Related Crashes [a*b]
Fatal	26	$334,815.58	$8,705,205
Injury	1,392	$28,573.81	$39,774,744
PDO	5,273	$3,973.39	$20,951,685
Total Cost of Distracted Driving-Related Crashes	**6,691**	**NA**	**$69,431,634**

As shown in Table 4, based on the contributing factors and convictions, there are on average **6,691** distracted driving-related crashes per annum during the period 2012 to 2014. The cost to Manitoba Public Insurance from these crashes is, on average, about **$69,431,634** per year during this period.

7.3 Additional Cost of Distraction Related Rear-End and Red-Light Running Crashes

This section estimates the additional cost of rear-end and red-light running crashes associated with distracted driving to adjust for under-reporting of distracted driving-related crashes.

It is well-recognized that the role of distraction in crashes is considerably underreported, meaning that data reporting distraction in crashes are likely under-estimated (TIRF, 2015). The driving errors associated with distracted driving can be very broad, and it is nearly impossible to include all the crash scenarios associated with distracted driving. Rear-ending and red-light running are two most common driving errors associated with distracted driving based on available literature and research, therefore they are examined in this study. The estimations of the additional costs of distraction related rear-end crashes and red-light running crashes are discussed in Sections 7.3.1 and 7.3.2 respectively.

7.3.1 Distraction Related Rear-End Crashes

If a crash was recorded as *Rear End* under Accident Configuration in the Traffic Accident Report, it was flagged as a rear-end collision.

Table 5 shows the total number of rear-end crashes identified in TAR by year and by accident severity.

Table 5: Total Rear-End Crashes in TAR Data

Year	Fatal	Injury	PDO	Total
2012	3	3,585	6,760	10,348
2013	1	3,705	7,208	10,914
2014	1	3,731	6,280	10,012
Average 2012-2014	**2**	**3,674**	**6,749**	**10,425**

If a rear-end crash has already been captured as a distracted driving-related crash in TAR, it was considered as a **distraction related rear-end crash.** Table 6 shows the

number of known distraction related rear-end crashes identified in TAR by year and by accident severity.

Table 6: Known Distraction Related Rear-End Crashes in TAR Data

Year	Fatal	Injury	PDO	Total
2012	2	428	845	1,275
2013	1	511	1,087	1,599
2014	0	666	1,141	1,807
Average 2012-2014	**1**	**535**	**1,024**	**1,560**

A research paper on distraction related rear-end crash scenarios (Campbell, Smith, & Najm, 2002) reported that overall, 32% of rear-end crashes are distraction related.

To estimate the number of distraction related rear-end crashes, 32% was applied to the total number of rear-end crashes in TAR data. Since some of the rear-end crashes in TAR have already been captured as distraction related based on contributing factors and convictions, they were removed from the estimation to avoid double counting. That is, only the distraction related rear-end crashes that have not been captured were considered in the final estimation. Table 7 summarizes the computation.

Table 7: Estimation of the Number of Distraction Related Rear-End Crashes by Crash Type in TAR Data

Accident Severity	Total Annual Number of Rear-End Crashes [a]	Estimated Number of Distraction Related Rear-End Crashes[1] [b] = [a*32%]	Number of Known Distraction Related Rear-End Crashes[2] [c]	Estimated Additional Number of Distraction Related Rear-End Crashes [b-c]
Fatal	2	1	1	0
Injury	3,674	1,176	535	641
PDO	6,749	2,160	1,024	1,136
Total	**10,425**	**3,337**	**1,560**	**1,777**

1. These numbers are calculated by applying 32% to the total number of rear-end crashes for each crash type in TAR data.
2. These are the rear-end crashes that have already been captured as distraction related based on contributing factors and convictions in TAR data.

The additional cost of distraction related rear-end crashes was calculated by multiplying the estimated additional number of distraction related rear-end crashes by the average cost per crash from Table 2 for each crash type, and summing the results. Table 8 presents the results of the computation.

Table 8: Computation of the Additional Costs of Distraction Related Rear-End Crashes by Crash Type

Accident Severity	Estimated Additional Number of Distraction Related Rear-End Crashes in TAR Data [a]	Average Cost per Crash (Claims Data) [b]	Additional Cost of Distraction Related Rear-End Crashes [a*b]
Fatal	0	$334,815.58	$0
Injury	641	$28,573.81	$18,315,812
PDO	1,136	$3,973.39	$4,513,771
Total Additional Cost of Distraction Related Rear-End Crashes	**1,777**	**NA**	**$22,829,583**

As shown in Table 8, there are on average, an additional **1,777** distraction related rear-end crashes per year during the period 2012 to 2014. The estimated additional cost to Manitoba Public Insurance from these crashes is **$22,829,583** per year during this period.

7.3.2 Distraction Related Red-Light Running Crashes

Since there is no specific code for red-light running as a contributing factor in TAR, the following have been used as a proxy:

1) If the crash happened at an intersection and there was traffic light at the site, and it was recorded for *disobeyed traffic control device* as a contributing factor;
2) If the crash happened at an intersection and there was traffic light at the site, and it was recorded for *disregard stop signal* or *ignore traffic signal* as a violation.

In addition, if a driver was convicted for *disobeying a traffic control signal* at the time of the crash, it was flagged as a red-light running collision. Table 9 shows the total number of red-light running crashes identified in TAR by year and by accident severity.

Table 9: Total Red-Light Running Crashes in TAR Data

Year	Fatal	Injury	PDO	Total
2012	0	71	81	152
2013	0	88	101	189
2014	0	96	66	162
Average 2012-2014	**0**	**85**	**83**	**168**

If a red-light running crash has already been captured as a distracted driving-related crash in TAR, it was considered as a **distraction related red-light running crash.** Table 10 shows the number of known distraction related red-light running crashes identified in TAR by year and by accident severity.

Table 10: Known Distraction Related Red-Light Running Crashes in TAR Data

Year	Fatal	Injury	PDO	Total
2012	0	5	7	12
2013	0	12	12	24
2014	0	22	15	37
Average 2012-2014	**0**	**13**	**11**	**24**

As shown in Table 9 and Table 10, 14% (i.e., 24/168) of the total red-light running crashes were distraction related in TAR. In 2012, the National Coalition for Safer Roads (NCSR) and FocusDriven analyzed data collected from 118 intersections in Arizona, California and Colorado over a three-month period (June-August 2012), and found that 12% of the red-light violations could be attributed to distracted driving. More recently, American Traffic Solutions (ATS) sampled data from 67 intersections with red-light safety cameras across the United States over a three-month period (June-August 2015). The analysis found that 19% of the red-light violations could be attributed to at least one type of distracted driving behaviour. The two studies used similar methodology and suggest that distracted red-light running has increased over the years.

In this study, 19% was applied to the total annual number of red-light running crashes from Table 9 to estimate the number of distraction related red-light running crashes in TAR. Since some of the red-light running crashes in TAR have already been captured as distraction related based on contributing factors and convictions, they were removed from the estimation; that is, only the distraction related red-light running crashes that have not been captured were considered in the final estimation. Table 11 summarizes the computation.

Table 11: Estimation of the Number of Distraction Related Red-Light Running Crashes by Crash Type in TAR Data

Accident Severity	Total Annual Number of Red-Light Running Crashes [a]	Estimated Number of Distraction Related Red-Light Running Crashes[1] [b] = [a*19%]	Number of Known Distraction Related Red-Light Running Crashes[2] [c]	Estimated Additional Number of Distraction Related Red-Light Running Crashes [b-c]
Fatal	0	0	0	0
Injury	85	16	13	3
PDO	83	16	11	5
Total	**168**	**32**	**24**	**8**

1. These numbers are calculated by applying 19% to the total number of red-light running crashes for each crash type in TAR data.
2. These are the red-light running crashes that have already been captured as distraction related based on contributing factors and convictions in TAR data.

The additional cost of distraction related red-light running crashes was calculated by multiplying the estimated additional number of distraction related red-light running crashes by the average cost per crash from Table 2 for each crash type, and summing the results. Table 12 presents the results of the computation.

Table 12: Computation of the Additional Costs of Distraction Related Red-Light Running Crashes by Crash Type

Accident Severity	Estimated Additional Number of Distraction Related Red-Light Running Crashes in TAR Data [a]	Average Cost per Crash (Claims Data) [b]	Additional Cost of Distraction Related Red-Light Running Crashes [a*b]
Fatal	0	$334,815.58	$0
Injury	3	$28,573.81	$85,721
PDO	5	$3,973.39	$19,867
Total Additional Cost of Distraction Related Red-Light Running Crashes	**8**	**NA**	**$105,588**

As shown in Table 12, there are on average, an additional **8** distraction related red-light running crashes per year during the period 2012 to 2014. The estimated additional cost to Manitoba Public Insurance from these crashes is **$105,588** per year during this period.

7.4 Summary of Estimation of Distracted Driving-Related Crashes and Costs to Manitoba Public Insurance

Distracted driving-related crashes based on the contributing factors and convictions are used to determine the base cost and magnitude of distracted driving to the Corporation. On average, there are **6,691** distracted driving-related crashes per annum based on the contributing factors and convictions, during the period 2012 to 2014. The cost to Manitoba Public Insurance from these crashes is on average, **$69.4 million** per annum.

To adjust for under-reporting of distracted driving-related crashes, rear-end and red-light running crashes associated with distracted driving are included to estimate the upper bound of the cost to the Corporation. When including the distraction related rear-end and red-light running crashes, on average, there are **8,476** distracted driving-related crashes per annum from 2012 to 2014. The estimated cost to Manitoba Public Insurance from these crashes is on average, **$92.4 million** per annum. Therefore, the cost associated with distracted driving-related crashes can range from **$69.4 million** to **$92.4 million** per year.

The results of the estimation are summarized in Table 13.

Table 13: Summary of Estimation of the Annual Cost of Distracted Driving-Related Crashes

Average 2012-2014	Distracted Driving-Related Crashes Based on Contributing Factors and Convictions	Estimation of Additional Distraction Related Rear-End Crashes	Estimation of Additional Distraction Related Red-Light Running Crashes	Estimation Including Distraction Related Rear-End and Red-Light Running Crashes
Average Distracted Driving-Related Crashes	**6,691**	**1,777**	**8**	**8,476**
Average Annual Cost of Distracted Driving-Related **Fatal** Crashes	$8,705,205	$0	$0	$8,705,205
Average Annual Cost of Distracted Driving-Related **Injury** Crashes	$39,774,744	$18,315,812	$85,721	$58,176,277
Average Annual Cost of Distracted Driving-Related **PDO** Crashes	$20,951,685	$4,513,771	$19,867	$25,485,323
Average Cost Incurred	**$69,431,634**	**$22,829,583**	**$105,588**	**$92,366,806**

Note: The average costs incurred may not add to the total due to rounding.

8.0 Determining the Number of People Killed and Injured and Vehicles Involved in Distracted Driving-Related Crashes

In addition to the cost, the impact of distracted driving-related crashes is also reflected in the number of people killed or injured and vehicles involved. A fatal crash means at least one person is killed as a result of the collision; it can also result in some people injured. An injury crash means at least one person has sustained some level of personal injury, but no one is fatally injured or killed. A PDO (property damage only) crash means no injury or fatality is sustained and only property damage is the result. All three types of crashes will involve at least one vehicle.

Similar to the procedure used to determine the costs, contributing factors and convictions are used to determine the base number of people killed and injured as well as vehicles involved, then rear-end and red-light running crashes are included to estimate the upper bound for the impact of distracted driving. The steps involved are as follows:

Step 1
Based on the contributing factors and convictions data, on average, the distracted driving-related crashes are responsible for **31** people killed, **1,805** people injured, and involve **10,530** vehicles annually, as shown in Table 14.

Table 14: Number of People Killed, Injured and Vehicles Involved in Distracted Driving-Related Crashes Based on Contributing Factors and Convictions

Year	People Killed	People Injured	Vehicles Involved
2012	39	1,271	7,622
2013	32	1,757	10,578
2014	22	2,386	13,391
Average 2012 – 2014	**31**	**1,805**	**10,530**

To adjust for under-reporting of distracted driving-related crashes, the number of people killed or injured as well as vehicles involved are estimated by including the distracted related rear-end and red-light running crashes.

Step 2
To estimate the number of people killed, injured and vehicles involved in distraction related rear-end crashes, the same proportion used in Section 7.3.1 (i.e., 32%) was applied to the total number of people killed, injured and vehicles involved in all rear-end crashes. Since some of those rear-end crashes have already been captured as distraction related based on the contributing factors and convictions, only those that

have not been captured were included in the final estimation of number of people killed, injured and vehicles involved. Table 15 shows the results of the computation.

Table 15: Estimation of the Additional Annual Number of People Killed, Injured and Vehicles Involved in Distraction Related Rear-End Crashes

Average 2012-2014	Total Annual Number of People Killed, Injured and Vehicles Involved in All Rear-End Crashes [a]	Estimated Annual Number of People Killed, Injured and Vehicles Involved in Distraction Related Rear-End Crashes[1] [b] = [a*32%]	Annual Number of Known People Killed, Injured and Vehicles Involved in Distraction Related Rear-End Crashes[2] [c]	Estimated Additional Annual Number of People Killed, Injured and Vehicles Involved in Distraction Related Rear-End Crashes [b-c]
People Killed	3	1	1	0
People Injured	4,616	1,477	674	803
Vehicles Involved	19,473	6,231	3,073	3,158

1. These numbers are calculated by applying 32% to the total number of people killed, injured and vehicles involved in all rear-end crashes.
2. These are the number of people killed, injured and vehicles involved in the rear-end crashes that have already been captured as distraction related based on contributing factors and convictions.

Step 3

To estimate the number of people killed, injured and vehicles involved in distraction related red-light running crashes, the same proportion used in Section 7.3.2 (i.e., 19%) was applied. Since some of those red-light running crashes have already been captured as distraction related based on the contributing factors and convictions, only those that have not been captured were included in the final estimation of number of people killed, injured and vehicles involved. Table 16 shows the results of the computation.

Table 16: Estimation of the Additional Annual Number of People Killed, Injured and Vehicles Involved in Distraction Related Red-Light Running Crashes

Average 2012-2014	Total Annual Number of People Killed, Injured and Vehicles Involved in All Red-Light Running Crashes [a]	Estimated Annual Number of People Killed, Injured and Vehicles Involved in Distraction Related Red-Light Running Crashes[1] [b] = [a*19%]	Annual Number of Known People Killed, Injured and Vehicles Involved in Distraction Related Red-Light Running Crashes[2] [c]	Estimated Additional Annual Number of People Killed, Injured and Vehicles Involved in Distraction Related Red-Light Running Crashes [b-c]
People Killed	0	0	0	0
People Injured	129	24	21	3
Vehicles Involved	347	66	50	16

1. These numbers are calculated by applying 19% to the total number of people killed, injured and vehicles involved in all red-light running crashes.
2. These are the number of people killed, injured and vehicles involved in the red-light running crashes that have already been captured as distraction related based on contributing factors and convictions.

Step 4

This step estimates the upper bound of the impact of distracted driving-related crashes by summing the number of people killed, injured and vehicles involved from Step 1, Step 2 and Step 3. The results of the estimation are summarized in Table 17.

Table 17: Summary of Estimation of the Annual Number of People Killed, Injured and Vehicles Involved in Distracted Driving-Related Crashes

Average 2012-2014	Based on Contributing Factors and Convictions [a]	Estimation Based on the Additional Distraction Related Rear-End Crashes [b]	Estimation Based on the Additional Distraction Related Red-Light Running Crashes [c]	Estimation Including Distraction Related Rear-End and Red-Light Running Crashes [a+b+c]
People Killed	**31**	0	0	**31**
People Injured	**1,805**	803	3	**2,611**
Vehicles Involved	**10,530**	3,158	16	**13,704**

As can be seen in Table 17, the distracted driving-related crashes based on contributing factors and convictions are responsible for **31** people killed, **1,805** people injured, and involve **10,530** vehicles annually. These lower bound numbers provide the base magnitude of the impact of distracted driving. When distraction related rear-end and red-light running crashes are included, there are annually **31** people killed, **2,611** people injured, and **13,704** vehicles involved in distracted driving-related crashes. These upper bound numbers provide the potential magnitude of the impact of distracted driving.

9.0 Summary and Conclusion

The impact of distracted driving is an emerging issue in the study of road safety. While driver distraction has long been noted as a contributing factor in traffic collisions, few studies have focused on the costs of distracted driving related crashes due to the broad scope of what constitutes driver distraction. While many of the scientific evaluations conducted to date have demonstrated that distracted driving contributes to crashes and societal costs, few have examined direct dollar costs with respect to vehicle insurers. A direct costing method (Real Dollar Estimates) was chosen to estimate the direct cost of distracted driving-related crashes to Manitoba Public Insurance.

As noted earlier in this report, distracted driving along with other factors may be recorded as being responsible for a crash. As long as distracted driving is identified as one of the contributing factors in a crash, that record is selected for this study. This study does not attempt to divide or separate the costs among the various contributing factors because drivers can have various different contributing factors recorded for a collision. Therefore, the costs of distracted driving-related crashes calculated in this study are not additive to other cost estimates that have been conducted (e.g., cost of alcohol-related crashes to Manitoba Public Insurance).

Distracted driving-related crashes based on the contributing factors and convictions are used to determine the base cost and impact of distracted driving. On average, there are per annum, **6,691** distracted driving-related crashes based on the contributing factors and convictions, resulting in **31** people killed, **1,805** people injured, and involving **10,530** vehicles during the period 2012 to 2014. The cost to Manitoba Public Insurance from these crashes is on average, **$69.4 million** per annum.

To adjust for under-reporting of distracted driving-related crashes, the rear-end crashes and red-light running crashes associated with distracted driving are included to estimate the upper bound of the cost and impact of distracted driving. When the number of distraction related rear-end and red-light running crashes are added to the base estimate, on average, there are **8,476** distracted driving-related crashes per annum from 2012 to 2014, resulting in **31** people killed, **2,611** people injured, and involving **13,704** vehicles. The estimated cost to Manitoba Public Insurance from these crashes is on average, **$92.4 million** per annum.

Therefore, the cost associated with distracted driving-related crashes can range from **$69.4 million** to **$92.4 million** per year.

Appendix A:

Discussion of Issues and Data Limitations

Discussion of Issues and Data Limitations

While the overall methodology is a valid approach for estimating the costs of distracted driving related crashes, there are some limitations and assumptions that are noted in the following section. The primary issues relate to the challenges in defining the scope of distracted driving, the method used to collect crash level information and the overall under-reporting of crash data.

An understanding of the issues associated with the data sources, establishing data assumptions, and applying consistent definition of terms with a well-defined methodology can provide a reasonable framework for the estimation of the direct cost associated with crashes (Mayhew and Vanlaar, 2007). This study combines the strengths of different data sources to identify relationships that would allow the quantification of the distracted driving-related crash problem to Manitoba Public Insurance. The estimates presented are best used as a measure of the minimum and maximum cost parameters associated with distracted driving-related crashes to Manitoba Public Insurance.

There are fewer studies on the cost of distracted driving related crashes due to the broad nature of the topic.

- Indicators to define Distracted Driving Related Crashes in this study include:
    - Contributing Factors (TAR)
        - Careless Driving
        - Distraction / Inattention
    - Convictions for use of a hand-held electronic device while driving or for careless driving
- The literature has focused primarily on cell phone use while driving as it's the most observable distracted driving behaviour. The law has also focused on the use of hand-operated electronic device while driving, even though it's one small portion of the distracted driving issue.
- Other considerations include looking at driving errors that distracted drivers commit most often (TIRF):
    - Following too close
    - Failing to maintain lane
    - Irregular speed
    - Red-light running

- Further studies mention internal vs. external distractions:
    - Animals/wildlife
    - Construction zones

For any given crash, three contributing factors that directly contributed to an accident may be recorded for each driver and vehicle involved. For instance, *exceeding speed limit*, *careless driving* and *impaired by alcohol* may be recorded as contributing factors in a crash. As long as *careless driving* or *distraction/inattention* is one of the contributing factors recorded for any driver/vehicle involved in a crash, that record was selected for this study.

Similar to the police-reported data collection before the 2011 Highway Traffic Act legislation change, attempting to determine the order of importance of the listed contributing factors is virtually impossible, and was out of scope for this study. This study does not attempt to divide or separate the costs among the various contributing factors. Therefore, the costs of distracted driving-related crashes calculated in this study are not additive to other cost estimates that have been conducted (e.g., cost of speed-related crashes to Manitoba Public Insurance).

Appendix B:

Literature Review

Cost of Distracted Driving-related Crashes To Manitoba Public Insurance

1.0 Introduction

The following is a review of existing research conducted about distracted driving involvement in traffic crashes. The purpose of this review is to identify current research about distracted driving as a contributing factor to traffic collisions. The articles that were selected for this review include: research that establishes the definition of distracted driving behaviours; distraction as a contributing factor in crashes; statistics of accident counts and severities; profile and demographic information associated with distracted driving-related crashes; studies that attempt to measure the cost of a crash to the society; and research based cost models that were applied to estimate the insurance claims costs. Research about the direct costs of distracted driving-related crashes within the context of business operations is limited within existing research.

2.0 Definition of Distracted Driving

Distracted driving is any activity that could divert a person's attention away from the primary task of driving. All distractions endanger driver, passenger, and bystander safety. Types of distractions include:

- Texting
- Using a cell phone or smartphone
- Eating and drinking
- Talking to passengers
- Grooming
- Reading, including maps
- Using a navigation system
- Watching a video
- Adjusting a radio, CD player, or MP3 player

Distracted driving is becoming the focus of many road safety initiatives. Most (75%) Canadians surveyed think distracted driving is a serious issue (TIRF, 2010). Texting while driving is considered the most serious traffic safety issue, with 90% of those surveyed mentioning it as their top concern. As a contributing factor, distracted driving has not been as extensively documented or studied, due to the broad spectrum of what is considered distracted driving. As a road safety initiative it is more difficult to address due to the complexity and diversity of behaviours. This, along with the countermeasures against distracted driving, is a main reason why many studies have focused on distracted driving as represented by cell phone use (TIRF, 2011).

3.0 Distracted Driving as a Contributing Factor in Collisions

Distracted driving research is limited; however it has been estimated to be a contributing factor in approximately 20% to 30% of traffic collisions (Hedlund, 2006). Collision statistics for Canada indicate that distracted driving is a contributing factor between 13-16% of fatal crashes and 23-27% of injury crashes (TIRF, 2011). This study also notes that distracted driving statistics should be interpreted with caution as there is under-reporting of the issue and no standard reporting protocol or data collection methodology across jurisdictions.

Based on Manitoba Traffic Collision Statistics for 2014, distracted driving was a contributing factor in 27% of fatal traffic collisions; 20% of injury collisions and 21% of PDO collisions. The previous five-year average (2009-2013) for Manitoba shows that distracted driving contributed to 30% of fatal collisions and 11% of injury collisions. Similar collision statistics are found in the United States where distracted driving is cited as a related factor in 10% of fatal crashes and 18% of injury crashes (NHTSA, 2013).

According to NHSTA (2013) distracted driving related crashes are currently underreported. Due to the negative implications of distracted driving, any self reported crash information will be lower than actual occurrence as with any traffic infraction. Additionally, especially for fatalities, law enforcement must rely on crash investigation and witness reports which may not be able to identify the cause of the crash.

A study by the National Safety Council (NSC) examined under reporting of cell phone involvment in fatal collisions. The study analyzed 180 fatal collisions occurring between 2009 and 2011 where evidence had been gathered of driver cell phone use. Of these collisions police reports (as recorded by the NHTSA's Fatality Analysis Reporting System) recorded cell phones as being a factor in only about 50% of the collisions. While the study used a convenience sample, the results still provide general insight into the extent of under reporting of cell phone involvement in collisions (National Safety Council, 2013).

Several studies have attempted to estimate under reporting in distracted driving related crashes. It is a major contributing factor in both rear end crashes and red-light running violations. Studies have shown that distracted driving is the most common contributing factor in rear end crashes where the lead vehicle is decelerating (37%), or the lead

vehicle is stopped (36%), and the second most common contributing factor where the lead vehicle is moving (23%). In crashes where the lead vehicle is moving, distracted driving is second only to unknown contributing factor as a percentage of crashes (Campbell, Smith & Najm).

Distracted driving also features prominently in red-light running violations. According to a 2013 study conducted by Focus Driven and the National Coalition for Safer Roads, distracted driving behaviour accounts for 12% of red-light running violations. A more recent study by American Traffic Solutions found that in 2015, 19% of red-light violations were caused by distracted driving.

4.0 Driver Profile: Involvement in Distracted Driving-related Crashes

Distracted driving-related traffic collisions, fatalities, injuries and vehicle damages are present across all demographics, but are much more prevalent for certain subgroups. According to TIRF (2010), drivers more likely to be involved in crashes where distracted driving is a contributing factor are:

- younger drivers (aged 30 or younger);
- drivers under 20 years of age account for the highest proportion of distracted driving related fatal crashes; and
- drivers involved in rear-end collisions.

While younger drivers (i.e. those under 30 years of age) are more likely to be involved in a crash due to distraction, older drivers may actually have more distraction sources to deal with while driving. It is more likely that distracted drivers make more driving errors, such as following too close, or red-light running, and these errors result in near misses or crashes.

5.0 Determining Costs Associated with Distracted Driving-related Crashes

Generally, there are two categories of costs associated with distracted driving-related fatalities, injuries and vehicle damage. Typically, these costs may be described as either: direct costs or indirect costs.

Direct Costs

Direct costs include how much was spent in terms of real dollars as a result of a crash, for example, property damage, emergency response, hospital care, other medical care

and insurance administration and out-of-pocket expenses by victims of traffic collisions. However, Traffic Safety professionals point out that it does not take into account the broader harm to society resulting from a traffic crash. For this reason, Traffic Safety professionals tend to lean towards using other models that estimate the total costs to society from traffic related crashes. It is important to mention, however, that those costing models are described for informational reasons and they will not be applied in the Manitoba Public Insurance costing study.

Indirect Costs

Indirect or societal costs include both human costs and vehicle costs, and incorporate other costs not directly dependent on the level of damage to vehicles or injury to persons (Bureau of Transportation Economics (BTE), 2000). Societal costs include values that cannot be easily put into monetary unit and are more difficult to measure. For example, the disability of victims, loss of regular activity and the loss of quality of life to the victim. It is a challenge to assign a monetary value to a person's lost life or a partial or full loss of one's life enjoyment due to an injury or a disability. Even though there are commonly accepted numbers for the value of the human life they are debatable and different methods of estimating it result in different figures (BTE, 2000). There are two generally accepted approaches to valuing the fatality and injury components of road crashes: the human capital approach (also referred to as Discounted Future Earnings) and the Willingness to Pay approach.

6.0 Theoretical Models to Determine the Cost of a Distracted Driving-related Crash

In general, there are three basic costing models that may be applied to estimate the costs of a distracted driving-related crash. Each model has different assumptions and definitions which lead to different calculations and results.

1. Real Dollar Estimates (RDE): How much will this cost in real dollars spent?
2. Discounted Future Earnings (DFE): How much will this cost in terms of lost goods, opportunity, or productivity?
3. Willingness to Pay (WTP): How much would be paid for this not to have happened?

Real Dollar Estimates (RDE)

The Real Dollar Estimates model, involves an assessment of expenditures incurred. For example, in the case of a traffic crash, vehicle repairs, medical costs, insurance payouts, and the other direct monetary costs would be considered. The estimate represents

actual dollars that would be saved if the crash had not occurred. As stated earlier, it does not take into consideration the societal costs resulting from a traffic crash, such as lives made less productive or the costs of enforcement and the courts. This method underestimates the costs of a crash to society, however from an operational perspective may be the best method for estimating the "out-of-pocket" financial impact. A 2010 collision cost study commissioned by CRISP (Capital Region Intersection Safety partnership) examined the cost of collisions for the capital region of Alberta[5]. The study estimated that a fatal collision had a direct cost of $181,390, an injury collision a cost of $39,500 and a PDO (physical damage only) collision a cost of $10,900 (de Leur, Thue and Ladd).

Discounted Future Earnings (DFE)

Discounted Future Earnings sometimes referred to as the Human Capital Approach estimates the costs of a crash by calculating both the immediate dollars spent, and the productivity that society loses from lost days at work, reduced employment opportunity, or a life shortened. This approach results in larger costs than the RDE model, but is not a realistic estimate of actual dollar savings had the crash not occurred, as it deals with theoretical savings. This approach uses the discounted present value of a victim's future earnings as a proxy for the cost of death or injury. Some of the disadvantages of this model are that it may provide misleading results in an economy with less than full employment; and it may not fully address the issue of quality of life, pain, suffering and grief, due to actuarial uncertainties regarding life expectancy and earnings (BTE, 2000).

A variation of Discounted Future Earnings approach is the Friction Cost method. Under this model the loss of productivity experienced by society is limited to the time until another worker is found to replace the worker affected by the collision. As a result the costs estimated by this model are lower than those generated by the Discounted Future Earnings method (de Leur, Thue and Ladd).

The 2010 CRISP study of the Alberta capital region estimated that Discounted Future Earnings adds an additional cost of $1,669,088 to a fatal collision and $41,535 to an injury collision above direct costs for a total of $1,850,423 for a fatal collision and $81,059 for an injury collision (de Leur, Thue and Ladd).

[5] The capital region of Alberta is defined as being composed of Devon, Edmonton, Fort Saskatchewan, Leduc, Sherwood Park, Spruce Grove, St. Albert, and Stony Plain.

Another study (BTE 2000) provided estimates of the average costs of car crashes of various severities based on the human capital approach. Cameron (2002) has updated these estimates to year 2000 Australian dollar (AUD) values using the Consumer Price Index for Melbourne. The values were then converted into $US equivalent using 0.93 AUD/$US exchange rate.[6] Average costs by injury category were $1.6 million for a fatal crash, $379 thousand per serious injury crash, $13 thousand per non-serious injury crash and $141 thousand on average per crash across all categories.

Willingness to Pay (WTP)

The WTP estimates the value of life in terms of the amounts that individuals are prepared to pay to reduce risks to their lives." It is a comprehensive approach that reflects individual preferences and incorporates subjective welfare costs. It is the most widely accepted approach to date for calculating total societal costs. Although willingness to pay is seen as the best approach in determining societal costs, it has its own disadvantages which include the following:

- aggregating individuals' willingness to pay will not necessarily reflect the social willingness to pay due to the fact that individuals may ignore external social costs or benefits;
- methodological difficulties such as inaccurate responses to the willingness to pay questionnaire, consciously giving incorrect answers due to personal considerations, may mislead the results; and
- difficulties arise in applying the concept of a statistical life rather than a realistic or particular life, and due to individual differences in perception of risk and difficulty understanding and valuing small risks responses may not reflect individual's true willingness to pay (BTE, 2000).

A variation of the Willingness to Pay approach is Willingness to Accept. This approach attempts to measure what level of compensation a society or individual would accept as a result of a collision (de Leur, Thue and Ladd).

The 2010 CRISP study of the Alberta capital region estimated that the Willingness to Pay approach adds an additional cost of $5,362,458 to a fatal collision and $95,032 to an injury collision above direct costs for a total of $5,543,793 for a fatal collision and $134,556 for an injury collision (de Leur, Thue and Ladd).

[6] Initial values in Australian dollars were first adjusted for inflation and then divided by 0.93 to arrive at values in U.S dollars

A study of Canadian jurisdictions (Vodden et al., 2007) measured the social costs of crashes that occurred in 2004 using the Willingness to Pay approach. Social costs of the 613,000 motor vehicle collisions in this study were estimated at $62.7 billion. By type of collision, 62.2% of social costs were for fatal collisions, 32.4% were for injury collisions, and 5.4% of costs were for Physical Damage Only (PDO) collisions. The province responsible for the highest percentage contribution was Ontario at $17.9 billion (28.6%), followed by Quebec at $17.4 billion (27.9%) and Alberta at $9.1 billion (14.5%). Manitoba was the 6th largest contributor and accounted for $2.2 billion (3.5%) in social costs resulting from car crashes.

The Willingness to Pay (WTP) approach was used to estimate the costs of crashes of various crash levels (Corben et al., 1994). The estimates were then updated to year 2000 AUD values by Cameron (2002) and converted into $US equivalent using 0.93 AUD/$US exchange rate and the figures were as follows.[7] Average costs by injury category were $4.2 million for a fatal crash, $373 thousand per serious injury crash, $76 thousand per non-serious injury crash and $201 thousand on average per crash across all categories. For two out of the three severity groups and for the overall average, Willingness to Pay approach gave higher estimates than the human capital approach. Only the average cost of a serious injury crash was estimated slightly higher using the human capital approach, which may be due to methodological differences (Cameron, 2002).

Neither the Discounted Future Earnings or Willingness to Pay approaches account for the social cost associated with the fact that lives saved today will become a "burden" on the society in the future since the "consumption of the elderly must be financed by members of the labour force." Both approaches lead to a rise of social equity issue since in both cases wealthier individuals will be more likely to be valued higher than relatively poor individuals. The Willingness to Pay approach generally leads to larger estimates of the cost of car crashes than the human capital approach, while the latter, however, provides a "fairly reliable lower bound estimate of the social cost of crashes" (BTE 2000).

7.0 Summary of Literature

The interest for studies about distracted driving has grown over the past decade, especially with the enactment of distracted driving legislation. Due to the broad nature

[7] Ibid

of the definition of what constitutes distracted driving, there have been few studies examining direct dollar costs with respect to vehicle insurers. Most of the research has reported on the number of distracted driving-related fatalities, injuries and damages to vehicles caused by hand-held cell phone use while driving and texting as they contribute to traffic collisions.

Further improvements in the measurement of distracted driving will contribute to more complete information about distracted driving involvement in traffic collisions. No single study can capture all of the information required to provide a complete impact of the distracted driving problem. Increased tracking of driver distraction across Canadian jurisdictions is required to support future studies. Effective road safety programs to reduce distracted driving behaviours will require continued research to provide insight into causes of distraction and their consequences for road safety.

References

American Traffic Solutions (2016). https://www.atsol.com/distracted-on-red/

Blincoe, L., Seay, A., Zaloshnja, E., Miller, T., Romano, E., Luchter, S., and Spicer, R. (2002). The economic impact of motor vehicle crashes: 2000. U.S. Department of Transportation, National Highway Traffic Safety Administration.

Blincoe, L. J., Miller, T. R., Zaloshnja, E., & Lawrence, B. A. (2014, May). The economic and societal impact of motor vehicle crashes, 2010. (Report No. DOT HS 812 013). Washington, DC: National Highway Traffic Safety Administration.

Bureau of Transport Economics (BTE). (2000). Road crash costs in Australia. Report 102, BTE, Canberra.

Campbell, Brittany N. Smith, John D. and Najm, Wassim G. (2003, October). Examination of Crash Contributing Factors Using National Crash Daabases. Cambridge, MA: National Highway Traffic Safety Administration Research and Special Programs Administration.

Cooper, P.J. and Zheng, Y.Y. (2007). Estimating the Contributions of Speeding and Impaired Driving to Insurance Claim Cost, Journal of Safety Research.

De Leur, Paul, Thue, Laura, and Ladd, Brian. (2010). Collision Cost Study. CRISP.

Eby, D. and Kostyniuk, L. (2003). Driver Distraction and Crashes: An Assessment of Crash Databases and Review of the Literature.

Hedlund, J. (2006). International Conference on Distracted Driving. Summary of Proceedings and Recommendations. International Conference on Distracted Driving. October 2005.

Manitoba Public Insurance (2014). Traffic Collision Statistics Report.

Mayhew, D., Robertson, R., Brown, S. and Vanlaar, W. (2013). Driver Distraction and Hands-free Texting. Traffic Injury Research Foundation.

National Coalition for Safer Roads and FocusDriven (2013, June). http://ncsrsafety.org/news/stop-distraction-on-red-2013-study/

National Highway Traffic Safety Administration, (2013). 2012 Motor Vehicle Crashes: Overview. Report no. DOT HS 811 856. Washington, DC.

National Highway Traffic Safety Administration, (2014). Distracted Driving 2012: Summary of Statistical Findings. Report no. DOT HS 812 012. Washington, DC.

National Safety Council, (2013). Crashes Involving cell Phones: Challenges of Collecting and Reporting Reliable Crash Data. Itasca, IL.

Robertson, R., Marcoux, K., Vanlaar, W., and Pontone, A. (2011). The Road safety Monitor 2010: Distracted Driving. Traffic Injury Research Foundation.

Robertson, R.D. (2011). Distracted Driving: So what's the big picture? Traffic Injury Research Foundation.

Robertson, R., Bowman, K., and Charles, J. (2015). Distracted Driving in Canada: Making Progress, Taking Action. Traffic Injury Research Foundation.

Transport Canada and Canadian Council of Motor Transport Administrators (2011). 2008 Canadian Motor Vehicle Collision Statistics.

Transport Canada. (2011). Road Safety in Canada. Road Safety and Motor Vehicle Regulation. Retrieved from: http://www.tc.gc.ca/eng/roadsafety/tp-tp15145-1201.ht m#s32.

Vanlaar, W, Simpson, H., Mayhew, D. and Robertson, R. (2006). The Road Safety Monitor 2006: Driver Distraction. Traffic Injury Research Foundation.

Vodden, K., Smith, D., Eaton, F., and Mayhew, D. (2007). Analysis and Estimation of the Social Cost of Motor Vehicle Collisions in Ontario, Ministry of Transportation of Ontario.

Zheng, Y., Cooper, P., and Dean, C. (2007). Modeling the Contribution of Speeding and Impaired Driving to Insurance Claims Counts and Costs When Contributing Factors are Unknown, Journal of Safety Research 38, 2007.