

Travelling Safely into the Future

**Roy Symons P.Eng.
Manager of Transportation Planning
ISL Engineering and Land Services Ltd.**

**Paper prepared for presentation
at the Transportation Safety and Security Session
of the 2015 Conference of the
Transportation Association of Canada
Charlottetown, PEI**

Table of Contents

1	Abstract: Travelling Safely into the Future.....	3
2	Introduction	4
3	Statistics.....	4
4	How can we Achieve Vision Zero?	7
5	How can Planners make us Drive Less?	8
5.1	Build Compact Walkable Communities.....	8
5.2	Provide Safer Alternatives to the Car	10
5.3	Reduce the Need to Drive with Technology Solutions	11
6	How can Designers make Safer Roads?	11
6.1	Design Streets for Everyone.....	12
6.2	Set Design Speed to Posted Speed	13
6.3	Design Roads to Encourage Lower Speeds.....	13
7	What can make us Drive with More Care?.....	14
7.1	Speeding.....	14
7.2	Impairment.....	15
8	How Can Governments and Manufacturers make Safer Vehicles?	16
8.1	Advanced Vehicle Technologies	16
8.2	Distracting Advanced Vehicle Technologies.....	17
8.3	Older Vehicles.....	18
9	Future Safety Concerns	18
10	Summary	19
11	References	20

1 Abstract: Travelling Safely into the Future

80 percent of the 269 fatalities recorded by the Insurance Corporation of British Columbia in 2013 were attributed to speeding, impairment or distraction. While not explicit, that leaves just 20% that could be attributed to driver error, road design, weather or other accidental causes. These fatalities however, do not tell the whole story, there were many more that drove above the speed limit, drove impaired by alcohol or drugs, or drove whilst distracted, luckily many without causing a collision or fatality.

While acknowledging that there are some sections of roadway that need to be upgraded to improve safety in order to reduce fatalities, our roads are not inherently unsafe. In each location where a fatality occurred, there were many other drivers who were able to negotiate that section of roadway without incident.

It is difficult to address the speeding, impairment and distraction issues as they are subject to human factors. The majority of the population will drive sensibly but a small percentage will feel the rules do not apply either through disregard for the law, foolishness, or naivety. So where should we be looking to remove these fatalities from our statistics? At the roads? At the drivers? Or the cars themselves?

This paper considers how transportation trends are changing, now and into the future, and how these changes may specifically relate to reducing the number of fatalities caused by speeding, impairment and distraction. For example: emerging trends being used in raising awareness; ways in which better and more responsible driving can be incentivized; and how vehicle technology is changing in ways that improve safety.

Author: Roy is Manager of Transportation Planning with ISL Engineering and Land Services in BC where he works to improve communities by making good transportation planning decisions. Roy also runs www.transportation-planning.com a website providing an outlet for interesting transportation related things he comes across in his day to day life.

2 Introduction

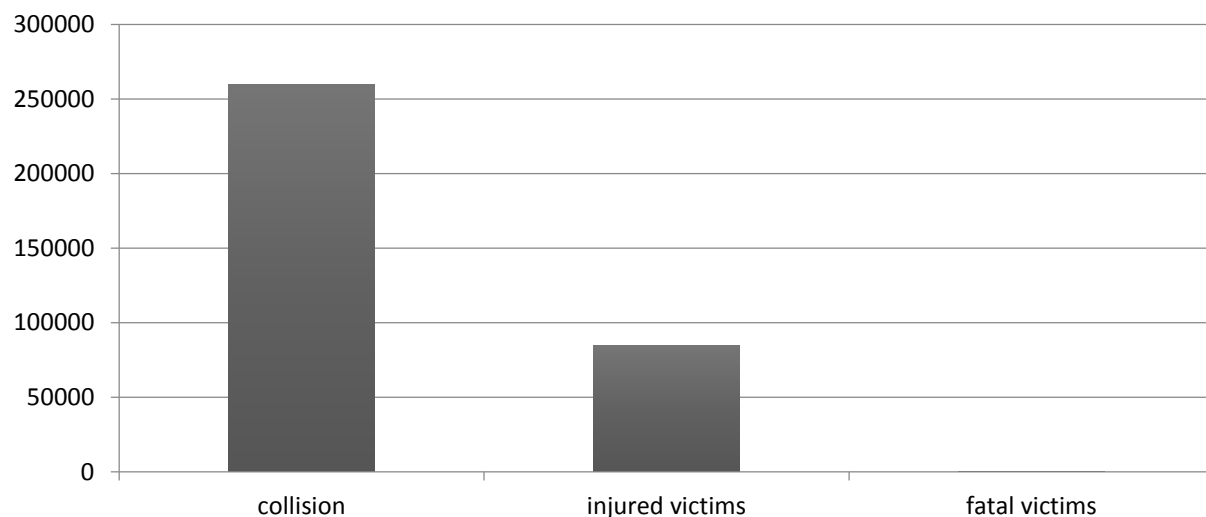
The theme of the 2015 Transport Association of Canada (TAC) Conference is '*Getting You There Safely*'. As a Transportation Planner with a need to look forward and plan for the future I wanted to consider how we could plan for a safer future. As I began to think about the many ways we could reduce collisions I began to categorize different solutions into different fields of expertise that are likely well represented by the staff and volunteers of TAC. This paper presents options to reduce collisions from the perspective of a planner, of a design engineer, from a vehicle standards perspective and from an individual perspective.

I hope as you read this that you think about your own travel patterns and choices, and how that can directly affect your own personal safety. If your work involves the planning, design or construction of communities and their infrastructure or the vehicles we drive I hope you think a little more about how your day to day job can influence safety and how small changes could reduce the number of vehicle collisions and fatalities.

3 Statistics

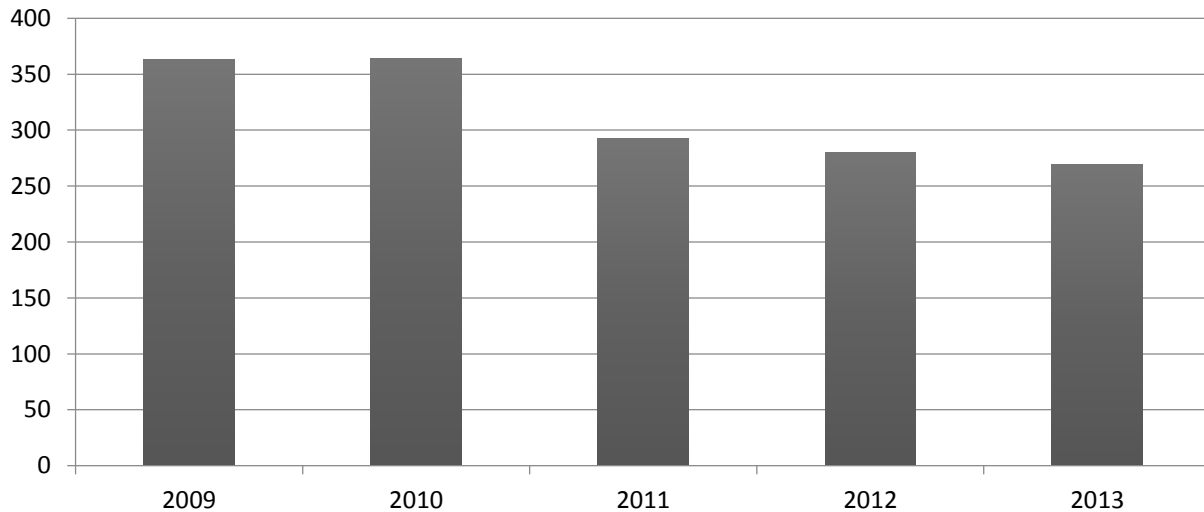
As a resident of British Columbia, I have focussed on statistics for that province. The number of total collisions (Figure 1) in BC has remained in the region of a quarter million each year from 2009 to 2013. Of those approximately fifty thousand have reported a casualty. Thus the number of fatalities (269) reflects a very small percentage, approximately 0.15% of total collisions or 0.73% of collisions including a casualty.

Figure 1: 2013 BC Collision by Type ⁽¹⁾



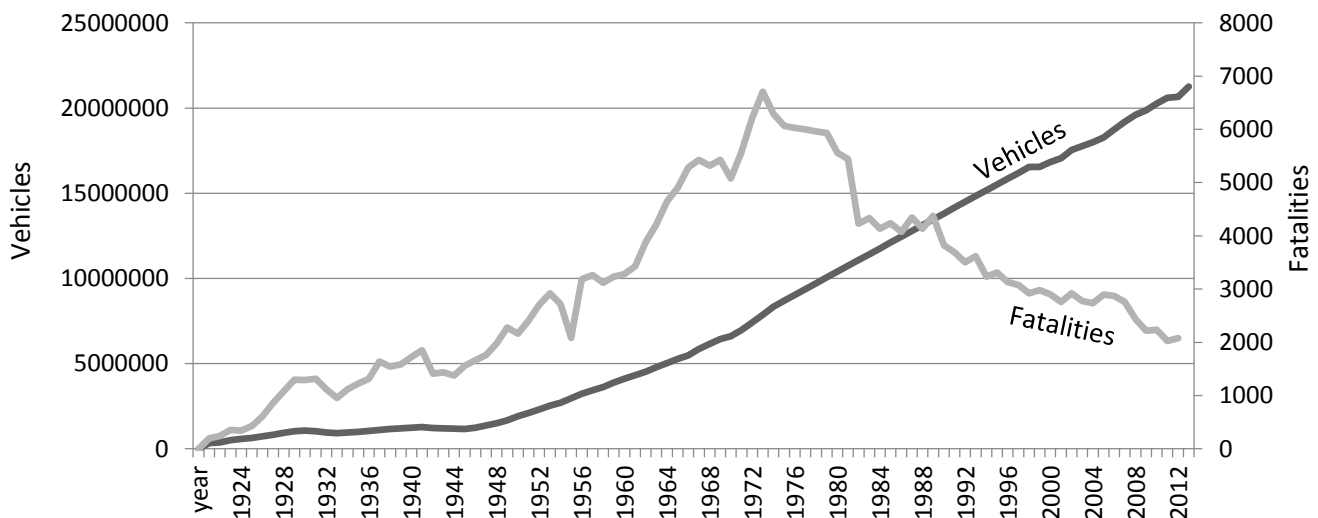
I think we can all agree that even one fatality on our roads is one more than we would like to see. Unfortunately, every year we see many more than that. In 2013 in British Columbia there were 269 fatalities (Figure 2) that were the result of a motor vehicle collision. On a positive note, fatalities have been declining over the previous five years.

Figure 2: Fatalities in BC ⁽¹⁾



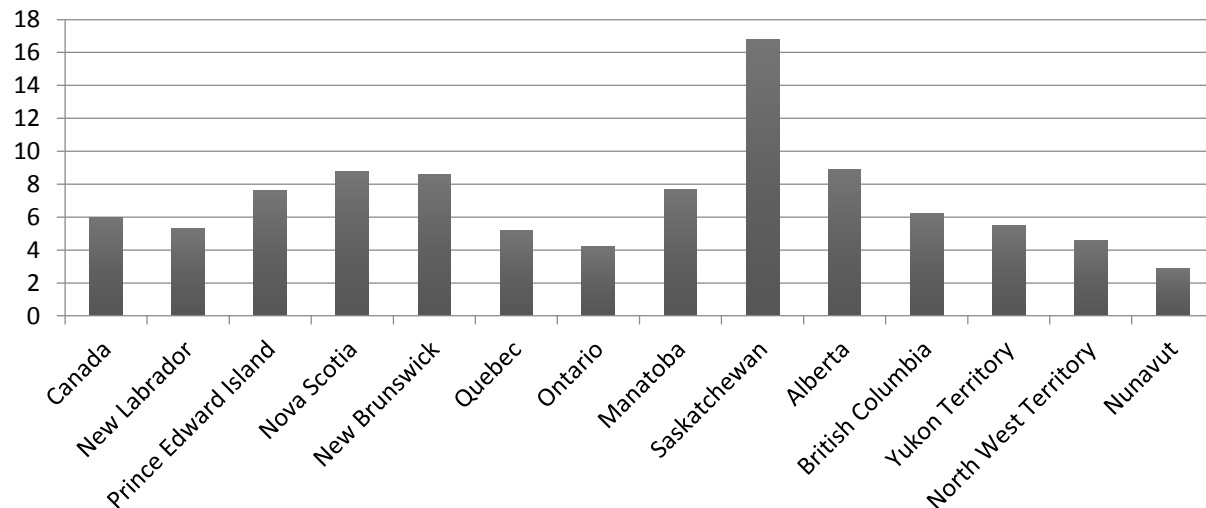
In many ways, this decline is due to safety improvements already made in the way we plan and design roads and the vehicles we drive, but it is still too many. Perhaps one of the biggest safety initiatives, making seatbelt use compulsory, was what started to reverse a historic pattern that had seen fatalities increasing year on year in line with the number of vehicles on our roads (Figure 3).

Figure 3: Fatalities v Car Registrations Canada 1921-2013 ^{(2) (3)}



British Columbia compares favourably with Canada as a whole, having approximately the same number of fatalities per 100,000 population (Figure 4). Ontario and Quebec fair better of the more populated provinces while Saskatchewan sees the number of fatalities almost twice that of other provinces.

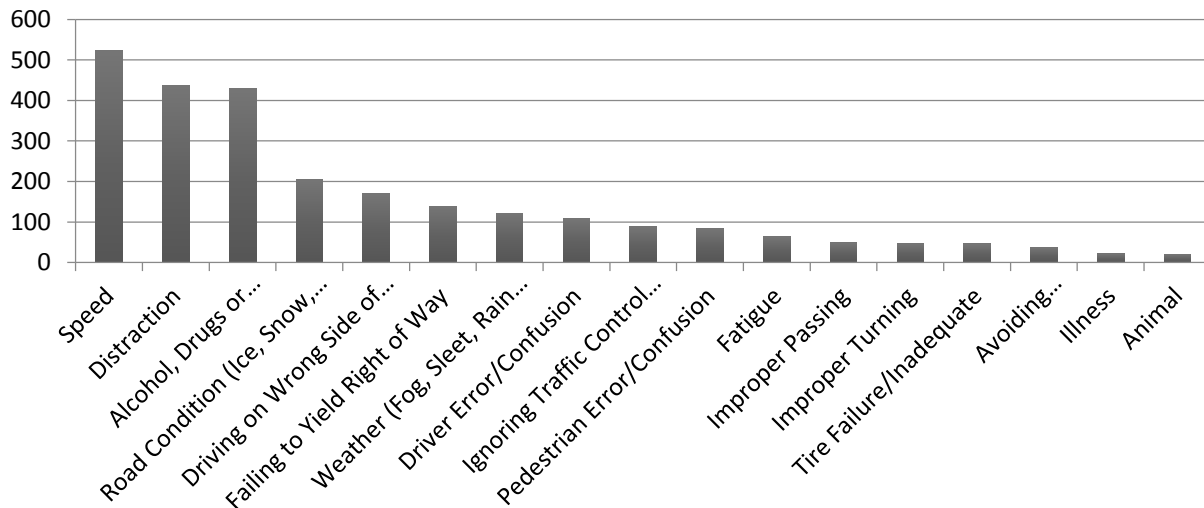
Figure 4: Fatalities per 100,000 Population ⁽⁴⁾



Initial investigation show the same predominant cause of fatalities in Saskatchewan as in BC, with speeding, impaired driving and distraction being the largest contributing factors.

If we are to consider ways to reduce or even eliminate the fatalities, we must first understand the contributing factors. The three primary factors are speed, distraction and Impairment (Figure 5). In most cases these can all be considered the results of personal choices or human factors. Those drivers didn't have to exceed the speed limit, they didn't have to drink and drive, they didn't have to look at their cell phone the moment they received that message, but some did and paid the ultimate price. Driving is something now taken for granted, and something we do automatically almost without a second thought. People must learn that it is a privilege that can be taken away.

Figure 5: Contributing Factors to Fatalities in BC ⁽¹⁾



These statistics have focussed on fatalities. Imagine how many collision or near collisions could have led to a fatality had events taken a slightly different turn. How many near misses are there every day? I'm sure many people reading this can recall a situation where they breathed a sigh of relief after avoiding such a near miss. The problem is that this happens all too regularly and the consequences are life changing, or worse, life ending. Cars are getting safer, road design is improving safety, and fatalities have been falling year on year for some time now. How do we take it further and eliminate fatalities entirely?

4 How can we Achieve Vision Zero?

Vision Zero⁽⁵⁾ is an initiative originating from Sweden based upon the premise that one life lost is too much, and the goal is to eliminate fatalities entirely. The premise is that humans will always make errors and that road system design should account for human fallibility in the design. It is an admirable goal and one we should all strive to support in whatever way we can both personally and professionally. It is now being adopted in many cities around the world.

I believe there are four main ways we can reduce fatalities further. We can drive less, we can build safer roads, we can drive with more care, and we can drive safer vehicles.

Motor vehicles are a relatively new phenomenon in the history of human beings, existing for a little over 100 years. If we go back to basics, before there were cars, there were no motor vehicle collisions or fatalities. Even now, if we all left our cars at home and walked everywhere there would be no motor vehicle collisions so the number of collisions is somewhat related to the number of cars, the amount we drive them and the

likelihood of conflict with other road users. It stands to reason that the less we drive, the lower our chances of being involved in a collision become. Transportation and Urban planners therefore can reduce fatalities by planning better communities that either reduces the need to travel or by offering alternative modes.

Our roads are not inherently unsafe, simply some locations require more care to negotiate. At every location where a fatality has occurred, there are many other drivers that were able to negotiate it without incident. Nevertheless, some locations are more collision prone than others, by eliminating the reasons these locations are collision prone, we can drive on safer roads. Our cities have been designed around the motor vehicle and roads are routinely designed with capacity and throughput in mind above all else. The very features that make these roads capable of carrying high volumes of traffic at high speeds are what make them inherently unsafe. As shown in Figure 5, speed is the number one cause of fatalities. An alternative approach is necessary that places an emphasis on safety.

The three top contributing factors were all human factors, speed, distraction and impairment. Compared to many years ago, education, enforcement and more restrictive limits have begun to change society's views on the acceptability of all three of these factors. It is not enough and many do not approach driving a car with the respect it deserves, many do not appreciate there can be consequences to their actions. But if we are to achieve vision zero, we must drive with more care. Understanding the life changing consequences of speed, distraction and impairment must continue to be something we strongly advocate for.

Lastly, safer vehicles will almost certainly negate all of the above at sometime in the future. Vehicles have been getting safer since the introduction of seatbelts, airbags, and anti-lock brakes. In time, autonomous vehicles will take out the human factors and in theory, if programmed correctly, remove all risk associated with actually driving the vehicle. Even if people continue to have a need for a car despite the efforts of our planners, they will be able to do their two hour commute in complete safety. In the interim, technology is improving every year some for the better, some less so. After the introduction of the autonomous vehicle, it will take time for older vehicles to reach the end of their life, and there will be those who will continue to want to drive themselves.

5 How can Planners make us Drive Less?

5.1 Build Compact Walkable Communities

The evolution of our world once saw us live and work in close proximity because we had to. We had no means to travel quickly over long distances. This changed during industrial times, as people no longer wanted to live in dirty polluted cities. The car was here and made it easy to leave, zoning was born and land uses migrated away from each other. Dirty industry for the most part has faded away but people continue to seek

the American Dream, which cannot be complete without your own home on your own lot. This dream is no different in Canada and many other parts of the world. We all aspire to bigger and better things.

However, in an increasingly overpopulated world this type of home ownership is not an efficient, nor sustainable use of land. As we can see below (Figure 6), there is barely a piece of Vancouver untouched by development, many of which are single family homes on their own lot, located far from employment. This creates a need to drive which increases our risk of being involved in a collision and potentially a fatal one.

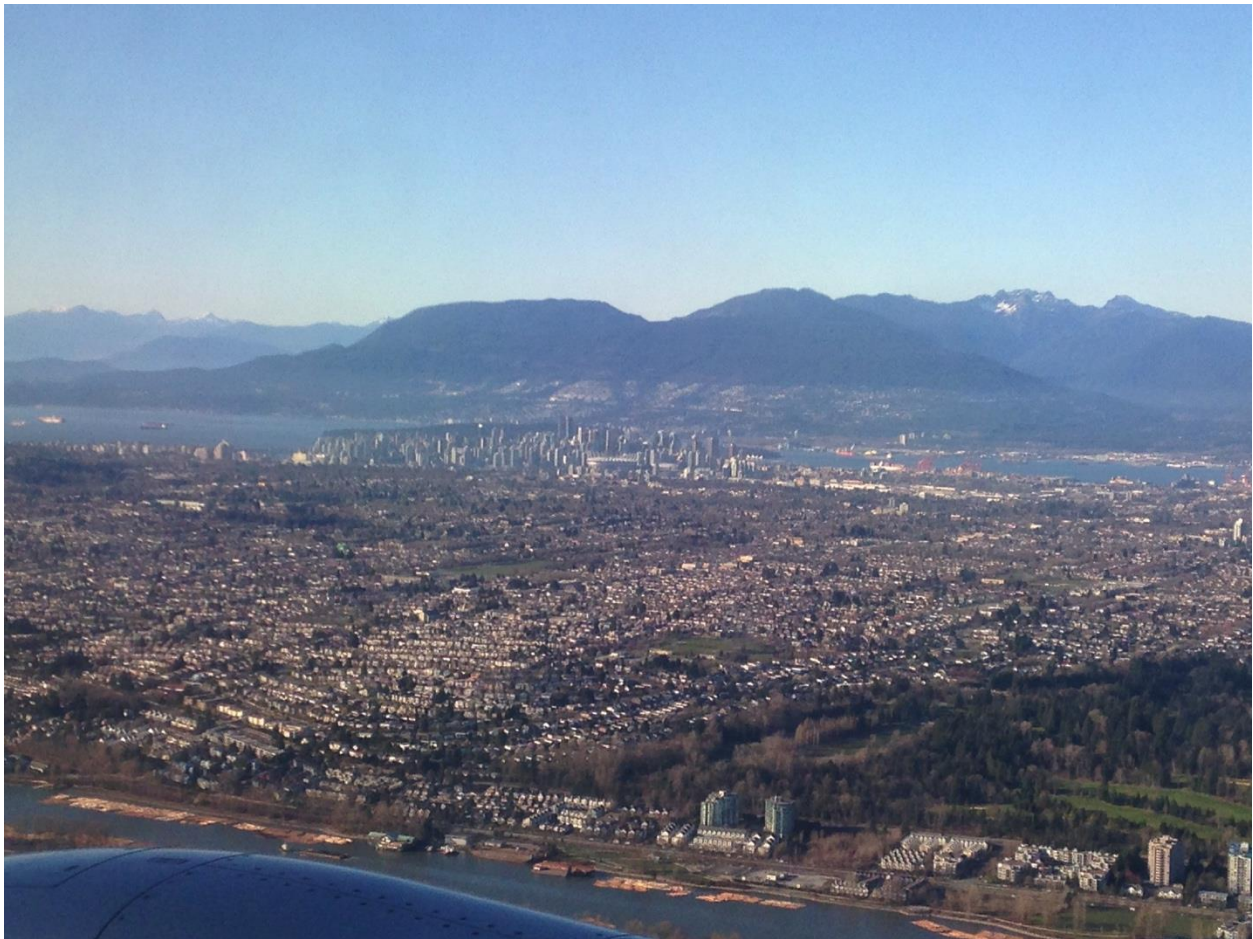


Figure 6: Vancouver from the Air

There is already an established movement towards city living, embracing this and advocating for this kind of lifestyle offers many benefits, but in relation to this paper, the reduced need to drive a vehicle undoubtedly results in a lower risk of collisions for those that choose this way of living, the more that do so, the better. So while not everyone is going to accept city living, it should be each City's priority in their planning process to

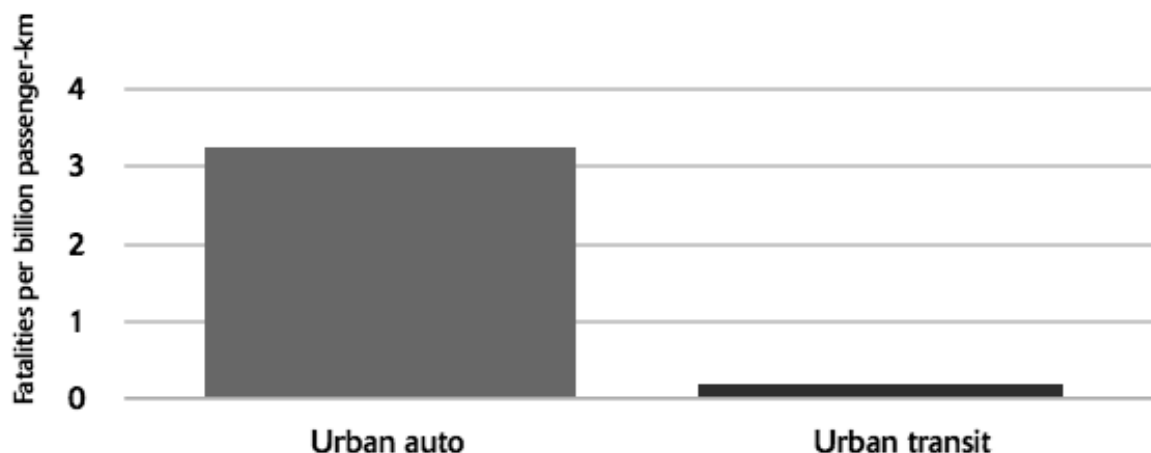
focus population growth in multi-family high density city centres where it will have the least transportation impacts.

The problem in achieving this today is house prices. Even if people wanted to live where they work, in many cases, they can no longer afford to. Affordable housing is ultimately the number one challenge in achieving a significant shift in population back to urban centres. Assuming there is responsible lending, a price crash (in Vancouver at least) does not look imminent. Given the constant need for growth in the economy, which requires growth in everything else, it is unlikely that this can be achieved without a significant change in policy. A mechanism must be found to force developers to provide a greater number of truly affordable units and over a range of configurations to allow individuals, couples and families on lower incomes the opportunity to live where they work.

5.2 Provide Safer Alternatives to the Car

The likelihood of being involved in a fatal collision while travelling by transit is much lower than whilst driving (Figure 7). Where a compact walkable city is not realistic, compact transit orientated neighbourhoods are the next best alternative, assuming transit provides appropriate links to the major employment centres. Whether it is single family homes or multi-family condo's, if there is no transit, then residents will have no option but to drive placing themselves at higher risk of being involved in a collision compared with taking transit.

Figure 7: Fatalities by Mode ⁽⁶⁾



5.3 Reduce the Need to Drive with Technology Solutions

Lastly in planning for safer mobility we must consider technology and techniques that can reduce our need to drive or allow us to drive at times of lower risk. Using technologies based around the internet, VPN network access, video conferencing and the telephone, we can often be just as effective working remotely (Figure 8) as we can from the office, removing the need to drive and the risk of a collision entirely.



Figure 8: Working Remotely Removes all the Risk of Driving

If we must be in the office, can we work flexible hours and travel at times where traffic volumes are lower and therefore there is lower likelihood of a collision? These simple things can reduce our personal risk greatly, collectively if many have the opportunity to change their travel patterns it could have a much greater benefit.

6 How can Designers make Safer Roads?

Even if through better planning, we reduce the need to drive, people will still drive, when they do so, it must be in an environment that encourages them to drive carefully. The old theory's of making driving safer by removing obstacles, increasing curve radii, and lane widths has only served to make it easier to speed and pay less attention. The TAC

Geometric Design Guide for Canadian Roads carries great responsibility and influence over our towns and cities. There is a movement towards focusing design on people rather than the automobile and while the TAC Guide recognises the importance of designing for all modes there are still some remnants left over from automobile focussed times that must change.

6.1 Design Streets for Everyone

Streets are for more than just cars, and many studies have shown those designed for people attract people, and in turn business, leading to a more prosperous economy. With respect to road safety people orientated cities are actually much safer than car orientated cities. Those cities designed for cars made roads wider and capable of higher speeds and as a result they attracted more traffic and faster traffic and it became easier for them to crash into each other. Those streets designed for people (Figure 9), no matter what mode they choose, slowed traffic down, provided safe space for each mode, and as a result, there were fewer conflicts. Those that did occur were at a lower speed resulting in fewer fatalities. Complete streets principles must be considered when designing new roads.



Figure 9: Hamburg, NY Main Street and Complete Street ⁽⁷⁾

6.2 Set Design Speed to Posted Speed

As stated above, speed is the top contributing factor in fatal collisions. The TAC Geometric Design Guide suggests that design speed should be higher than the posted speed (Figure 10), the reason being that it is safer for drivers if they exceed the speed limit.

flow characteristics	interrupted flow	interrupted flow	interrupted flow	uninterrupted flow except at signals and crosswalks		flow except at signals	(grade separated)
design speed (km/h)	30 - 40	30 - 50	50 - 80	50 - 70	60 - 100	80 - 110	80 - 120
average running speeds (km/h) (off-peak)	20- 30	20 - 40	30 - 70	40 - 60	50 - 90	60 - 90	70 - 110
	passenger	passenger	passenger	all types up to 20%		all types up to	all types up to

Figure 10: TAC Design Speed Recommendations ⁽⁸⁾

However, this achieves exactly the opposite effect. Because the road is designed for a higher speed, people drive at a higher speed, when they then make a mistake, the consequences are much higher due to the additional speed.

If you design a road for the speed limit, drivers are more likely to obey the posted speed because that is what feels comfortable. Because they are travelling slower they have greater reaction time to avoid a collision and if they are in a collision, at least the speed is lower and therefore it's less likely to be fatal.

The section on design speed must be rewritten to stop this trend of designing road for higher speeds than the posted limit.

6.3 Design Roads to Encourage Lower Speeds

Assuming design speed can be set to the posted speed limit, we must begin to design the features of the road to reflect that design speed. Number of lanes and lane widths are a big determinate of driver speed, in a highway environment it is acceptable that they be wider to allow for greater margin of error at high speeds. It is not logical that a 120 kph road requires the same lane width as a 30 or 50 kph road. If 3.65m lanes are fine on the highway, it should be much less on a slower street. In the urban environment they should be lower to remove margin of error and driver comfort, unknowingly forcing drivers to drive slower and more carefully.

By reducing vehicle lane widths it allows greater space for other modes and the creation of dedicated space for each, we can add bike lanes, wider sidewalks and reduce conflicts. The use of street furniture, trees and car parking on the street further narrow the roadway and introduce consequences for driving carelessly.

7 What can make us Drive with More Care?

If we are to drive with more care we must increase the public's sense of personal responsibility, understanding of the rules that must be followed when driving and the consequences of not following these rules. Unfortunately it is not something we can easily overcome in many cases, as some will disregard the law regardless of any consequences. This may be a medium term problem given technology may enforce vehicle speeds, and ultimately the self driving car may negate the hazard of impaired driving.

7.1 Speeding

Speeding is the largest contributing cause of fatal collisions, but other than a few spot checks little is currently done or can be done to deter this practice. Spot Speed cameras simply have a localised affect, average speed cameras can work well for a problem corridor but are not a province wide solution. GPS based tracking linked to incentivized insurance maybe the most likely way to reduce speeding and therefore fatalities caused by speeding. There are already schemes in some provinces within Canada (Figure 11) that offer reduced rates based on safer driving habits. The technology is there and it's something every insurance provider in the world should be utilising. Of course at present it is optional and more likely to be adopted by already careful drivers. Those that are less careful are unlikely to choose such a product unless it was made mandatory.

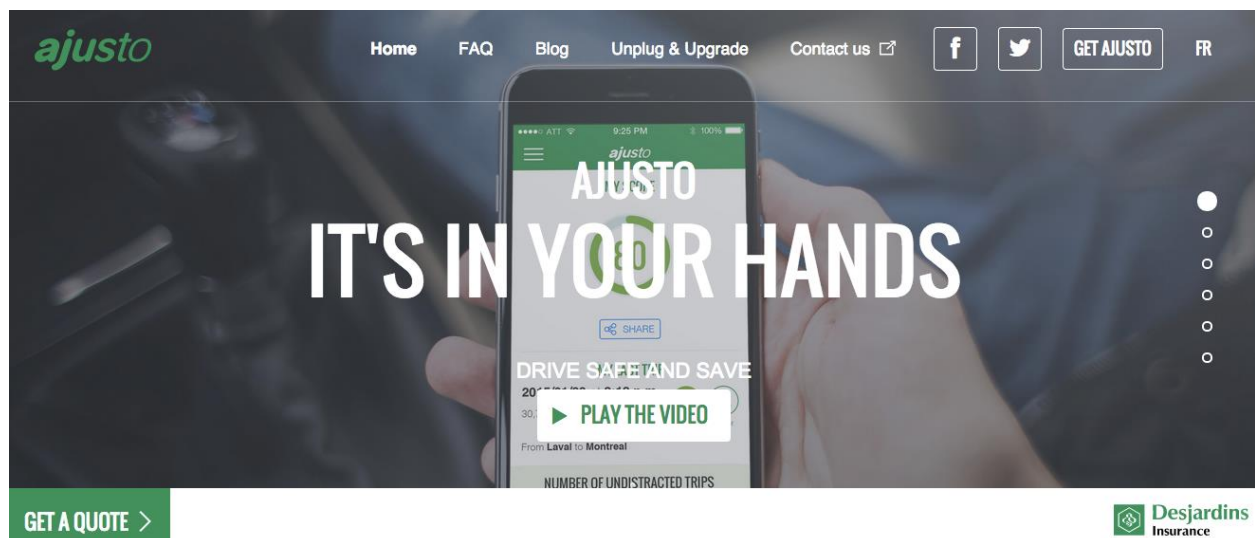


Figure 11: Ajusto Incentivized Insurance Example ⁽⁹⁾

Vehicle driving report cards (Figure 12) have been introduced recently from some manufactures, and allow the vehicle owner to review the driving history of the vehicle if it has been used by another person. It will report such metrics as top speed, sharp acceleration, and hard braking. This will be invaluable to many parents lending their car to their newly licenced teenage children. Young drivers are typically overrepresented in collision statistics, and such features could influence young drivers to drive with greater care than if unmonitored. This feature is so simple and can be implemented easily. It should be a standard feature on every car.

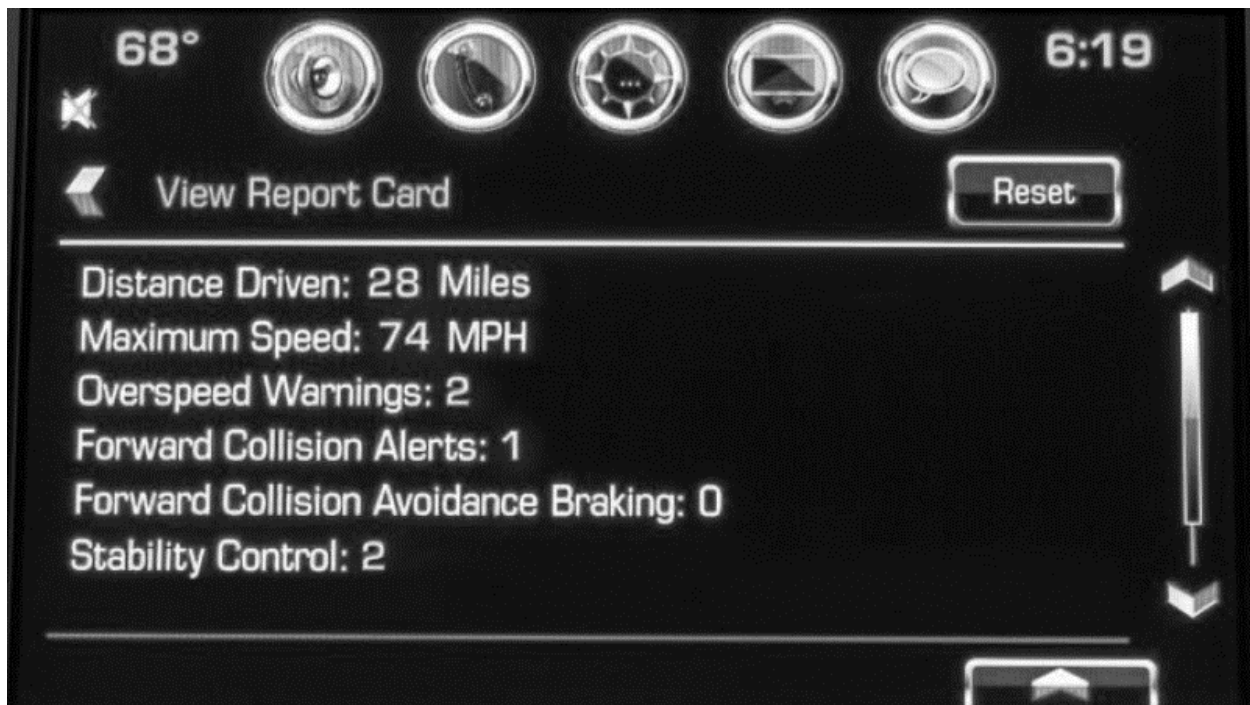


Figure 12: Vehicle Report Card Example by Chevrolet ⁽¹⁰⁾

7.2 Impairment

Impaired driving will continue to be difficult to deal with until humans are no longer responsible for control of the vehicle. It relies on personal responsibility and consideration of others within your community. Unfortunately, this is something that not all individuals possess, particularly when under the influence. Technology will ultimately solve the problem with self-driving vehicles, in the interim there is limited scope to influence someone who does not wish to take personal responsibility.

Continuing education and enforcement, perhaps with harsher penalties must continue, enforcing the message that there are wide-ranging and life-changing consequences to individual actions because of a lack of self-control. For those that have been caught driving impaired, some technology solutions such as alcohol interlocks can be installed in

vehicles requiring a breath sample before allowing the ignition to start. Preventing people offending in the first place must be the priority though and this can only be done through education and harsher penalties.

The other method of reducing the likelihood of impaired driving is to ensure suitable alternatives are available. Drinking establishments should be located only in close proximity to transit, transit must run past closing time and other services should be advertised and readily available such as taxi services and Uber.

8 How Can Governments and Manufacturers make Safer Vehicles?

Arguably, it is safer vehicles that have reduced the number of fatalities the most and stopped the increase in fatalities rising in line with the number of vehicles. As technology evolves, safety improvements are addressing more and more scenarios that could lead to a fatality, and it is safer vehicles that likely present the greatest opportunity to achieve Vision Zero. While early improvements such as seatbelts and airbags reduced the risk of fatality greatly once involved in a collision, emerging technology is now focussed on preventing a collision from happening.

8.1 Advanced Vehicle Technologies

Distraction is one of the major contributing factors to fatalities. Many things can cause distraction, the guy shaving on his way to work, the girl applying her makeup, the kids in the back seat fighting with each other. It is difficult to stop such things without enforcement. However, car safety improvements are now focussing on addressing distraction with a multitude of sensor technologies and associated driver warnings should a potential collision scenario be detected these include forward collision detection, lane departure warning and blind spot detection (Figure 13).

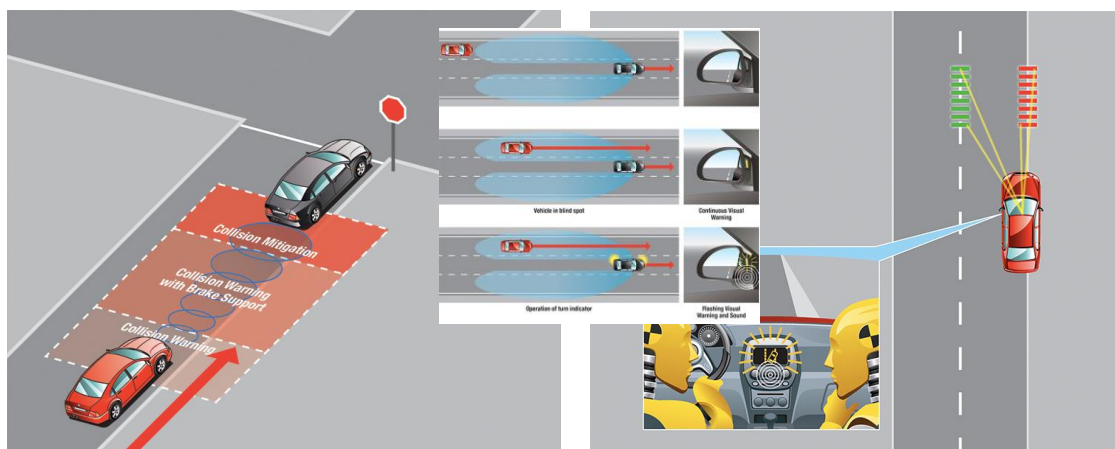


Figure 13: Driver Assistance Technology ⁽¹¹⁾

Forward collision detection uses radar and/or a camera systems to determine the distance from the car in front and can determine if a collision is likely, these system typically warn the driver if they are approaching too fast, and when necessary will apply the brakes to avoid a rear end collision. These systems are often also integrated with cruise control to provide adaptive cruise control that will maintain a safe distance from the car in front. Blind spot detection point the radar sensors behind the car and typically provide a light indicator in the wing mirrors to warn of a vehicle in the blind spot. Using similar technologies, lane departure warning is becoming increasingly common on new vehicles. They operate by detecting a vehicle crossing the painted lane markings on the roadway and activate if this happens when the turn signals are not used.

8.2 Distracting Advanced Vehicle Technologies

Some changes in vehicle technologies are less welcome. The government previously decided using our phones in the car was a bad idea, and in 2010, BC banned the use of hand held cell phones in vehicles, albeit Bluetooth has become a standard feature. Whilst this undoubtedly allows you to focus on driving more than holding your cell phone in your hand, my experience is that taking a call in the car definitely adds distraction, and results in reduced driver attention and awareness. Legislating manufactures to reduce such features will likely backfire however and result in more handheld use again. However, some technologies have been trialled that block cell phone use entirely inside the vehicle. The likelihood of this becoming available would require government enforcement, as people are unlikely to pay to include this in their vehicle.

Another recent trend which I feel is contributing to distraction are modern touch screen entertainment and control systems (Figure 14) which are often more complicated and less intuitive than a traditional system with buttons. Furthermore they often include web services and notification for social media services, and they are often used to control systems such as air flow and climate control. If you have ever tried adjusting the volume or heating by pressing an onscreen button you will know it is much more difficult to locate and requires a greater degree of focus on the screen compared with traditional controls. The design of such system is often less easily read than traditional controls, incorporating graphics, shading, and multiple colours, which require more focus from the driver to understand and interpret.



Figure 14: Touchscreen In-Car Entertainment and Control System ⁽¹²⁾

This is a worldwide problem, but the time has come to set some guidelines about in car entertainment system design. Emphasis must be on one-touch use with physical buttons that are easy to find without taking your eyes off the road.

8.3 Older Vehicles

Although vehicle condition seems to play little role in fatal collisions I still find it concerning that there is no annual vehicle safety check, in BC at least. In the UK for example, all vehicles over three years old must undergo an annual MOT inspection which performs a series of checks to confirm the roadworthiness of the vehicle.

9 Future Safety Concerns

Some issues have not been addressed which could hamper the vision zero goal, weather conditions, poor road surfaces, unpredictable wildlife, and mechanical problems could still result in fatalities regardless of addressing all the above concerns.

In addition new technologies may bring new issues with them. When everything becomes computer controlled what happens if the computer becomes corrupt and

crashes, what if connected vehicles are hacked, what if someone runs into the road and the vehicle has to decide between two possibly fatal outcomes?

10 Summary

At a personal level you can improve road safety by considering your travel patterns and how you can reduce the amount you drive. Next time the phone rings whilst driving, let it go to voicemail. If you are out for dinner, do you really need that one or two drinks and risk being over the limit? Most importantly, think about the consequences if you do make a mistake. It could affect not just your own life, but your family, your friends and complete strangers who did nothing but be in the wrong place at the wrong time.

If you are involved in the planning of towns, cities and their transportation systems, make sure safety is considered and think of less obvious ways to improve safety by reducing the need for people to drive, compact walkable mixed use communities with good transit are the key.

If you design roads, think about your design criteria from a logical point of view, ask yourself why you would design for a higher speed than intended, ask yourself if you are catering for people regardless of mode of travel or just those that are privileged enough to have a car. Design complete streets for all people, not just the privileged few.

If you have any influence over legislation and penalties associated with speeding and impaired driving, consider if the current penalties are sufficient, if they are, at least do your best to advertise what they are, and make people aware of the consequences.

If you work in the car design industry, or specifically in in-car entertainment and car control systems, stop with the touchscreens, bring back buttons and switches and hurry up with those self-driving cars! They will change the world as we know it and improve safety with it!

11 References

1. Insurance Corporation of British Columbia, Quick Statistics, April 2015
<http://www.icbc.com/about-icbc/newsroom/Pages/Statistics.aspx>
2. Statistics Canada, Historical Transportation Statistics, Series T271-284, Motor vehicle traffic accident victims, 1921 to 1975
3. Transport Canada, Canadian Motor Vehicle Traffic Collision Statistics: 2010,
<https://www.tc.gc.ca/eng/motorvehiclesafety/tp-1317.htm#2>
4. Transport Canada, Motor Vehicle Traffic Collision Statistics 2012
https://www.tc.gc.ca/media/documents/roadsafety/cmvtcs2012_eng.pdf
5. Vision Zero Initiative, <http://www.visionzeroinitiative.com/>
6. CUTA Issue Paper 23, Transit Safety and Security http://www.cutaactu.ca/en/public-transit/publicationsandresearch/resources/IssuePaperNo.23_TransitSafetyandSecurity.pdf
7. Image of Hamburg, NY's Main Street, Photo: Dan Burden, Walkable & Livable Communities Institute via flickr.com
<https://www.flickr.com/photos/completestreets/4566182096/>
8. Transport Association of Canada Geometric Design Guide for Canadian Roads, Table 1.3.4.2.
9. Image screenshot of Ajusto Car Insurance by Desjardins Insurance
<http://ajusto.desjardinsinsurance.com/>
10. Image of Chevrolet Malibu Report Card Feature by Autoblog
<http://www.autoblog.com/2015/04/02/new-chevy-malibu-helps-parents-monitor-teen-drivers-performance/>
11. Images of Transport Canada Advanced Vehicle Technology Graphics
<https://www.tc.gc.ca/eng/motorvehiclesafety/safevehicles-vehicle-safety-related-technologies-1068.htm>
12. Images of Touchscreen In-Car Entertainment and Control System
<http://thetrendythings.com/read/21664>