

# Threats to Canada's Transportation System

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## Abstract

The transportation system of any country is a vital part of their economy and public life. Country's national security is majorly based on the transportation system by which most of the commercial businesses are done through all coasts and parts of nation. The objective of this paper is to categorize numerous critical dangers and their relative safety measures on Canada's national transportation system such as rail, road, marine and air transportation. Transportation system may face natural, accidental and malicious harms. The national transportation structure is so crucial that a damage of such conveyance mode or system would have a devastating impact on national economic security, public health or safety, or any other critical sector such as trade or business. Critical hazards and vulnerabilities to transportation systems through various modes of damages were recognized for a long time and many new ways and regulations came out to reduce and regulate those deficiencies after such big causes of devastation. Canada's transport ministry had induced many new conventions and safety supervision systems in order to prevent and minimize the critical threats to major transportation systems of the nation. Canadian government had introduced various safety programs such as CATSA (Screening Contractor Management System) for airport security and safety management system (SMS) for rail security. This paper will also discuss various recommendations and safety measures to be taken while various critical conditions happen and it also contains a possible solution to various problems regarding the security of various modes of transportation in Canada.

**Keyword-** Critical infrastructure, critical threats, national security, public safety, Transportation security

## I. INTRODUCTION

Transportation in Canada is categorized in four major modes such as air, rail, road and marine. The transportation sector has an important impact on the economic development of a nation. The transportation system in Canada is majorly collective in the growth of trade, finance, and energy (oil & gas) industries. Road and rail transportation are mainly focused on the enhancement of tourism and business sectors while air and marine transportations are effective to trade and energy supply industries.

Canada is world's second-largest country in total area, which represent to have transportation system with a high-capacity and efficient network in the nation. Canada has widely spread transportation system which includes 1,400,000km (870,000mi) of roads, 10 major international airports, and 300 smaller airports, 72,093 km (44,797 mi) of functioning railway track, and more than 300 commercial ports and harbors that provide access to the Pacific, Atlantic and Arctic oceans. <sup>[8]</sup>

Transportation in Canada has a major influence in country's economic growth. For instance, in the year 2005, transportation industry had contributed 4.2% of GDP which is comparatively higher than the GDP contribution of 3.7% by mining and oil & gas extraction industries. <sup>[8]</sup>Most Canadian cities and town has its own efficient and convenient transport systems.

These transport systems are designs as per the city's need and flow of traffic. There are several major cities in Canada, which has their own significant transport system. For instance, Toronto has the subway, Montreal has the metro, Vancouver has its sky train and Ottawa own an O-train. This transportation system is a heart of country's growth and economic development in many ways which suggest the importance of safety and security of these modes of transportation.



Fig. 1: Major Transportation systems in Canada  
Source: [https://en.wikipedia.org/wiki/Transportation\\_in\\_Canada](https://en.wikipedia.org/wiki/Transportation_in_Canada)

## II. SCOPE OF THE STUDY

The main scope of this research belongs to a study of major transportation threats and their relative vulnerability in Canada. The transportation industry is a high sensitive mode to convey food, energy and goods to a various location of a nation, which promptly suggest having high safety and security of this mode in order to maintain an economic and public growth of the nation. There are mainly four major transportation systems are considered for the study such as rail, road, air and marine transportation. This main mode of transportation is significantly responsible for country's growth in the economic sector which suggest having better safety and security. There is major kind of hazards are considerably affect this mode, which are natural, accidental and malicious destructions.

## III. OBJECTIVE OF RESEARCH

This paper will aim to study the identification of the major causes and effects of the transportations hazards. There are several factors which could create threats to the transportation system and such causes may result in big hazardous. This paper is mainly focused on the study of threats and vulnerabilities of the major transportation system of Canada and it will also recommend the various ways to secure various mode of conveyance system in the nation.

This paper is intended to clarify the transportation hazards and recommend suitable steps to preserve it.

Main points to be considered in the study are given as

- To identify the type of hazard to transportation system and their relative recommendations.
- To categorize the various sources of causes of threats and give suitable solution to them.

## IV. THREATS TO CANADA'S TRANSPORTATION SYSTEM

The transportation system in Canada is most advanced in today's date which reflects the amount of serviceability and efficiency of this infrastructure in the nation. The transportation industry is principally connected with several other sectors to maintain the growth of a nation. Energy supply, food and public health, communication and government finance and trade is mainly dependent sectors on the transportation system. In addition, failure of such system may affect these critical sectors in many ways which may result in a big hazardous condition in the nation. There are several types of threats which could affect the transportation system such as natural threat, human-caused and accidental or technical.

These are some most critical threats to transportations system of Canada are described below.

### A. Natural Threats

69.9% of hazardous in Canadian history have been accounted due to natural disasters. Floods and severe storms are a most serious threat to be identified for the big hazardous conditions. [8] Road, rail, air and marine transportation system may face such hazardous condition due to natural threats. Figure 2 show the rail failure due to flood in Calgary in the year 2003 and another devastating image of road failure happened in Calgary during a same flood event.



Fig. 2: Damaged LRT tracks over the Elbow River between Erlton and stampede station. Calgary, 2003  
Source: <https://www.tumblr.com/search/Calgary-flood>

Flood and some other land centered dangers could affect rail, road and marine transportation severely. Severe storm and climate change may create hazardous conditions for air transportation mode. As mentioned in the Public safety general of the Canadian government, Geomagnetic storms, earthquakes, forest fires, tsunamis and health-related epidemics all represent significant natural hazard threats to Canadian transportation system. [3]

There are several case occurred due to natural hazards which deliberately affect the economy of a country. For instance, in last few years, death due to natural hazardous decreased. However, the economic cost has increased due to such defects.

### B. Accidental Threats

Accidental is basically meant unforeseen happening or hazardous. There are several hazardous which could happen due to many unanticipated circumstances. According to a government of Canada's threat analysis, Accident occurred due to human error, mechanical failures, and computer programming errors are considered as accidental threats. [3]



Fig. 3: Air Canada Flight 797 end in a tragedy  
Source: <http://deicinginnovations.com/?p=4892>

There are various accidents happened in Canada due to human error and given image (figure 3) show the tragedy of Air Canada Flight 797 in year 1983.

Road collisions, aircraft crash and system failure are a major accidental threat to a transportation system. These kinds of failures are mainly affected by air and rail transport systems as this mode of transportation are vital and constructively based on

the technical provision. Marine and road transport system are also affected by many accidental threats such as vehicle collision, oil spilling due to human error and so on.

### C. *Human Caused or Malicious Threats*

Transportation and major Infrastructure has long been a target for malicious attack, whether for criminal or political purposes. Transportation supports society, delivering a range of services upon which, other sectors depend. <sup>[2][3]</sup> Any damage or interruption cause calamity across all the sectors. There are range of factors to distract transportation infrastructure such as high destructive weapons (from conventional weapons, weapons of mass destruction - including chemical, biological radiological and nuclear agents, to cyber tools), physical bomb and so on. These weapons could be in any destructive range to destroy any size of infrastructure, whether it is a small bus or a huge airport. Human caused threats are effective for long time, which has been used to destroy critical point of nation which may induce many economic losses to nation. There are several other way to harm the system which include cyber-attacks and biological hazardous. Air, rail and marine transportation is dependent on cyber communication and as a result harm to that system may create malicious circumstances for sector of transportation.

## V. EFFECTS OF CRITICAL INFRASTRUCTURE ATTACKS

Transportation infrastructure could face various critical conditions after the attacks or hazardous incidents. There could be three type of attacks on transportation system as we discussed before which includes natural hazardous, human error or accidental threat and malicious or human-caused hazardous. All different attacks have different effects and outrage on various transportation systems. Natural disasters can have a significant impact on transportation infrastructure elements in a short period of time.

The primary point of impact tends to be the physical infrastructure, such as Airports, rail stations and bridges. The ice storm in Central and Eastern Canada in 1998 is an excellent example of the degree of damage that can occur in a short time period. <sup>[10]</sup>

This is a brief note about various effects on transportation infrastructure after severe attacks.

### A. *Impacts of Natural Disasters on Transportation System*

- 1) Natural disaster have most severe effect on transportation system as it could be flood, earthquake, severe storm, climate change or any other natural threat.
- 2) Flood and storm are most severe and common threats to transportation system in Canada as many regions and areas are prone to such kind of hazardous. As a result, government is spending more on this area to secure major transportation system from flood and storm. However, during last some years these maintenance techniques and finical allowance on these hazardous is meant to have no beneficial results on the protection factor, which directly impact on finical account of government and result in economic loss.
- 3) The impacts of natural disaster could create many deficiencies in the system and also effect on economic and public growth of nation.

### B. *Impacts of Accidental Threats on Transportation System*

- 1) According to Canadian threat analysis report, accidents can interrupt service and supply of telecommunications and energy, disrupt transportation networks (e.g. creating bottlenecks in rail networks), and disrupt hundreds or thousands of people, and cause injury or death. <sup>[10]</sup>
- 2) Accidental threats are severe cause of damage in transportation system and it also a major cause of human fatality.
- 3) The increasing interconnectedness of transportation system means the impact of an accident is greater and more widespread. For Instance, in 2000, the Port of Montreal handled more than one million 20-foot-equivalent units (TEU's), equaling 9,205,120 tons of cargo. The port serves markets in Ontario, Quebec, and the U.S. Northeast and Midwest. <sup>[3][10]</sup> The accidental sinking of a ship in the Montreal harbor could freeze activities on the docks, disrupting rail traffic across North America and causing ships to be denied entry to the port or be diverted to other ports. <sup>[10]</sup> This is an example of accidental threat on port which depict the high amount of damage and fatality. <sup>[3][10]</sup>

### C. *Impacts of Malicious or Human Caused Threats on Transportation*

- 1) Malicious attacks on transportation system may impact the delivery of service, such as, health care, energy, food and major transportation modes.
- 2) As per the previous discussion impacts of this accident can cause severity in a large area as the amount of service is spread along wide area. For instance, the explosion at the Utah Power electrical plant during the 2001 Salt Lake City Olympic Games caused a power outage that left 33,000 homes in Salt Lake, Davis and Tooele counties without power for nearly one hour and later sparked a fire at the Tesoro oil refinery in North Salt Lake. Smoke from the fire was so thick that Interstate 15 had to be closed. During the power outage, the airport ran on emergency generators. (Government of Canada [threat analysis 2003], p.35). <sup>[8][10]</sup>
- 3) Human caused or malicious harms are most devastating and mostly responsible for major human fatality. There are many past attacks happened due to such reasons which caused major property loss, human deaths and injuries. For instance,

Attacks on London rail and bus transit in July 2005 is one of the most devastating example of human caused attacks. There are 59 human fatality occurred along with 700 small injuries during the event of London attacks.

## VI. TRANSPORTATION SYSTEM PROTECTION

Government is always responsible to ensure safety and security of particular critical transportation system during the most severe and hazardous conditions. Protection of these modes of conveyance is always a major concern for government in order to maintain the economic growth of nation. There are several ways to protect such transportation modes from severe conditions. Transportation could be harm by many ways. For instance, accidental threats, natural threats and malicious hazardous. There are suitable ways to protect system with their relative threats. Air and rail are most critical modes of transportation, which should be protected in any ways as major trade and economic developments are based on it.

### A. Protection of Air Transportation

- 1) Canadian government has proposed special security program called CATSA Screening Contractor Management System Standard to make sure the security of air transportation in several critical conditions. The main purpose of this standard to ensure that all passengers are properly screened and have proper baggage at any designated Canadian airport. <sup>[11]</sup>
- 2) Government also proposed program called The Air Travelers Security Charge (ATSC) in April 2002 to fund the air travel security system, including CATSA, Transport Canada's regulations and oversight activities. This system is majorly based on funding to all security services on all major Canadian airports to ensure the security level. This service is payable by passengers who indirectly the benefited for this security services.

### B. Protection of Rail and Subway

- 1) Rail safety is one of the important part of transportation protection system. Rail safety is highly regulated in Canada, transport Canada (TC) has managed to look over several sector of safety in rail transportation which includes safety regulations, legislation and rules.
- 2) Safety Management Systems (SMS) was implemented by *railway safety act* in year 1999 to ensure better protected and safe rail transportation. Safety management system is not the replacement of existing rules and regulations by railway safety board but it represent the additional level of regulation through which railways must emphasis on risk management and safety performance. Safety management system (SMS) added some new requirements for railways to ensure several criteria.
  - To make sure to have safety targets and report result to transport Canada;
  - Develop processes to ensure employees are aware of regulations;
  - Mitigate hazards to reduce or eliminate risks;
  - Measure, monitor, and track hazards and defects.

## VII. RECOMMENDATION

Security and safety of transportation system can be protected by evaluating the threats and vulnerabilities. After that, a plan to counter threats and vulnerabilities should be developed. Counter threat plans could help to minimize the threats on the transportation system. There are some criteria need to be fulfilled to ensure the transportation system protection. <sup>[1][3]</sup>

- Assessing Transportation Infrastructure threats and vulnerabilities to physical, natural or accidental attacks.
- Development of such plans to eliminate substantial vulnerabilities and threats.
- Development of plans for alerting, comprising and rebuffing attacks in progress.
- Propose systems for identifying and preventing attempted major attacks.

These are various important recommendations to be considered while making plans for security and safety of transportation system. A security-organization should be established to deliver timely information to government departments about threats, actual attacks. Security agencies are also responsible to ensure type of threat or attack on particular mode of infrastructure which could helpful to rescue area of accident.

## VIII. CONCLUSION

Transportation system and assets are very important to a country because they contribute a share to the social life and the economic growth of nation. Transportation modes are very crucial in order to maintain trade, tourism, health & food and medical sectors of the country. These transportation systems must maintain their conditions in any circumstances. There are many threats and vulnerabilities exist within and around these infrastructures. This paper discusses the threats that exist in transportation substructures. Transportation Infrastructure vulnerabilities were also discussed along with the possible solutions to these problems. There are numerous recommendations discussed within the body of paper which clarify the idea of safety and security of system. Transportation infrastructures must be protected since they are so vital to the society and economy.

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