

INTRODUCTION TO THE CTRF 2024 CONFERENCE

Joseph Monteiro, Barry E. Prentice, and Anna Robak

The theme of the 2024 conference is “Mobilizing Transportation Research in Canada”. COVID-19 has now receded into the past and supply chains are again being reconfigured in light of the Russian-Ukrainian war, the Israel-Hamas war and the water level problems in the Panama Canal. In this post COVID-19 environment, deep questions in transportation policy, equity, technology, cross-agency visibility and collaboration, climate change, funding and financing of infrastructure, and data use are explored.

At the 59th conference, CTRF defines the most important transportation research needs for the good of Canada and strengthens ties with the organisations and communities that have the biggest questions and challenges. During COVID-19 work habits of individuals changed dramatically and with that travelling to work vs. work from home. Changes to online purchases also increased. All these developments affect transport needs. Airlines increased cargo capacity dramatically and now face excess supply and competition issues. Adjustments in supply chains and changes in transportation routes caused by changing work patterns, climate and weather disasters, wars in the Ukraine and the Middle East are creating ongoing problems. To add to this, inflation, dramatically higher interest rates, and labour unrest have created for less predictable world. Climate change is driving consumers to adopt electric vehicles, but lack of charging stations creates uncertainty. How are policy and regulations adapting to these changes? The conference proceedings contain a rich collection of papers on these issues with particular emphasis on the post-Covid-19 impacts on transportation systems, mobility of people, and transit. These proceedings demonstrate the range and depth of topics that make the Canadian Transportation Research Forum the foremost annual venue of its kind.

Organization of the Proceedings and an Overview of Individual Papers

The papers in this Proceedings are organized under eighteen sessions. 1.1 Supply Chain; 1.2 Transportation Modelling and Emerging Issues; 1.3 Policy, Equality and Sustainability; 2.1 Rail Freight and Ridership; 2.2 Air Transportation; 2.3 Data and Technology; 3.1 Aviation and Maritime: Big Picture; 3.2 Improving Urban Air Quality; 3.3 Sharing, Hailing and Volunteering; 4.1 Logistics; 4.2 Getting to Net Zero; 4.3 Household Choice; 5.1 Danger! Crashes and Hazardous Goods; 5.2 Active and Green Transportation; 5.3 Business Cases & Pricing; 6.1 Minimizing Disruption; 6.2 Electric Vehicles; and 6.3 Emerging Urban Transportation Issues. A summary of each paper is provided hereafter.

1.1 Supply Chain

Mark Hemmes, Warren Bohm - A Comparative Analysis of West Coast vs. East Coast Routing of Grain to Global Destinations

The largest proportion, over 70%, of Western Canadian grain is shipped from west coast ports. The question of why more grain shippers did not use an eastern routing was prompted by the massive flooding from an atmospheric river in November of 2021. At the time, railways proposed that alternate routing of traffic through eastern ports would alleviate the strain on the supply chain. Most shippers and exporters saw an alternative routing as economical. The idea of diverting more traffic through eastern ports, however, has continued to be raised by one of the railways and members of government as an option to alleviate some of the stress on the West Coast supply chain, even in normal operating periods. This analysis looks at the reasons, economic and logistical, why shippers prefer the west bound routing for the majority of western grain movements.

Razieh Larizadeh, Babak Mohamadpour Tosarkani - A Data-Driven Optimization Approach for Operational Efficiency and Environmental Impact Reduction in the Plastic Industry

This research aims at reducing logistics and environmental costs within the plastics industry by optimizing production planning, particularly in the exploration of recycling opportunities. Due to ever-changing market demand, it is crucial to consistently reassess operational decisions. To tackle this challenge, the authors propose a data-driven rolling-horizon planning approach that leverages historical data to adjust to market changes. Through a comprehensive study, they examine the impact of varying rolling horizon durations on logistics costs and environmental effects. The authors' findings highlight the significant potential of employing the proposed approach to enhance production efficiency and address environmental considerations.

Mohsen Roytvand Ghiasvand, Babak Mohamadpour Tosarkani - Optimizing Plastic Bottle Recycling: A Data-Driven Approach to Closed-Loop Supply Chain Design

Recycling plastic can provide environmental as well as economic benefits. There are, however, some challenges associated with recycling plastic bottles. The location and the number of different entities in the network influence the overall performance of the Supply Chain Network (SCN) for plastic bottles. Moreover, the value of uncertain parameters, such as demand and return rates, can affect the overall configuration of the SCN. Therefore, a Mixed-Integer Linear Programming (MILP) model is introduced in this paper to configure a plastic bottle SCN. The results indicate that the proposed framework can avoid over-conservative solutions and ensure that optimal solutions are feasible.

Lawrence Mckeown, Zahra Aback - A New Strategy for Supply Chain Data in Canada

This paper starts with an examination of supply chain disruptions and impacts on employment, business recovery and prices. Although these initial impacts appear to have subsided to some extent, there are longer term challenges such as extreme weather events, productivity, and an aging workforce that remain lurking. It concludes by describing existing and new data metrics that are being proposed to help support the resiliency of Canada's supply chains.

1.2 Transportation Modelling and Emerging Issues

Nick Tepylo, Jeremy Laliberté - A Canadian Survey on Transportation Mode Choice and Automation

In this study, a survey was conducted to gain insight into participants' conventional travel behaviours and to assess how autonomous modes of transportation would influence their preferences. The stated preference survey found that for intracity travel, participants preferred public transportation over rideshare services mainly due to the lower cost. For the studied intercity route between Ottawa and Montreal, the majority of respondents chose the rail option, again due to its lower cost over urban air mobility. Automation made little difference in mode preference in comparison with cost. The current use of rideshare services influenced willingness to pay as those familiar with a pick-up and drop-off model responded more favourably to more expensive modes of transportation. Studies such as this will assist in influencing policymakers to develop equitable and informed transportation policy.

Bita Farokhian, Catherine Morency - Multi-Modal Travel Demand and its Variability through Different Phases of Covid Using Statistical and Machine Learning Time Series Models: A Case Study of Montreal

This paper captures demand variability of 5 modes of transportation including bikesharing, carsharing, subway, taxi, and bus through different phases of COVID spanning from pre-COVID (Jan 2019) to post-COVID (April 2023) in the Greater Montreal Area. Different datasets are employed. First, change point detection methods are employed to identify mode-specific phases of COVID with the same underlying time series characteristic. The variability of travel demand is measured and compared between different phases of each mode and between different modes using time series variability indicators. In the final

step, given defined COVID phases and exogenous variables such as weather and type of the day, prediction models are designed to measure the impact of each phase of COVID-19 on demand variability as well as predict future trends of demand variability for each mode.

Matilda Lucas, Amy Kim, Kiranjot Kaur, Carlos Molina Hutt - Healthcare Accessibility in Seismic Events: A Metro Vancouver Case Study

The study aims to assess and compare the accessibility of emergency medical care to the population and also seeks to identify areas that experience greater changes in healthcare accessibility from a baseline scenario. The authors' goal is to develop an analysis framework that can be applied to cities with similar inputs. These findings are expected to assist healthcare authorities towards earthquake disaster planning activities, including identifying where emergency services may be most efficiently located, and identifying areas with lower accessibility to healthcare facilities in post-earthquake scenarios that require increased attention.

Bijoy Saha, Mahmudur Rahman Fatmi, Nazmul Arefin Khan - Investigating the Impacts of Telecommuting Using an Agent-based Transport Demand and Network Simulation Model

The authors in this paper aim to evaluate the impacts of telecommuting on 24-hour traffic flow using an agent-based transport simulator. Methodologically, a nested structure has been implemented to generate departure time, mode, and destination choice joint decisions and accommodate their inter-dependencies. Given the behavioural differences among different population groups, separate models are implemented for these different groups. Following the generation of the 24-hour activities, activity itineraries are applied within a dynamic agent-based multimodal transport network model using the open-source MATSim platform. This modelling and simulation exercise has been implemented for the entire population of the Okanagan, B.C. The simulation results suggest that with the increase in telecommuting population, an increase in all types of non-mandatory travel in the off-peak hours of the day occurs.

Fatmi, Mahamudur, Ahmed, Mostaq - Unveiling Activity-Travel Patterns After The pandemic: Findings from the British Columbia Activity-Time Use Survey (BC ATUS) – Wave 1

The opportunity to meet our daily needs by performing activities virtually (e.g., work-from-home) and/or in-person (e.g., work-at-the-office) has changed the way we used to go around in our daily life. This has changed our travel demand and these changes may have occurred in temporal, spatial and modal dimensions. Data to accurately quantify travel and tele-activities, their inter-relationship and consequent changes in travel demand is not commonly available. With this motivation, we have undertaken a longitudinal time use survey that includes a 24-hour activity log – i.e., gathering information on how individuals use their time virtually and in the physical space. The first wave of this survey has been conducted from October - December of 2023 in the Okanagan and Metro Vancouver regions of British Columbia, which will be discussed in this paper.

1.3 Policy, Equality and Sustainability

Sanjay Castelino, Joseph Monteiro, Barry E. Prentice - The Important Regulatory Developments In Canadian Transportation In 2022 And 2023

Regulations that affect transportation have been used to achieve various policy goals. These regulations often have a direct effect on the costs, profits, and services that transportation companies can provide. They also have a direct effect on services available to consumers and on protection to consumers because they are safety and health related. While some changes are made rapidly others take years before they are woven into the fabric of the overall transportation laws. This paper reviews the important regulatory and

policy developments in Canadian transportation during 2022-23. Major developments are examined in each transportation subsector (air, rail, water, and road) together with a brief comment. The conclusion considers some of the impact of these regulations and the emerging policy themes for the next few years.

Wolfgang H. Schulz, Oliver Franck, Henrik Kleis - Facilitating Paradigmatic Shifts in Mobility Solutions through Strategic Economic System Architectures Lessons from Europe's GAIA-X Projects for Canadian Transportation Policy

This paper focuses on the GAIA-X mobility projects and analyzes the development of decentralized platforms as a strategic counterweight to the dominant hyperscalers in digital mobility. New mobility solutions based on digital identities are introduced to accelerate innovations. The theoretical foundation of the authors analysis is based on the theory of institutional role models. The authors demonstrate how these theoretical concepts can be applied to the concrete development of business models for the mobility sector. They illustrate how the European transportation policy, through the GAIA-X projects, brings forth innovative solutions that could also be of interest to Canadian transportation policy.

Maria Laura Guerrero Balarezo, Geneviève Boisjoly, Martin Trépanier, Léa Ravensbergen, Steven Farber - Transport Poverty in Canada: Prioritizing public transport investments

This paper proposes a methodology to calculate an index to measure transport poverty at the national scale. The index is generated for many Canadian cities, at the Dissemination Area and Dissemination Block levels, combining a social disadvantage component with a transport disadvantage component (integrating public transport). By comparing Canadian cities, the presentation shows how social and transport disadvantages interact towards transport poverty and Transport Related Social Exclusion, and the need to have different schemes to interpret the index depending on the levels of compactness/dispersion of urban fabrics and the urbanity/rurality of the territories being assessed.

Sonya Sula, Kirk Goodlet - Removing Barriers to Accessibility in the Canadian Transportation System

Transportation is a key priority area under the Accessible Canada Act in order to build a barrier-free Canada by 2040. There has been a focus on solutions that address specific disabilities rather than the barriers encountered during travel. This paper discusses the importance of focusing on the barrier instead of the disability. Furthermore, the obligations of the service provider and the crucial role of manufacturers in reducing barriers to equal participation in the Canadian transportation system are examined. This paper analyzes the potential for emerging technologies to eliminate barriers for people with disabilities. Accessible technology, as well as the demographic of users, outpaces regulatory change. This paper raises the question of what transportation service providers can do to bring stakeholders up to speed.

Derya Parmaksız, M. Ali Ülkü, Heidi Weigand, Denise Hinds - On Sustainable Rural Logistics and Transportation: Perils and Prescriptions from a Quadruple Bottom Line Perspective

In a climate-changed world, rural logistics and transportation (RLT) calls for a comprehensive understanding of context and research for effective solutions. Challenges in RLT include low population density, long distances, high distribution costs, poor road conditions, and infrastructure issues. These cause a lack of public transportation and limited logistics operations in rural areas. The authors explore alternative solutions to public transportation and to increase accessibility for rural communities, as well as some barriers to implementation. Considering the quadruple bottom-line (QBL) pillars of sustainability, the author underlines that cultural sustainability warrants further investigation, which is a significant gap in the RLT literature. Furthermore, this study provides valuable information to policy-makers adopting the QBL perspective and stimulates topics for further research. m-Line Perspective

2.1 Rail Freight and Ridership

Malcolm Cairns - The Development of Private Freight Rail Cars in North America

Many freight rail cars in North America are neither directly owned, nor leased by the railroads themselves. This paper is described in three parts. Part 1 reviews the historical development of private freight cars from the onset of the railway industry in the 1830s up to the present time. Part 2 provides a profile of all freight cars “by number, type of car, and commodities” over the past 10 years to 2022, and then focus on the private freight cars and the rules and regulations associated with their use. Part III will look to future developments.

Lucia Stuhldreier, Ryan Gallagher and François Tougas - Consequences or Conjectures: The Impact of Extending Railway Interswitching Limits

The re-introduction in 2023 of a temporary expansion of regulated interswitching limits in the prairie provinces renewed the debate regarding the potential adverse consequences of increasing the scope of this pro-competitive mechanism. An analysis of publicly available data relating to the previous expansion of interswitching limits from August 2014 through July 2017 and the more recent legislative and regulatory developments casts doubt on speculative predictions of increased congestion, loss of traffic to United States corridors and threats to the financial viability of Canadian railway companies.

Conner Wylie, Lucia Stuhldreier - Yours or Mine: A History of Interswitching in Canada

Recent developments in rail freight regulation in Canada and the United States have stimulated public discourse around the role that regulated interswitching can play in supporting fair and effective rail supply chains. However, railway regulation, particularly in Canada, cannot be divorced from history. This paper will explore the history of interswitching in Canada, from the first interchange movements at the turn of the 20th century, through the introduction of the National Transportation Act, 1987, to the 2023 temporary expansion of regulated interswitching limits in the Prairie Provinces. By reviewing interswitching, this paper seeks to properly contextualize the contemporary discourse around regulated interswitching and provide a solid base for future discussion about the role of regulated interswitching.

Ryan Gallagher, Lucia Stuhldreier, François Tougas - Setting The Record Straight: FAIR Rail Coalition's Response to Public Claims and Analyses Regarding International Rail Freight Rate Comparisons

In early 2023, the Railway Association of Canada (RAC) published a report prepared by CPCS, comparing rail freight rates in Canada to rates in other jurisdictions. In response, the FAIR Rail Coalition engaged several recognized experts to assess the RAC claims and the CPCS methodology and findings. The FAIR response exposes misleading or false conclusions drawn by RAC and others, including the RAC claim that Canadian freight railways “[o]ffer the lowest rail freight rates among leading trading nations showing the robust competition that exists between Canadian railways”. FAIR’s response demonstrates that the CPCS report compares rail freight rates between countries whose rail systems are not comparable. The authors’ analysis examines these critical errors and addresses the faulty conclusions.

Harshini De Silva, Narendra Malalgoda - Exploring Factors Affecting Rail Ridership In The US: A Comprehensive Analysis

Rail ridership in the US plays a pivotal role in sustainable transportation, urban mobility, and economic development. Understanding its significance is vital for policymakers, urban planners, and transportation authorities to devise effective strategies aimed at enhancing rail systems nationwide. This study conducts a comprehensive time series analysis to examine the influential factors shaping rail ridership trends across the US. As a first approach, the research employs temporal regression models to identify the most influencing factors of rail ridership for individual agencies. Then, it subsequently extrapolates these factors to encompass a broader understanding across all agencies, consolidating insights obtained from

each. The goal is to contribute valuable insights for developing targeted strategies that address demographic considerations, promote equitable and sustainable rail transportation in urban environments.

2.2 Air Transportation

Barry Prentice, Narendra Malalgoda, John Wilms - Fallout of the covid-19 pandemic: Air Cargo Boom and Bust

The COVID-19 pandemic prompted major shifts in the aviation industry, with a significant downturn in passenger demand leading airlines to pivot towards cargo operations. In response, airlines worldwide strategically restructured, investing in conversions of passenger aircraft into dedicated cargo service, and repurposing passenger aircraft to carry freight. As the pandemic wanes and passenger demand rebounds to pre-pandemic levels, a unique challenge emerges - excess cargo capacity. This article presents an economic model of belly freight on passenger flights, as a by-product, and the profit margin risk of dedicated cargo carriers that operate on by-product freight rates. This research aims to provide a comprehensive understanding of the economic challenges posed.

Christopher Greer, Ian Kincaid - Building Resilience in the Face of Future Shock Events: A Systematic Methodology for Airports

The COVID-19 pandemic has shown that many aspects of the aviation sector were vulnerable to a major shock event. With few tools currently in place in forecasting, infrastructure, and financial planning to predict or identify shock events, airports and other economic actors in the aviation and transportation sector suffered major negative impacts during the pandemic. The paper will present a five-step methodology which will enable users to identify and describe shock events, understand their potential impact across an airport's business, and develop strategies to mitigate and withstand the potential impacts of a future shock event. The objective is to provide airports and other users the tools to build a more resilient business model and create a better understanding of strategic risks facing the aviation industry.

Hongting Zhou, Saiedeh Razavi - Air Freight Demand Forecasting using CNN- LSTM Model

Air freight transportation plays a pivotal role in global trade and commerce by facilitating the rapid and efficient movement of goods. Reliable and accurate air freight demand forecasting enhances supply chain efficiency, allowing strategic resource allocation, operational cost reduction, and improved logistics management, which contribute to a more resilient network. Because of the impact of numerous socio-economic factors and unforeseen events, it is still a challenge to capture the patterns from quantitative data of air freight demand and obtain favorable forecasting results. In this study, the authors utilized an efficient forecasting method based on the CNN-LSTM model to capture the intricacies and variability in freight demand. It provides valuable insights for freight management, allocation, and forecasting.

Maryna Klymchuk, Robert Parsons, Paul D. Larson - Canada and Ukraine: A Comparison of Opportunities for Sustainable Aviation Fuel

Reducing greenhouse gas emissions from aviation is critical for achieving CO2 targets. According to IATA estimates, sustainable aviation fuel (SAF) could contribute around 65% of the reduction in aviation emissions needed to reach net-zero by 2050. SAF can be produced using a variety of oil seed crops, of which Canada and Ukraine are both important producing nations. In both countries, financing of SAF production is an important issue. The use of green bonds (debt securities issued by organizations to finance or refinance projects that contribute positively to the environment and/or climate) is explored as a potential financing tool for SAF products in North America and Europe. This paper compares and contrasts SAF opportunities in Canada and Ukraine.

Teresa Krings, Josh Chang, Iryna Borschchova, Jeremy Laliberte - Building a Model for Safe Integration of RPAS into Low-Level Canadian Airspace

This paper addresses a crucial gap to build a low-level uncorrelated Canadian encounter model by employing established methodologies. Such a model assumes no air traffic control (ATC) involvement and focuses on altitudes below 10,000 feet above ground level, of interest for near-term RPAS operations. By employing track filtering methods, data handling protocols, and Bayesian networks, the model provides information on aircraft behaviour as speeds, turn rates, accelerations, vertical rates, and aircraft classifications. Applications of these models include the evaluation of detect-and-avoid equipment and hold the potential to support evidence-based policy development. By enhancing the understanding of intruder aircraft behaviour, the authors can better model the risk associated with low-level altitude RPAS flight, supporting the development of policies that enable their safe integration into Canada's airspace.

2.3 Data and Technology

Saba Sabet, Bilal Farooq - WiFi Sensors and Artificial Intelligence in Crowd Management and Forecasting

This study presents a WiFi-based crowd counting approach applied to GO train platforms, offering insights into robust crowd analysis methodologies. Using WiFi probe request data and MAC address tracking, the authors created occupancy heatmaps revealing crowd behaviors and platform usage patterns. The findings showcase detailed visual representations of platform occupancy at 15-minute intervals, providing critical insights into peak hours on weekdays and weekends. Discrepancies between WiFi sensor and PRESTO transaction data during specific timeframes highlight the need for further investigation into ticket usage modes. This study offers a cost-effective means for crowd management and infrastructure planning. It serves as a scholarly cornerstone in augmenting public space safety and optimizing transit systems, particularly during pivotal events and peak periods of activity.

Ahmad Mohammadi, Joseiry Marrero Rivas, Tanvir Chowdhury, Peter Y. Park, Greg Pereira - From Conventional Simulation To Virtual Reality: A Novel Tool For Investigating Truck-Friendly Measures In Freight Traffic Management

Traffic congestion poses significant challenges, notably increased travel times, greenhouse gas emissions (GHG), and traffic incidents in freeways. One potential solution is the implementation of truck only lanes, which prioritize truck traffic and separate it from other vehicles to alleviate congestion. This study aims to assess the impact of truck-only lanes as a truck-friendly measure on Highway 401 in Durham Region, Ontario. It spans 62 km length with 26 interchanges on the Highway. The authors employ three measures of effectiveness, i.e., travel time, GHG, and traffic conflicts as a surrogate measure of traffic incidents.

Ali Faisal, Suliman Gargoum - Automated Assessment of Pavement Rutting Using Mobile LiDAR Data

Pavement rutting is a common but critical form of deterioration in road surfaces that results in an uncomfortable ride for drivers while exposing them to potential safety risks including hydroplaning and loss of skid resistance. Conventional automated rutting assessments typically depend on cross-sectional pavement analysis to detect rutting. This may not yield a thorough understanding of the full scope and severity of distresses across the entire pavement. This research proposes a tile-based novel method for measuring and quantifying pavement rutting from LiDAR data by using road surface fitting and computational geometry algorithms.

Ali Ardestani, Hao Yang, Saiedeh Razavi, Zhao Zhang - Enhancing Traffic Speed Prediction with Neural Temporal Relational Networks (NTRN) and Missing Data Imputation

Accurate traffic prediction is crucial for efficient transportation system management. Despite advancements in data collection technologies, missing data remains a challenge for prediction models. This research introduces an innovative approach to enhance traffic flow prediction by integrating the

Neural Temporal Relational Network (NTRN) with missing data imputation methods. Unlike traditional methods like Long Short-Term Memory (LSTM) networks, NTRN demonstrates superior capabilities. The integration of NTRN with missing data imputation techniques proved instrumental in predicting traffic congestion even in the presence of data gaps. The results showcase the efficacy of the proposed approach in advancing traffic prediction accuracy, demonstrating its potential for real-world application.

Farah Ghizzawi, Matthew J. Roorda - Developing a parking choice model using the fusion of limited data: The case of commercial vehicles in Toronto

In this study, the authors deploy data fusion to develop and estimate a parking location choice model for commercial vehicles in Toronto. Multiple data sources are used to identify explanatory variables and choice sets. First, GPS data of travelled routes is used to construct tours, hence inferring stop locations, durations, and frequencies, as well as trip attributes, like day, time, inbound and outbound trip lengths, etc. Second, parking location attributes are inferred from data specifying the typology of the parking infrastructure, including type, cost, and capacity and/or occupancy. Third, the authors deploy industry sector as an indicator of commodity and/or service type. A buffer zone is created and establishments within this zone are classified by industry. The authors' predictions are validated against the results of a road-driver intercept survey conducted by the Ministry of Transport of Ontario.

3.1 Aviation and Maritime: Big Picture

Barry E. Prentice, Ross Prentice and David Willis - Solving the Housing Crisis In Northern Canada: Year-Round Cargo Airship Service

Canada has 128 identified remote communities with a population of 123,435 people (2021 census). The housing shortfall for these communities is estimated to be more than 15,000 dwellings. This housing gap is increasing because housing construction cannot keep up with the rapid population growth rate, deteriorating structures and cost. The most important barrier to overcoming the chronic shortage of suitable housing is the lack of affordable, year-round cargo transport to the remote Northern communities. This paper reports on an economic study of cargo airships to transport building materials through six gateways to Northern Canada.

Jody Kositsky, Kirk Goodlet - Becoming a Liability Rather Than an Advantage" 30 Years of the National Airports Policy

In 1994, the Canadian Government officially released the National Airports Policy (NAP), concerning the future of Canada's airports. The NAP would launch a new era of airport operations in Canada, with the devolution and privatization of the 26 larger or capital airports across the country. The Canadian model of not-for-profit airport authority remains a unique operating model globally. While there are successes of the NAP, with billions invested in capital infrastructure, this has come at a cost. This paper will review the key elements of the NAP, the driving forces behind the policy, the policy options that were considered, the performance of Canadian airports over the last 3 decades and consider whether the policy has achieved its stated purpose. Looking forward to the next 30 years is the NAP the right system?

Desai Shan, Cory Ochs, Evan Mackenzie - Maritime Labour Convention, 2006 Amendments: Lessons For Canada

COVID-19 public health restrictions degraded the labour and human rights of seafarers globally. Seafarers were denied access to medical care, repatriation, shore leave, and timely access to adequate food and water. In 2020/21, more than 400,000 seafarers were stranded at sea beyond their contracts. The fourth meeting of the Special Tripartite Committee of the International Labour Organization voted on amendments to the Maritime Labour Convention (MLC), 2006. This paper discusses the strengths and gaps reflective of approved changes to the legal instrument.

Rishi Luthra - Navigating Seamless Connectivity: A White Paper on Canada's Need for a Maritime Single Window

Vessel arrival and departure reporting is crucial for port efficiency and trade success. The International Maritime Organization's Facilitation Committee (FAL) Convention aims to streamline maritime trade. Studies show paperless trade can significantly reduce export costs and compliance time. Canada, as an IMO member, adheres to the FAL Convention, stressing the need for Maritime Single Window (MSW) to meet international standards. This white paper examines MSW's role in Canada, addressing the challenges faced by seafarers and agents due to documentation complexities, drawing from other countries' MSW successes, and outlining a strategy for Canada's MSW implementation, considering potential obstacles and benefits for the Canadian maritime industry.

Ahmed Moussa, Elkafi Hassini, Mohamed Ezzeldin, WaelEl-Dakhkhni - Investigation of Heavy-cargo Drones for Last-mile Delivery

Using drones for package delivery has gained significant attention from researchers, industry, and policymakers. Drones offer a cost-effective and efficient alternative for goods delivery, enabling faster and more reliable deliveries than traditional methods. Using drones for heavy cargo transport has been under-explored in the literature. The current study fills this knowledge gap by investigating the potential of this topic. Specifically, the study develops a framework to conceptualize the operations of a fleet of drones and assesses the associated feasibility. Subsequently, the study applies the framework to address traffic congestion problems around Hamilton International Airport and shows that the annual operating costs of a fleet of drones are cheaper than that of a fleet of trucks but requires a high investment cost.

3.2 Improving Urban Air Quality

Seyed Hamid Delbari, Vahid Hosseini - Quantifying the Impact of Transportation on the Air Quality of the City of Vancouver through a PMF Analysis of Year-round PM2.5 Samples

In a specific case study conducted in the City of Vancouver, the positive matrix factorization method was used to quantify the contribution of road traffic to overall particulate emissions. This investigation utilized data collected during the timeframe spanning from January to December 2018. The outcomes revealed that Transportation-linked air pollution (TRAP) sources account for roughly 33 % of the total reconstructed mass of PM2.5. When compared to the 2015 Vancouver's emission inventory, the latter notably underestimates the TRAP contribution signifying the importance of field-measured analysis for a credible source apportionment. The above approach holds promise for accurately identifying the primary as well as the secondary local sources leveraging toward new sustainable transportation policies enactment or evaluating the impact of the ongoing policies.

Amir Hossein Karbasi, Hao Yang - Exploring factors affecting emissions on all types of Ontario's highways: A multivariable regression approach

This research aims to fill the lack of comprehensive research by examining the elements affecting emissions on Ontario's highways. It involves categorizing these highways based on different criteria like speed limits, number of lanes, truck percentage, and traffic demand, resulting in approximately 11,000 scenarios. These scenarios were analyzed using the SUMO simulator, focusing on emissions including CO, CO₂, HC, PM_x, NO_x, and fuel consumption. The study utilized multivariable regression to investigate the relationship between these emissions (dependent variables) and factors such as speed limits, number of lanes, truck percentages, and traffic demand (independent variables). The derived equations offer valuable insights for policymakers, aiding in the prioritization of different elements in emission reduction strategies and the refinement of related policies.

Rei Bertoldi, Yasamin Sharifi, Rivkah Gardner-Frolick, Sakshi Jain Jain, Nika Martinussen, Naomi Zimmerman, Amanda Giang - Using Dispersion Modeling And Low-Cost Sensor Monitoring To Estimate Neighborhood-Level Air Pollution From Urban Transport In Strathcona, Vancouver

Existing tools including stationary monitoring, low-cost sensors (LCS), and air quality modeling can aid understanding of the impacts of urban transportation emissions on air quality. However, they are limited in efficiently, affordably, and accurately estimating pollutant concentrations. Here, the authors use data fusion to address these limitations and include various freight transportation modes. They generate and compare high spatial resolution pollution concentration maps at the neighbourhood level via three methods: 1) ordinary kriging with LCS alone; 2) AERMOD modeling of major neighbourhood transportation emission sources; and 3) the data fusion method, external drift kriging. They hypothesize that data fusion could be a feasible method for generating spatially resolved air pollution maps.

Laura Deveer, Laura Minet - Real-Time Air Quality Prediction Using Traffic Videos and Machine Learning

On-road transportation is a significant source of air pollution, impacting public health. Traditional techniques for estimating air pollutant concentrations rely on data from monitoring stations and satellites, and do not provide spatially and temporally resolved information. Statistical models tend to oversimplify the complex nature of air pollutant concentrations, but machine learning techniques have been found to yield better accuracies. This study develops a model to accurately predict air pollutant concentrations by extracting traffic variables (e.g., vehicle count, speed, type) solely from traffic videos. The authors' proposed model accurately predicts R-squared value of about 0.80 and provides timely and accurate reporting of traffic-related air pollution for effective implementation of traffic management policies. This cost-effective approach demonstrates high accuracies in predicting air quality using: a video camera.

Laura Deveer, Laura Minet - Beyond the Horizon: A Study on the Influence of Cruise Ship Activities on Traffic Patterns and Local Air Quality

The cruise ship industry, the highest growing sector in maritime transport has gained attention for its contribution to local and global emissions. While existing studies have focused on emissions from cruise ships, little attention is given to activities induced by cruise ships, particularly their influence on on-road traffic. This study investigates the impact of cruise-ship induced traffic on the local air quality in James, Bay neighborhood of Victoria, B.C. Results indicated notable increase in carbon monoxide concentration across all locations, correlating with cruise ship activity. While pollutant concentrations exhibited an upward trend with the increase in the number of cruise ships, ozone consistently decreased. These findings stress the need for effective environmental policies emissions induced from cruise ships.

3.3 Sharing, Hailing and Volunteering

Shuoyan Xu, JingLi, Eric J. Miller - The ride-hailing service supply forecasting with a deep learning approach

The ride-hailing system is a two-sided platform that connects users with drivers. By optimizing supply and demand interactions, the system reduces waiting times and enhances overall efficiency. This study aims to develop a dynamic supply prediction model for ride-hailing services using a deep learning approach. Driver activity data were gathered from ride-hailing companies in the city of Toronto between January and March 2020. The spatial-temporal analysis is conducted to understand the supply patterns of ride-hailing services. The results indicate imbalanced spatiotemporal supply patterns. To address this, a graph neural network has been developed to estimate supply generation over different time intervals. The developed graph neural network model can enhance the understanding of the supply generation process in ride-hailing services while aiding the rebalancing strategies for shared mobility systems.

Emilie Savard, Martin Trépanier, Catherine Morency - Assessing the variability of usage of carsharing services in Montreal

In Canada, carsharing becomes increasingly popular by offering fleets of shared cars to the population, trying to discourage the use of private cars and increase the use of public transit and active modes. The literature fails to propose methods that would help carsharing companies target specific groups with specialized offers. The authors look at the frequency of carsharing use in Montreal and is based on three years of reservation data from Communauto, the predominant carsharing provider. The goal of this study is to categorize the monthly use of the station-based and the free-floating services, taking into account the interpersonal and intrapersonal variabilities of members. To accomplish this objective, the study creates eight groups of members and performs spatial-temporal analyses to better understand the differences in behavior between groups. Finally, it examines how the frequency of carsharing usage fluctuates according to the characteristics of its members, the availability of other modes of transport and the land-use.

Seyed Ali Azimi, Amir Shabani, Vahid Hosseini - Bike sharing trip and total distance travel prediction for scenario-based urban mobility emission reduction forecasting

The study aims to predict the number of trips and distances covered by a bike-sharing system using a robust machine-learning framework. An extreme gradient boosting method (XGBoost) model was used to determine the number of bike trips, and subsequently, a Random Forest model was used to calculate the hourly average covered distance. In the context of Vancouver's bike sharing system, the study found that the XGBoost model achieved effective predictions of bike trips, boasting an impressive R-squared value of 0.92, while the Random Forest model demonstrated notable performance with a 9.75% error, affirming their accuracy in forecasting bike-sharing system metrics. The novel approach in modelling will enable a more accurate prediction of greenhouse gas reduction and potential health benefits stemming from the decarbonization of the urban transportation sector.

Romaine Morrison - Can I Automate It? - Artificial Intelligence and its Use in Volunteer Driver Programs

Artificial Intelligence (AI) applications have significantly grown in popularity and usage over the last year. The launch of OpenAI's ChatGPT in November 2022 brought mainstream access to the power of AI for some everyday tasks. Since then, developers of this application and others have been seeking ways to use AI to make many tasks more efficient and accurate. This paper will discuss AI, its applications and briefly examine the state of practice for its use in transportation planning and operations. It will discuss the suitability of AI applications for the optimization of volunteer driver programs.

Catherine Morency, Hubert Verreault - How good is the Montreal transit network? An evaluation based on quality thresholds of transit options

There is a scientific consensus on the importance of transit in the transformation of travel behaviors. However, the current consensus is not in phase with the required shift. In the Quebec Province, for instance, transit operators are facing critical challenges in obtaining sufficient funding to maintain their level of service and do not have the possibility to further improve their services. This research proposes a methodology to assess how good is a transit network based on the systematic evaluation of travel times for a wide set of trips. Using an "absolute quality" concept, the research assesses whether transit routes are sufficiently competitive to be considered as travel options by various population groups.

4.1 Logistics

Carlos Rivera-Gonzalez, Matthew Roorda - Transforming Urban Logistics: Demand-Centric Policy Impacts on Freight Efficient Land-Uses

Efficient freight transportation and logistics are key elements of sustainable economic growth. Supply chains connect supply and demand in rapidly changing markets but also generate large amounts of externalities. Traffic conditions heavily influence the efficiency of supply chains throughout the day and the spatial relationship between supply, demand, and the location of logistical facilities in urban areas. This research solves whether optimal locations for Distribution Centers (DCs) are sensitive to changes in demand management policies. The significance and novelty of this research are twofold. First, it provides a roadmap for the public sector in reserving land for logistic activities. Second, logistics managers and commercial real estate developers can use the research results to improve supply chain inefficiencies.

Dogukan Toktas, M. Ali Ülkü, M. Ahsan Habib - Decarbonizing City Logistics: A Systematic Review with a Focus on Sustainability

Pressing global issues such as increased urbanization, unsustainable population growth, and climate crisis motivate this research: Decarbonizing city logistics (DCL). Based on extant literature, the author explores the current state of the DCL research that adopts analytical approaches to formulate potential solutions for distinct challenges associated with city logistics. The analysis discusses the most recent changes and innovations in DCL, the barriers and enablers to DCL, and propose a framework for future research venues.

Jowel Akkeh, Tanvir Chowdhury, Peter Y. Park, Sabrina Khanc - Mobility Impact of Implementing Dedicated Truck Left Lanes at Signalized Intersections on Urban Arterial Roads

The authors investigate the operational benefits of introducing a dedicated truck lane (DTL) for left-turn movements on urban arterial roads. The study focuses on analyzing the effectiveness of expanding left-turn lanes from one to two dedicated lanes. A micro-simulation model is developed using PTV VISSIM across 32 signalized intersections, covering 19.2km in the Region of Peel, Ontario. The DTL performance was assessed by comparing it to a baseline 'Do-Nothing' scenario. The analysis involved evaluating delays and the number of stops for various vehicle types, such as passenger vehicles, trucks, and long combination vehicles (LCVs). Results show that the implementation of DTLs significantly reduces delays and stops for all vehicle types substantially improving traffic flow efficiency for all types of vehicles.

Adonai García, Kevin Gingerich - A Data-Driven Model for Electric Cargo Cycle Battery Performance

The recent years have seen a rising popularity for Electric Cargo Cycles (ECCs), driven by technological advancements, evolving consumer preferences, and growing environmental concerns. Despite representing a relatively minor fraction of the total mass, batteries emerge as a crucial and environmentally significant component in ECCs. They hold a pivotal role in energy storage and power management, and heavily influence transportation and logistics operations' efficiency, cost, and environmental footprint. This study analyzes the correlation of different variables such as battery range, capacity, power, speed, load weight, cadence, road grade, ambient temperature, and rider heart rate. These variables are analyzed with respect to ECC performance on various roadway infrastructure.

David Tran, Kevin Gingerich - A Bikeability Index for Last-Mile Electric Cargo Cycles

A scoring index is developed as a tool to analyze the attractiveness of the built environment in urban areas for last-mile logistics using electric cargo cycles (ECCs). While there are no existing scores for ECCs, there are existing indexes available for different modes of travel such as conventional biking, walking, and public transit. Existing bikeability scores tend to focus on infrastructure and operations-based characteristics of a route such as the presence of cycling lanes and the number of destinations accessible by cycling. Additional characteristics of comfort and safety become more critical for ECCs due to the increased weight over a conventional bicycle when transporting goods. This project develops the ECC scoring index using a survey riding on four different routes within the York University Keele Campus.

Michael Haughton and Alireza Amini - What Should Be Expected From The Crystal Ball Of Advanced Load Information?

The author's key finding is that in spot markets for freight transportation services, both carriers and shippers can benefit from carrier's possession of advanced load information (ALI). Specifically, the author finds that ALI simultaneously yields higher profits for carriers and lower freight delivery rates for shippers. The key novelty of the authors work is that it considers ALI in the context of inter-carrier rivalry where carriers engage in price competition for the posted loads. The author demonstrates how ALI's impacts are influenced by competition and the reality of carriers having to set their bid prices under uncertainty.

4.2 Getting to Net Zero

André de Palma, Robin Lindsey, Yannik Riou - Meeting the European Union's zero-CO₂-emissions target for cars in France

Growing concern about the environmental effects of Internal Combustion Engine Vehicles (ICEVs) has spurred the development of electric vehicles (EVs). Yet, despite advances in technology, EVs are still more expensive than ICEVs, and concerns persist about driving range, access to chargers, charging times, battery lifetimes, and availability of critical materials. In response, governments are supporting EV sales by offering purchase subsidies, discounting electricity prices and implementing other measures. The EC has also adopted a Directive to ban the sale from 2035 onwards of new passenger cars that emit CO₂.

Hubert Verreault, Catherine Morency - Systematic approach to estimate GHG reductions of transport/land-use scenarios: The case of Quebec City

In Quebec Province, transportation accounts for 44% of the GHG emissions. In recent years, GHG reduction targets have been announced by Quebec: reduction of -37.5% of GHGs below the 1990 level and carbon neutrality for 2050. As of today, the main strategy adopted by Quebec to reach these targets is electrification. Programs such as financing purchase of a new hybrid or electric car, financing home charging stations, implementing charging infrastructures and supporting implementation of battery industries are top priorities. Replacing gasoline-powered by electric cars does not lead to a change in mobility behavior. A research question is whether other strategies, with positive externalities, should be encouraged by governments to contribute to the reduction of transportation-related GHG emissions.

Yunfei Ma, Elkafi Hassini, Saiedeh Razavi - Framework for Emission Analysis of Transportation Infrastructure: A Data-Driven Approach With a Freight Movement Case Study

This research develops a model to estimate emissions for freight transportation, aiming to diminish the environmental impacts at freight bottlenecks using telematics data. The model conducts detailed emissions calculations for individual vehicles and aggregates this data at the road segment level. It integrates truck performance and fuel consumption data with road network information from OpenStreetMap and employs the parallel connected components algorithm to identify and analyze the network-level congestion for freight vehicles. The analysis then compares emissions across various routing options, ultimately pinpointing the trajectories that demonstrate the lowest environmental impact. These findings aim to guide strategies towards net-zero route optimization and emission reduction.

Julien Lépine - Comparison of Strategies for Decarbonizing Heavy Vehicles in Canada

This paper evaluates four key technologies for decarbonizing heavy vehicles: battery electric trucks, hydrogen fuel-cell electric trucks, electric-road systems, and renewable natural gas trucks. Divergent advocacy by different interest groups reflects the complexity of the transition. The aim of this paper is to assess the benefits and shortcomings of each technology, comparing them based on physical limitations, energy efficiency, and economics. The analysis reveals that no single solution comprehensively addresses all challenges. Fossil-free freight transportation necessitates an optimized combination of these

technologies. This paper contributes factual comparison of these solutions, emphasizing the need for an integrative approach to achieve sustainable heavy-vehicle transportation in Canada.

Jacob Klimczak, Carlos Rivera-Gonzalez, Matthew Roorda - Gridlock in the Dugout: Quantifying the Impacts of Induced Demand by Toronto Blue Jays

The Toronto Blue Jays typically attract significant fan demand, generating congestion in the road network. The arrival and departure of fans at the stadium create a spike in travel demand, increasing travel time and creating a gridlock effect. This research explores both the changes in emissions and the downstream human health impacts created by Blue Jays games in Toronto. Telematics GPS data from 2019 (January to December) are used to estimate the effects of Blue Jays games on traffic flows. Preliminary results show increases in trip duration on 'game nights' across the city. This research will further estimate the social cost of large events in Toronto. It will enable transportation professionals and policymakers to suggest policies to mitigate the increased congestion before and after large events.

Maha Shehadeh, Vahid Hosseini - Enhancing On-Road Emission Quantification: A Comparative Analysis Using US EPA MOVES

The research by the authors focuses on the application of the US Environmental Protection Agency (EPA) Motor Vehicle Emission Simulator (MOVES4) model. MOVES4 is a powerful tool for estimating vehicular emissions on street level, but the output quality is highly related to the input quality. The authors study compares emissions derived from different data sources: sensor measurements, total Vehicles Km Travelled (VKT), and traffic model simulations. Additionally, the study incorporates a sensitivity analysis, exploring the model's responsiveness to different inputs and comparative MOVES4 analysis at county and project scales. The research seeks to contribute to developing more robust and standardized methodologies for on-road emission estimation. The findings show that traffic-related emissions vary highly from one community to another based on link activity level. The study findings can help inform decision-making policies and effective air quality management at the local and community levels.

4.3 Household Choice

Todd Litman – Good News From The 2022 CRD Travel Survey Less Driving, More Non-Auto Travel, And Potential For More Efficient And Equitable Transportation

The Capital Regional District (CRD) recently released the 2022 Origin Destination Household Travel Survey, the latest in a series. This survey shows large increases in active mode (walking and bicycling) trips and declines in motor vehicle travel. Active mode shares increased 7% through the region, and 23% in the City of Victoria, and per capita daily vehicle trips declined 20%, from 1.52 in 2017 to 1.22 in 2022. These reductions are particularly large in communities that have improved walking, bicycling and public transit conditions. This is good news! These changes reflect significant progress toward regional and provincial transportation goals. It shows that there is significant latent demand for non-auto travel and demonstrates that given suitable infrastructure and incentives residents will drive.

Alexander Bigazzi - A Consequential Framework to Quantify the Climate Impacts of Household Travel

Transportation generates approximately one third of Canada's greenhouse gas emissions and is an increasing share of the total despite decades of efforts to improve fuel efficiency and encourage mode shift. This paper proposes a new approach: a consequential framework to quantify the climate impacts of household travel (i.e., 'carbon footprints'). Consequential methods have already been adopted in the energy production sector and are long overdue in transportation. Recent research estimating marginal operating emissions from transportation systems in the USA demonstrated the inflated greenhouse gas emissions attributed to transit users in low-ridership systems. Building on that research, this paper motivates and develops a complete framework.

Md Shahadat Hossain, Mahmudur Fatmi, Mohamad Ali Khalil - Microsimulation of Households' First Vehicle Purchase Timing and Type Choice Decisions within an Integrated Urban Transportation Model

This study focuses on microsimulating vehicle ownership (VO) decisions within an agent-based Simulator for Transportation, Energy, and Land use for Regional Systems (STELARS). Each household acts as an agent within the simulation environment. Once the agents are active, they change their VO by making two inter-connected decisions. In the vehicle transaction stage, households decide whether to add, dispose, or replace a vehicle. In the vehicle type choice stage, agents decide which vehicle to choose in terms of their body, vintage, fuel, and technology type. Vehicle transaction is simulated as a continuous time decision using a hazard-based model. Once the timing of the transaction is determined, the vehicle type choice simulation transitions into a discrete time step. This paper reports the microsimulation and validation of the VO module for the Okanagan region of British Columbia from 2011-2021.

Hasan Shahrier, Muhammad Ahsanul Habib - Household Level Vehicle Type Choice Decision: An Econometric Modelling Approach

This study utilizes mixed logit modelling approach to explore the vehicle type choice decisions of Halifax residents. It utilizes data from the 2022 Halifax Travel Activity survey, a cross-sectional survey that includes respondents' socio-demographic characteristics, accessibility measures and travel attributes. In this research, along with electric vehicle, three different types of regular gasoline driven vehicles are considered based on the rate of fuel consumption to estimate model parameters. The conclusions drawn from this analysis offer direction on boosting Electric Vehicle adoption in the near future and also includes integrating various policy strategies aimed at reducing vehicular emissions.

Usman Ahmed, Mohamed Saoudi Hassani, Francois Tomeo, Eric J. Miller - School Location Choice Modelling for the Montreal Metropolitan Area

The choice of an educational institution (school) location is one of the long-term decisions made by students. In this study, the authors model school location choice for students in the Greater Montreal Area. The authors model 7 school types and further investigate the impact of public and private schools and find that distance and number of public and private schools in a zone impact school location choice. In the case of universities, the size of a university is another key factor in modelling the location choice.

Ladan Berahman, Mohammad Haghighi, Eric J. Miller - Investigating the Impact of Residential Parking Types on Activity Scheduling

Residential parking can significantly affect travel outcomes, influencing factors such as mode choice and car ownership levels, which have traditionally been explored within travel demand models. A noteworthy shift has occurred in travel demand modelling, with the emergence of activity-based models that address limitations inherent in conventional four-stage travel demand approaches. Activity-based models aim to comprehensively capture the influence of travel attributes throughout the decision-making stages of activity-travel processes. Residential parking can influence activity scheduling since most trips are home-based. Considering residential parking type as a significant travel attribute of car usage behaviour, this paper employs an econometric model to investigate the extent to which residential parking types affect activity scheduling attributes, such as start time and trip frequencies.

5.1 Danger! Crashes and Hazardous Goods

Ehsan Hassanzadeh, Amy Kim - Optimizing Wildfire Evacuation Strategies in Small Canadian Communities: An Integrated Agent-Based Simulation Approach

Canada has witnessed a significant increase in extreme weather events in recent years. This research responds to the need for advanced planning and strategic preparedness in case of wildfire evacuations by considering the complex interactions between wildfire, transportation networks, and human behavior in an evacuation simulation framework using the MATSim (Multi-Agent Transport Simulation) platform.

The authors build their models using data gathered from five small communities in British Columbia and Alberta. Then, results from a fire exposure model, which predicts the spread and impact of wildfires, and survey data from their human behavior model, which provides insights into community responses during evacuations, are used for scenario building and movement parametrization, respectively. The authors primary objective is to develop strategic recommendations for transportation operations management on improving evacuation strategies in a broader sense.

Nishit Bhavsar, Elkafi Hassini, Manish Verma - Analytics based approach to estimate dangerous goods moving on Canadian highways

Every effort should be made to assess and mitigate risk due to dangerous goods movement in transportation networks. This requires realization of dangerous goods flow in transportation networks. However, it is quite challenging in Canada, to obtain this type of data. Surveys conducted by the government are available only in aggregated form as details are conserved to maintain confidentiality. As a result, quantification of risk based on different risk measures are mostly not obtained. This research focuses on estimating the volume of dangerous goods moving over a Canadian road network. The authors perform analysis to demonstrate dynamics of accidents involving dangerous goods in Ontario and visualize gasoline movement in a region.

Vadhul Krishnan Veerakumar, Chris Lee - A Simulation-Based Study on Enhancing Traffic Safety and Efficiency using Traffic Signal Countdown Timers at Signalized Intersections

This research investigates the impacts of Traffic Signal Countdown Timers (TSCT) on traffic safety and efficiency at signalized intersections along the Huron Church Road in Windsor, Ontario. Based on the observational data from previous field studies, changes in driver behaviours (e.g., vehicle approach speed, acceleration, deceleration, reaction time to signals, and driver compliance rate) in the presence of TSCT were replicated using PTV Vissim traffic simulation. Four scenarios - no timer, only-Green Signal Countdown Timer (GSCT), only-Red Signal Countdown Timer (RSCT), and GSCT + RSCT - were tested. Results show that GSCT + RSCT significantly reduced total vehicle conflicts by 14% while it reduced delay of the road network by 5% compared to no timer. Additionally, the GSCT shifted the Dilemma Zone (DZ) away from the intersection by 18 m and increased its length by 14 m. These results demonstrate that TSCT can potentially improve safety and efficiency at signalized intersections.

5.2 Active and Green Transportation

Gil Armand Aluning, Yanick Clement-Godbout, Christina Vietinghoff - Canadian Bikeway Comfort and Safety Classification System & Spatial Access Measures: Combining Spatial Accessibility and Comfort

This study examines the Canadian Bikeway Comfort and Safety Classification System and Spatial Access Measures to determine the relationship between the spatial accessibility of cycling infrastructure and comfort level. The insights gleaned from this study aim to support the development of higher comfort cycling infrastructure by illustrating that there is a significant difference in levels of spatial accessibility between cycling infrastructure comfort levels. This analysis not only elucidates the impact of cycling infrastructure comfort on spatial accessibility but also determines specific distinctions between various comfort levels. Identifying variations in cycling infrastructure comfort levels which affects amenity accessibility highlights the pivotal role of infrastructure quality in spatial access. This provides policymakers with concrete evidence for informed decision-making and promoting equitable.

Eiad El-Fateh, Jean Pamphile, Matthew Quance, Yanick Clement-Godbout, Bjenk Ellefsen, Nick Newstead - Enhancing Sustainable Mobility: Spatial Measures of Access to Amenities via Active and Public Transport in Canada

The Spatial Access Measures dataset comprises 28 indicators. The study's methodology involves quantifying travel ease from an origin dissemination block to different destination types. Varied

methodologies were employed based on amenity types, considering masses or counts within specific dissemination blocks derived from industry classifications and databases. Overall, this research not only introduces a comprehensive spatial access measurement system but also delineates the intricate methodologies used to quantify accessibility to diverse amenities via different transportation modes. The insights garnered from this study aim to support the development of sustainable and resilient active and public transportation systems across Canada.

Alexander Bigazzi, Amir Hassanpour - Travel Behaviour and Greenhouse Gas Impacts of the Saanich E-Bike Incentive Program

Electric bicycles are an increasingly popular mode of transportation. This study investigates the true GHG mitigation impacts of their e-bike purchase incentive program (in District of Saanich, BC). The results show that the purchase incentives have been effective in increasing e-bike purchases and that those purchasers have gone on to regularly use their bicycles. It also shows that around 40-50% of the reported e-bike use has substituted for automobile trips, reducing overall driving by 50-60 km per week and travel-related GHG emissions by 16-19 kg CO₂e per week. The findings of this case study contribute valuable insights to inform future decisions on e-bike purchase incentives, advancing climate goals.

Elmira Berjisian, Alexander Bigazzi - Cyclists' Typology: Who are Dedicated and Casual Riders?

This study aims to classify cyclists into distinct types based on their self-reported behaviours and preferences and assess how well this typology aligns with their observed travel behavior. Two main types of cyclists emerged from the survey responses: Radical and Casual Riders. Radical Riders expressed a stronger preference for cycling, reported more and faster rides, and engaged in generally more moderate-to-vigorous physical activity. The observed travel behavior of each type corresponded with their inferred typology. Radical Riders had greater average speed, trip length, and trip frequency. Cyclist types did not significantly vary across socio-demo characteristics, except for age and bike ownership, which displayed a moderate association with inferred types. The identified typology provides insights for urban planners.

Christopher Lehmann Skelton, Bruce Hellinga, Chris Bachmann - Modelling Pedestrian Crossing and Violation Behaviour as a Pathfinding Process

Pedestrians exhibit a diverse array of behaviours, including crossing violations. This research proposes a new pedestrian routing simulation model that includes crossing behaviour, where pedestrians find a path through a dynamic intersection or mid-block environment. The environment is modelled using a grid, where each grid cell is assigned a “resistance” cost that may vary dynamically based on the presence of nearby vehicle traffic or changes in the crossing status of a surface (e.g., signal indications). This approach integrates crossing behaviour with route choice and allows the dependencies between the two to be modelled. The behaviour of the proposed model has also been assessed.

5.3 Business Cases & Pricing

Todd Litman - A Business Case for Raising Intercity Public Transport Service Quality

During the last century intercity public transport services have experienced a cycle of declining service, ridership and revenue. This is inefficient and unfair. It leaves many travellers with inadequate mobility options and forces motorists to spend time and money chauffeuring non-drivers. This paper introduces an intercity public transport LOS rating system which measures service frequency, affordability, comfort and amenities. It describes, and where possible monetizes, various benefits and costs of raising public transport LOS. This analysis indicates that conventional transportation planning, evaluation and funding practices are biased in various ways that tend to undervalue and underinvest in intercity public transit. The paper applies this analysis framework to the Victoria-Nanaimo travel corridor on Vancouver Island.

Muntahith Mehadil Orvin, Mahmudur Fatmi - Housing Prices in Vancouver and Kelowna: Comparing Pre-, During-And Post-Covid-19 Pandemic Periods

This study aims to compare the prices across the pre-, during-, and post-pandemic phases in both Metro Vancouver and Okanagan regions, utilizing an extensive multi-year period housing transaction data. The analysis will focus on how housing prices vary across dwelling (e.g., number of bedrooms), market (e.g., mortgage rate), neighborhood (e.g., percentage single-detached dwelling), land use (e.g., land use index), and accessibility (e.g., proximity to school) characteristics, among others. This research provides a deeper understanding of housing market dynamics and valuable insights into how socio-economic disruptions like COVID-19 impact housing markets differently in various geographical areas by contrasting the pre-existing trends with the evolving patterns during and after the pandemic.

Zhi Yuan Chua - Dynamic Parking Levies versus Tolls to Manage Road Traffic Congestion under Various Market Arrangements

Given the political and operational challenges associated with congestion tolling, the author investigates the use of a dynamic parking arrival levy for road congestion management as a substitute for a toll. The author analyzes four access control scenarios for the parking lot. The planner may or may not also impose a toll at the bottleneck. If planner and firm are both active, they engage in a Stackelberg game with the planner moving first. In Regime (2), the planner sets a time-varying levy that is negative at the beginning and end of the travel period. The levy eliminates queuing and leaves travellers better off than with a congestion toll. The efficiency of the levy increases with the share of travellers who park at the lot. In Regime (3) the firm sets a time-varying fee that renders the planner's parking levy completely ineffective in reducing queuing.

Kevin Porras, Marianne Hatzopoulou, Eric J. Miller - Toll Policy Evaluations for Reducing GTHA Transportation GHG Emissions

This paper evaluates the impacts of four tolling policies on reducing GHG emissions and improving transportation system performance in the GTHA. In the GTHA, there is a lack of quantitative support for toll policy deployment. GTAModel, which simulates travel within the GTHA on a typical weekday, is used to model the impacts of the tolling policies. The tolls are applied to the key DVP and Gardiner roadways. The modelled results show that on a per weekday basis, tolling leads to a decrease of ~1 million vehicle kilometers travelled and a reduction of more than 180,000 kg CO₂e in the highest-toll scenario, as well as improved network-wide travel times. The results show revenue potential being over \$400,000 per day in the highest-toll scenario, not including social cost savings from reduced emissions. These results quantitatively support tolling the Gardiner and DVP.

Azin Golrizkhatami, Chi-Guhn Lee, Matthew Roorda - Unveiling Crowd Shippers' Behaviour through a Two-Sided Market Approach

The authors consider the dynamics of crowd shipping and online food delivery services, such as Uber Eats, with a particular emphasis on their pricing models. Its objective is to identify and rectify weaknesses in these models, balancing equity for crowd shippers with profitability for the platforms. Given the importance of equity in crowd shipping services, where shippers are not regarded as contract employees and lack associated benefits, the primary objective is to understand and improve the pricing strategies. To achieve this, the authors investigate crowd shippers' behavior, examining factors influencing their decisions to accept or reject offers. They assume crowd shipping as a two-sided system, with crowd shippers on one end and the platform on the other.

6.1 Minimizing Disruption

Kaveh Rezvani Dehaghani, Catherine Morency - To What Extent Bus Systems Can Mitigate the Impact of Short Term Metro Disruptions in Metropolises?

In modern urban transportation, the metro system is a crucial element shaping mobility in metropolises. Since disruptions in the metro system can potentially pose a limit to travel possibilities in transit networks, extensive research has been conducted on metro disruptions and related mitigation measures. Although statistical studies indicate short-term disruptions occur more frequently than other types, the absence of a precise definition for short-term disruptions has led prior researchers to concentrate on medium and long-term disruptions. Focusing on short-term disruptions, this study introduces a comprehensive five-step framework for evaluating the efficiency of combining the existing bus system with metro system during metro disruptions. Introducing quality indexes, the study assesses the efficiency of existing bus system in mitigating the impact of short-term disruptions in metro network.

Paula Cid Ornelas, Amy Kim - The Impact of Spatial Characteristics on the Duration of Hazard Disruptions in Transportation Networks

As disruptions due to natural hazards become more frequent and increasingly severe, there is a pressing need to develop strategies to improve the resilience of the transportation infrastructure. This paper investigates the impact of spatial characteristics - such as road infrastructure and weather - on post-disaster recovery times in British Columbia. This study not only offers valuable insights into the spatial factors that can minimize disruption time in the face of natural disasters but also provides a framework that can be used to model the relationships among various characteristics in different locations in studies.

Zahra Mashayekhi, Manish Verma - Optimizing Rail-Truck Intermodal Network Design in the Presence of Random Disruptions at Intermodal Terminals

In this paper, the authors have developed a model for designing an optimal rail-truck intermodal transportation network while considering random disruption at intermodal terminals. The proposed model determines the optimal locations of intermodal terminals, the number and type of intermodal train services, and the freight routing. As the location and level of disruption are uncertain, the authors have defined disruption scenarios and proposed a two-stage stochastic problem where the locations of intermodal terminals, and the number and type of intermodal train services are first-stage decision variables, and the freight routings are the second-stage decision variables. Finally, the proposed optimization program is applied to study numerical examples.

Yuhang Gu, Saiedeh Razavi, Saeid Habibi - Cycle Queue Length Estimation at Signalized Intersections: A Learning-Driven Approach

To effectively manage signalized intersections, a thorough assessment of intersection performance is essential, with maximum cycle queue length serving as a critical metric. In peak hours, as vehicles accumulate at intersections, they form distinct profiles of queuing and non-queuing status. This study leverages vehicular movement data gathered through a simulation environment to implement a binary classification task that distinguishes between queuing and non-queuing statuses through machine learning algorithms, etc. A fuzzy inference system (FIS) enhances the classification outcomes by establishing rules derived from the interplay between feature values and the connectivity of queuing statuses, yielding a more accurate queue length estimation result by the end of the red light in current signal cycle. A comparative evaluation of these models is performed.

Jing Li, Hao Yang, Saiedeh Razavi - Freeway Non-Recurring Congestion Forecasting: A Multi-Step-Ahead and Spatio-Temporal Approach

This study aims to examine multi-step and spatio-temporal forecasting of Forecasting non-recurring congestion (NC) using comprehensive crash data and an interpretability-enhanced approach. To pursue

this objective, the study collected a rich dataset. This dataset includes variables such as crash severity, type, number of vehicles involved, and weather conditions. An attention-based multi-encode-decoder model is proposed for multi-step spatio-temporal prediction. The model's attention mechanism aims to assign varying degrees of importance to different segments of input data, thereby enhancing interpretability for accurate NC prediction. Prediction horizons, ranging from 5-60 minutes, are tested in the proposed model. The results show that the proposed model consistently achieves better prediction performance and robustness compared with benchmark models, indicating the importance of enhancing comprehensive crash data and interpretability in accurate NC prediction.

6.2 Electric Vehicles

Mohammad Reza Khodoomi, Babak Tosarkani, Eric Li - Strategic Planning for Electric Vehicle Charging Stations in Sustainable Urban Transportation

This study employs a combination of Multi-Criteria Decision Making (MCDM) and Geographic Information System (GIS) to determine the sustainable and optimal locations of EVCS. Initially, relative and sustainable criteria of site selection for EVCS are identified, and relevant data is gathered based on geographic maps. These criteria encompass societal, economic, and environmental considerations, etc. Subsequently, potential areas are defined and ranked. This current study ensures a comprehensive evaluation of potential locations, taking into account the diverse criteria involved. The integration of MCDM and GIS not only enhances the precision of the site selection process but also contributes to sustainable decision-making in the deployment of EVCS.

Ali Shehabeldeen, Moataz Mohamed - Optimal Electric Bus Transit System with Energy Consumption Uncertainty and Battery Degradation

Implementing battery electric buses (BEBs) in transit is set to promote sustainable mobility and reduce environmental impact. However, the BEB system configuration faces numerous challenges, including battery degradation, uncertain energy consumption, and limited charging resources. This study develops an optimal lifecycle BEB system configuration model. The model optimizes the charging schedule, component sizing, and allocation of resources while considering battery degradation and energy consumption uncertainty. A deterministic multi-stage optimization model is first developed, incorporating battery degradation and replacement decisions. Subsequently, a multi-stage stochastic model is formulated to address uncertainties of energy consumption.

Mwendwa Kiko, Eric J. Miller - EVs and Gas Stations: Insights from a Travel Demand Model

The widespread switch from Internal Combustion Engine Vehicles (ICEVs) to EVs is likely to force many retail gas stations to close or stop selling gasoline (the first order effect); the reduced number of retail gas stations is then likely to discourage use of the ICEVs that remain, and even encourage more people to switch from ICEVs to EVs (the second order effect). This study seeks to quantify the magnitude of that effect in the Greater Toronto Area (GTA). Making use of a state-of-the-art travel demand model, and a survey of travel behaviour, models of vehicle ownership, fuel economy, and EV adoption have been developed. Based on these, scenarios of replacement of ICEVs by EVs have been constructed, and their impact on gas stations examined. The result is a comprehensive understanding of the second order effects of the transition to EVs and how these might accelerate that transition.

Kashfia Nahrin Nokshi, Muhammad Ahsanul Habib - Integrating Vehicle Evaluation and Fuel Type Choices for Emission Modeling

A cutting-edge vehicle choice model is developed within the innovative Integrated Transport Land-use and Energy framework in this research. This model demonstrates remarkable proficiency in discerning the optimal fuel type for vehicles. Applying these refined fuel type choices, a forward-looking emission modeling system projecting emissions trends up to the year 2030 is developed using the Traffic Simulator

and Emission Simulator. This analysis aims to closely monitor and quantify the consequential reduction in greenhouse gas emissions due to the increasing adoption of electric vehicles. The results show a 21% reduction in emissions for gasoline-powered vehicles in 2030. The findings also reveal a gradual decrease in the overall usage of gasoline-powered vehicles.

Amaury Philippe, Frédérik Lavictoire, Martin Trépanier, Normand Mousseau - More electricity for heavier cars: the trends in electromobility in Quebec

The aggressive electrification strategy of the Québec government brings more and more electric cars on the road of the province. There is now a need to assess how much electricity will be needed to power all these cars in the next years. In this study, the authors propose a method to: 1) estimate the annual “mileage” (kilometrage) of private vehicles based on the Société de l’assurance-automobile du Québec fleet inventory and vehicle transactions data, and 2) estimate the annual energy consumption of electric cars specifically. The presentation will discuss the trend of selling heavier and bigger vehicles over the years and the impacts it will have on energy needs scenario for Québec.

6.3 Emerging Urban Transportation Issues

Catherine Morency, Jean-Simon Bourdeau - What about Auto-Besity? Various perspectives on the transformation of the car fleet

In the Quebec Province, the population of private vehicles is increasing faster than the population of adults, and their features are transforming. This research proposes new metrics to better quantify the spatial and energy footprint of private cars. It aims to document how important the issue of increasing and transforming car fleet can be for cities and neighborhoods and provide additional tools to illustrate the scale of the problem. This presentation will first propose some background elements with respect to the impacts of cars in cities. It will then provide the main methodological elements relevant for the proposed estimation namely the data sources, the study area and a description of the various footprint indicators proposed. Trends on the fleet of personal cars are the examined, followed by results of the indicators.

Amir Hassanpour, Alexander Bigazzi - Multi-Year Trend in Volume and Speed for 27 Types of Personal Mobility Devices: Implications for Vehicle Regulation, and Facility Design

The objectives of this research project are to determine: 1) the 4-year trend in volumes and speeds for each type of Personal mobility devices (PMDs) in metropolitan Vancouver; 2) the empirical impacts of regulatory changes on PMD volumes and speeds; and 3) the implications of continuing PMD growth for speed, comfort, and climate in cycling facilities. Preliminary results suggest the mode share of electric bicycles and electric scooters have quadrupled since 2019 in metropolitan Vancouver while the speed profile of the cycling facilities has experienced minimal changes. The outcomes of the proposed research will provide essential information for Canadian governments to manage PMDs safely, equitably, and effectively through vehicle regulation, and facility design.

Laura Weli, Adam Weiss - Do E-Scooters Zoom Everywhere? - A Geospatial Analysis of E-Scooter Trip Patterns in Calgary

The research presented analyses how temporal characteristics, land-use and transportation infrastructure have influenced the production of dockless E-scooter trips in the City of Calgary, during their 2019 e-scooter pilot. Within this context, a trip generation model based on Origin Destination E-scooter trip data collected by the City of Calgary will be developed and linearly regressed against point of interest and land-use data, transportation network data, and temporal characteristics. The results will highlight key usage patterns relating to impacts of the built environment on E-scooter activity and the occurrence of intermodal travel, and will convey how E-scooters act as transitory and primary transportation modes, stimulating sustainable transportation activity around diverse land-uses.

Aimee-Larissa Dushime, Chris Lee, Kathryn Lafreniere, Kenneth Cramer - Analysis of Distracted Driving Behaviour and Its Relationship with Driver Characteristics

This study comprehensively investigates the effects of no distraction and three different distraction tasks (listening to music, texting using cell phone, and following a route using an in-vehicle navigation system) on driving behaviour of 52 licensed drivers. A survey was also conducted to collect information about the drivers' characteristics. Using the driving simulator and Fitbit data, driving variables and heart rate were compared among different scenarios (e.g., average speed, standard deviation of the speed, lane offset). Within each scenario, these variables were also compared among different driver groups. This study provides scientific evidence that distracted driving is very dangerous and increases the likelihood of more severe collisions. It highlights the importance of training with a high tendency to distracted driving.

Hamed Malekzadeh, Catherine Morency - Investigating Anticipated Post-COVID Transit Ridership Using a Pseudo-Panel Approach

This study suggests a pseudo-panel approach to help predict people's transit usage based on their characteristics and observed/anticipated travel behaviors from a pool of cross-sectional surveys conducted before and during the pandemic. To do so, based on characteristics of individuals, households, and neighborhoods, the respondents are grouped. Then the evolution of each type's current and expected transit usage is examined. Through this typology, the authors provide insights about people's anticipated trip frequency and usage of transit. This approach illustrates how to value small-sample surveys to reduce the necessity to conduct large-scale Origin-Destination surveys for specific population cohorts. This study also identifies the particular population segments significantly associated with changes in transit usage. The results of this study provide understanding of the future demand for public transportation.

William Morrison, Trevor Hanson - Synthesis of select Canadian jurisdictional practices for designating a railway grade crossing for pedestrians who use assistive devices

Since 1990, there have been several fatalities in Canada due to a pedestrian's wheelchair becoming immobilized in a "flangeway gap", the gap between the road and the railway tracks that allows the flange of train wheel to pass unimpeded. The Transportation Safety Board (TSB) has identified the potential of flangeway fillers to reduce or eliminate the gap while allowing the train to pass, but additional research on product suitability is needed, including deployment criteria. Grade crossings can be "designated" by road authorities for persons using assistive devices and Transport Canada's Grade Crossing Standards (1) outline the geometric requirements including a maximum flangeway width and depth. Designated crossings may be candidates for flangeway fillers, however, but the road authority designation process is not well understood at a national level. This paper presents an inventory of practices for crossing designation among select road authorities across Canada including a discussion of potential next steps in this field.