

INTRODUCTION TO THE CTRF 2023 CONFERENCE

Adrian Lightstone, Joseph Monteiro, and Barry E. Prentice

The theme of the 2023 conference is “Getting Back on Course: Transportation and Supply Chains in an Uncertain World”. COVID-19 created a shift in demand from the service sector to goods consumption. This led to a shortage of capacity for key inputs like computer chips and an increase in demand for all imports. This unanticipated demand congested the ports and broke transportation supply chains. To complicate matters further, the Russian-Ukrainian war in 2022 inflated prices and added to supply chain problems. The economic impact of COVID-19 is receding, but the after effects remain as supply chains are being reconfigured in an uncertain world.

The 58th Annual Meeting examines adjustments in supply chains and changes in transportation caused by changing work patterns. Have supply chains corrected? How have people’s transportation needs changed from travelling to work vs. working from home? Is the shift to online purchases permanent? Are shifts to electric vehicles and automation increasing? Is the infrastructure and regulation adapting to these changes? The conference proceedings contain a rich collection of papers on these issues with particular emphasis on the after effects of Covid-19 on transportation systems and the 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. Commercial Regulatory and Legal I. 2. Inclusive and Accessible Transportation I. 3. Parking and Curbside Management. 4. Urban Transport I. 5. Air Transportation I. 6. Transportation Modelling I. 7. Urban Freight I. 8. Supply Chains. 9. Safety and Disruption. 10. Urban Transport II. 11. Transportation Modelling II. 12. Transportation Modelling III. 13. Student presentations. 14. Connected and Automated Vehicles. 15. Commercial Regulatory and Legal II. 16. Ports and Marine. 18. Air Transportation II.

1. Commercial Regulatory and Legal I.

Andrew Tam - Commercial insurance for trucking in North America: A trucker’s nightmare?

In North America, truck insurance premiums constitute an important component/percentage of motor carrier costs. In recent years, the insurance industry is known as ‘a hard market’ for commercial truck and fleet operators who face double-digit increases in insurance costs if they can find coverage at all. This inflationary trend has been driven by several factors, which has resulted in a less crowded market with less competitive conditions. The impacts across large and small carriers and owner-operators are not the same. This paper presents an overview of the above situation and issues with particular reference to Canada as well as tracking some key developments of interest, such as ATRI’s the study of the “Impact of Rising Insurance Costs on the Trucking Industry” and the Insurance Bureau of Canada’s National Task Force on Commercial Insurance and assess the common coping strategies.

Veiko Parming, Joseph F. Schulman – Railway freight rates — international comparison

The Railway Association of Canada (RAC) engaged CPCIS to compare railway freight rates internationally. Rates are measured as average freight revenues per revenue ton-mile (RTM) for 2021 in US cents, with conversions made using purchasing power parities. Ten countries’ rates are presented. Canada’s rate, at an average of 4.16 cents (US), falls among the lowest. This is 11% lower than the US rate and significantly lower than the European rates. Between 1988 and 2001, average Canadian railway freight rates grew more slowly than prices in general, and more slowly than US rail rates. The slower growth vis-à-vis US rates is due to the behaviour of Canadian and US rates since 2010, resulting in average rail rates in Canada having been below those in the US since 2015.

Dr. Malcolm Cairns - Merger of Canadian Pacific and Kansas City Southern Railways Interim report

This report provides an overview of the proposed merger of Canadian Pacific (CP) and Kansas City Southern (KCS) freight railways written in the summer of 2022, based upon the application on October 29, 2021 by CP and KCS to the Surface Transportation Board (STB) in the US for approval of control, and the responsive applications on February 28, 2022 of UP, BNSF, NS, CSX and CN with comments and requests for conditions. It is an interim report, and a final report on the outcome of the application will be prepared once the STB has made its final decision in 2023.

Dr. Malcolm Cairns - Merger of Canadian Pacific and Kansas City Southern Railways Final report

The final decisions by the STB to approve the merger on March 14, 2023 are summarized in this report. This involved two distinct processes: an environmental review process that was conducted by the STB's Office of Environmental Analysis; and a transportation-related process that examined the competitive, transportation, and economic implications of the proposed merger on the national rail system. In particular, it will review the STB responses to the range of conditions requested by all the interested parties, and outline gateway commitments to be followed by the merged railway CPKC.

2. Inclusive and Accessible Transportation I.

Boer Cui, Alec Knowles, Chelsea Gurr, Fearghal King, Nicole Geitebruegge, Marisa Espinosa - Development of the translink equity evaluation framework for transport 2050: 10-year priorities

This study presents a novel approach of applying a time and motion study to estimate the maximum bus throughput capacity of a new, multi-operator bus terminal in Toronto. The study makes use of video camera recordings to record key bus events from the time that the bus enters the terminal to the moment it exits. The video data is used to calibrate a capacity and timeslot management model, previously used in the context of airport operations planning, to estimate throughput capacity. Options analysis for timeslot management and capacity maximization is also carried out using the model. Recommendations are then made based on the results. Findings from the study can be used to inform relevant future decision-making authorities, so as to minimize delays for bus riders at the terminal and maximize revenue for this operator.

Felita Ong, Patrick Loa, Khandker Nurul Habib - Factors influencing the use of ride-sourcing by people with mobility impairments: The case of Metro Vancouver Region

This study considers the factors influencing ride-sourcing adoption by those with mobility impairments, using a survey administered in the Metro Vancouver region. The influence of factors such as socio-demographics and attitudes and perceptions are explored through an empirical model. Aside from identifying the motivations to use ride-sourcing, the model offers insights into barriers to adopting ride-sourcing. The results of this study can be used by planners and policymakers to improve the provision of accessible ride-sourcing and paratransit services.

Gonzalo Martinez Santos, Sara Wagner, David Kossowsky, Sara Diamond, Dr. Matthew Roorda - A generative design tool for designing complete communities

This research aims to develop a tool that implements a genetic algorithm to optimize community design given a set of objectives and constraints. This tool receives a set of user inputs in the form of optimizable measures, land use restrictions, and demographic context, which are encoded as a numerical string chromosome encapsulating relevant information for a given community. The genetic algorithm is used to optimize a neighbourhood's land use distribution and roadway network based on the weighted objectives. By outputting candidate solutions as geospatial files, users can directly visualize prototype designs using 3D urban-modelling software. The ultimate goal is to integrate this tool into a larger complete community design process, where the tool helps planners generate a set of design alternatives based on different objectives, and the stakeholders' experience is fed back into the algorithm in an iterative manner until a final design is chosen.

Anna Robak, Trevor Hanson - Rethinking benefit measures in transportation decision-making: What are we missing and approaches for addressing the gaps

One of the most powerful benefits of transportation is that it connects goods and services to markets – it allows people to exchange these things and thrive economically. But in transportation economics, the typical practice is not to value this “connection” of goods and services to markets, but to measure the incremental speed or safety benefit of this transaction. The risk of this approach is two-fold: those people who are not already benefiting from the service are not considered in the equation; and decisions are limited to improvements to whatever variables influence the calculation of benefits. In this paper, the authors explore alternatives to the current approaches to transportation economics and planning, who benefits and who does not, and the dimensions through which benefits are captured or not.

3. Parking and Curbside Management.

Dave Attema, Clarence Woudsma - Curb complexities: Evaluating curbside management potential in Canadian cities

This paper introduces a best practice-based evaluation framework for cities to better understand how they presently manage their curb, and their curbside management potential. This framework is applied to five case study cities in Canada: Victoria, Edmonton, Hamilton, Montreal and Halifax. Research findings reveal organizational and policy integration, curb utilization data collection, and pilot implementation as areas with the greatest potential to improve management of the curb in the Canadian urban context.

Wenhan Luo - Parking pricing: An analysis of dynamic parking pricing pilots

Dynamic Parking Pricing is done to ensure that there is at least one parking space available in any given parking area, while also utilizing all parking resources. These monitored occupancy levels are usually obtained through sensors but by using transaction data, costs can be reduced from having to install occupancy detection infrastructure. Two models are generated to tackle two areas of interest. One is to predict occupancy based on existing transaction data to a high accuracy, accounting for the compliancy rate of users (illegal parkers). The second is to use the occupancy rates generated from model 1 to predict occupancy changes when parking prices are changed in a network of parking groups. Both models use neural networks on a large simulation to obtain this.

Elham Heydariharaei, Mehdi Nourinejad - Parking occupancy detection using dash cams

In recent years, many drivers have installed a Dash Cam in their cars to record whatever happens on the road. The authors use the Dash Cams data to prepare a digital parking availability map. Firstly, we apply a pre-trained model on the raw video recorded by a Dash Cam to perform the object detection and object classification tasks. Then, the authors filter out unnecessary detected objects as well as sensitive data to respect people’s privacy. Finally, they extract the metadata collected by Dash Cams to retrieve GPS data and locate the detected cars to deliver the parking occupancy map.

Farah Ghizzawi, Usman Ahmed, Matthew J. Roorda - A comparison of parking behaviours of delivery trucks and e-cargo tricycles

In this study, the authors analyze and compare the parking behaviours of delivery trucks and e-cargo tricycles for courier deliveries in dense urban areas using passively collected GPS data. The GPS data are processed to identify trip ends, stop locations and durations, and parking events. Additional data sources, including delivery and parking infrastructure characteristics, are used to augment the GPS data. The authors show the potential of passively collected GPS data in identifying parking and comparing the parking patterns of trucks and e-cargo tricycles. This study is a first step towards developing more comprehensive parking behaviour models for commercial vehicles.

4. Urban Transport I.

Kareem Othman, Amer Shalaby, Baher Abdulhai - Unlocking the potential of dynamic bus lanes for better corridor performance: Exploring the benefits at different traffic compliance rates

Surface transit is one of the most common modes of transportation. However, surface transit is traditionally slow when compared with competing modes. Thus, exclusive bus lanes (EBLs) have been implemented in multiple cities for prioritizing and improving transit service performance. The major drawback associated with EBLs is the reduction in the road capacity for other road users. The emerging dynamic bus lane (DBL) strategy, which relies on vehicle-to-vehicle (V2V) communication, can be used for addressing this limitation of EBLs. DBLs are general traffic lanes that can be converted into exclusive bus lanes when transit is present. This study focuses on analyzing the ability of DBLs to prioritize transit service and improve the corridor performance under different traffic compliance rates using a micro-simulation model for the Eglinton East corridor in Toronto. The results show that a 70% compliance rate is needed to minimize the total person travel time when compared with the case of no priority.

Yuxuan Wang, Catherine Morency, Martin Trépanier - Evaluating transit reliability issues: Comparing travel time and travel speed approaches

In this study, the authors try to evaluate transit reliability using travel times and travel speeds calculated from archived automated vehicle location data from Montreal, Canada. The authors focus on common reliability indicators such as the mean, variability, or extreme values. These indicators allow them to identify segments and intersections with reliability issues, as well as the potential correlation between various factors causing delays. Such research has planning implications: it can provide additional information to transit agencies when evaluating various strategies to improve their services.

Kaveh Rezvani Dehaghani, Catherine Morency - A systematic vulnerability analysis: Comparing the impact of random and targeted disruptions in urban metro network

More than ever, Urban Metro Systems (UMNs) play an important role in urban mobility. This explains why numerous studies have been conducted to assess their vulnerability. However, a few research gaps remain that this research aims to fill. First, in this research, the authors introduce an indicator called redundancy representing the number of alternative routes of all potential ODs weighted by the observed OD pairs of the metro system using data from the 2018 Montreal Origin-Destination survey. Second, in this research, the authors consider wide range of indicators simultaneously -such as betweenness-centrality, degree-centrality, closeness-centrality, PageRank, Eigenvector-centrality, etc. to select the most important station.

5. Air Transportation I

Barry E. Prentice and Narendra Malalgoda - Economics of cargo airships and potential applications

Significant demand exists for airships in several industries. From the supply side, recent airship developments are ground-breaking, such that the wait for their return is almost over. In terms of demand, one kind of airship will not serve all uses. The economics of airships defines the needs and the designs. The paper discusses different airship types, current investments led by different countries, work underway, core benefits, and the improvements that need to be addressed to make this a sustainable substitute means of air transportation. The paper provides a big-picture overview of the current state of knowledge regarding airships and future advancements that will make the commercialization of this technology a reality.

Jody Kositsky, Christopher Greer, Ian Kincaid - How airport forecasting and planning can be more robust to shock events

In the last two decades, the aviation industry has been impacted by three major shock events (9/11 terrorist attack in 2001, the 2008/09 Global Financial Crisis and the COVID-19 pandemic). Predicting the exact nature of such events may be largely impossible, but preparing for the possibility of these events could provide substantial value to airports and the stakeholders and communities they serve. This research considers the methods available to airports for better addressing shock events, drawing on experience and analysis in academia and other industries such as finance, project planning and energy infrastructure. These methods have been found to improve robustness to shock events and could be applied to airports.

Bahar D Viniche, Mehdi Nourinejad – Truck-and-drone last-mile delivery planning tool: A conceptual framework

In the paper, the authors focus on creating a Truck-and-Drone Delivery Planning tool to assist logistic firms in drone-enabled last mile deliveries. The authors propose an operational optimizing model which takes into account the fleet structure of the logistic firm as well as drone operational constraints. This includes their limited flight range in addition to the synchronization between trucks and drones' movement. The tool is useful for different delivery purposes in various scenarios and the authors implement the model in the real-world map to propose routing strategies considering the road characterizations and drone flight restrictions.

6. Transportation Modelling I.

Jihao Deng, Chris Bachmann, Lei Gao, Qiangqiang Shangguan - Who are on the urban expressway? An exploratory analysis between two passenger vehicle usage patterns based on the panel binomial logistic regression model

In this study, based on a week's operation data of 3,064 CMT vehicles and 2,690 Non-CMT vehicles in Shanghai, the authors use the vehicle-traveled kilometers (VKT) on expressways to compare the usage characteristic differences in different scenarios. Based on binary Logit models, the authors analyze what factors affect travelers' choices on using the expressway. They find that: 1) the commuting travels of CMT vehicles heavily rely on expressways while the same trend can be seen in home-based travels of Non-CMT vehicles; 2) a user would like to use the expressway when traveling further; 3) the OD locations and the travel purpose are significant variables that affect a traveler's choice of using the expressway. The methodologies and conclusions of this study provide guidance for employing customized active traffic demand management measures to alleviate traffic congestion on urban expressways in metropolises.

Ghazaleh Mohseni Hosseinabadi, Mehdi Nourinejad, Peter Park - Multi-Transfer Point selection in multimodal trip planning

This study proposes a strategy for finding the optimal transfer points between modes of transport. In the route-finding strategy, the authors consider compatibility matrices for any mode combination. The algorithm optimizes the transfer point location selection process using related subset data and defining mode search zones at a reasonable distance. Additionally, the study is followed by developing a multimodal trip planner which evaluates the multimodality and proper transfer point selection by displaying sustainability metrics. This platform could assist in finding which transfer points should be invested in to improve multimodal transportation metrics while promoting active and alternative low-emission modes.

Hamed Malekzadeh, Catherine Morency - Investigating prospective travel behavior of individuals using a pseudo-panel approach

This investigation proposes a pseudo-panel approach to assist in forecasting people's travel behaviours based on their characteristics and observed/anticipated travel behaviours from a pool of cross-sectional surveys conducted before and during the COVID-19. For this purpose, first the data from the surveys are pooled into one comprehensive database. Second, the respondents are clustered into typologies using people, household, and neighbourhood features. For each typology, changes in their current and expected travel behaviours are analyzed over time. This could provide individuals' anticipated trip frequencies and mode usage and to propose projected OD surveys for the future. The results of this investigation could assist policymakers and planners identify the required transportation supplies necessary to meet the prospective travel needs of people.

Mohammad Haghighi, Eric J. Miller - Week-Long activity-based modelling: A review of the existing models and datasets and a comprehensive conceptual framework

Activity-based travel demand models emerged mainly to fix the conceptual, statistical, and operational deficiencies of conventional trip-based models. In the “Next Generation” of activity-based models (ABMs), researchers are making an effort to improve their capacity to replicate the travel-activity patterns of urban populations more realistically. This study is devoted to exploring the existing literature on multi-day activity-based modelling, categorizing its elements in a systematic manner, searching for the research gaps in the existing models and proposing a comprehensive framework to fill those gaps.

7. Urban Freight I

Pratyay Datta, Arifin Zaman, Francisco Baltodano, Narendra Malalgoda - A green last-mile delivery system using public transit: A case study on Winnipeg

This paper focuses on the current best practices of sustainable last-mile delivery (LMD) and offers a novel solution based on micro hub selection and utilizing the free capacity of public transit networks to deliver small and medium-sized packages for the end users. GIS and remote sensing techniques could determine the micro hub selection and utilize real-time information on public transit routes and time schedules to ensure the accurate delivery of packages to the end users. The rewards system attached to this could attract more public transit users to contribute towards the delivery system while gaining more transit riders for the public transit agencies.

Clarence Woudsma - Industrial and beyond: Exploring logistics spaces in the post-pandemic city

The last two decades have witnessed significant changes in the spaces or properties that are associated with the physical distribution of goods in the economy. This paper explores these spaces with a focus on the drivers of change, the variety of form and function, and the policy impacts and implications. A typology for urban logistics spaces is developed and tested in several Ontario cities. Among the results, the disconnect between the need to plan for and accommodate logistics activity in the city and current practices and capacity remains firmly in place.

Usman Ahmed, Tho V. Le, Matthew J. Roorda - Commercial Travel Survey: Insights of urban goods movement in the GTHA

Policies that promote efficient movement of goods and services play a key role in maintaining and improving our transportation systems, fostering economic growth, and reducing negative externalities of freight transportation such as congestion and environmental emissions. The development of effective policies requires; 1) a thorough understanding of the freight transportation system including actors that play a major role in supply chains such as shippers, receivers, and carriers, and 2) a forecast of freight flows using travel demand modelling. In this study, the authors present their experience in the conduct of the survey and insights about urban goods movement related to trip generation, commodity transportation, commercial vehicle ownership, and supply chain relationships.

Carlos Rivera-Gonzalez, Ziang Feng, Hasan Bayanouni, Kevin Carr, Matthew Roorda - A freight data repository as foundational pillar for sustainable urban freight research

This research shows the key components and lessons learned from a leading-edge freight data repository in Canada. The Freight Data Warehouse, hosted at the University of Toronto, was developed as part of the Smart Freight Centre—which is a collaboration between three Canadian Universities and key stakeholders in the Greater Toronto and Hamilton Area. The data repository exemplifies the collaboration between the private and public sectors with academia. This research presents the key aspects of data security, data governance framework, data classification, data handling, and data policy that were developed for the data repository. It also discusses the key insights the Freight Data Warehouse has learned over its four years of operations.

8. Supply Chains.

Andrew Tam - Inter-provincial trade, Ontario and transportation: Past, present and future

The relative importance of international and inter-provincial (merchandise) trade in Canada has been changing for quite a long time, particularly with reference to Ontario. A paper presented at CTRF's 1997 Annual Conference provided a short statistical review of the evolving patterns since the 1980s. This paper gives a broader treatment of the topic of inter-provincial trade and covers a wider scope of areas. It includes a review of the forces that have influenced the shifting trade patterns in Canada, with an update on the status of internal trade and related statistics. It also reviews the efforts that have been made so far to remove internal trade barriers and future trends. More importantly, the paper examines the implications of these internal trade developments for the future of Ontario's multi-modal freight transportation system.

Jonathan Thibault - Strengthening all links: Building more resilient, fluid supply chains in Canada

Through a series of case studies, this paper takes a magnifying glass to select supply chains (e.g., grain from the Canadian prairies to export markets in Asia), inspecting each link, identifying weaknesses and opportunities for improvement. By gaining a better understanding of the root cause of supply chain delays, more targeted, appropriate solutions can be proposed. Whether it is a change in policy, reorienting the regulatory environment, education/training, targeted investments, or enhanced data sharing from all supply chain partners, supply chain slowdowns need to be addressed. As a trading nation, everyone has a stake in ensuring that we are not trying to 'fix' what is not broken and focusing on fixing what is broken.

Lawrence McKeown, Zahra Aback - Supply chain challenges in Canada: Recent trends in transportation and warehousing

A confluence of factors emerged to disrupt supply chains after COVID-19. Supply chains transitioned from just-in-time efficiency to just-in-case redundancy, as rising delivery costs began to fuel inflation. Other factors such as extreme weather events and rising global energy costs only served to further the upward pressure on delivery prices. This study reviews three Canadian transportation and warehousing trends: Employment and job vacancies; Economic output and obstacles; and Consumer and producer prices with Statistics Canada data. While higher wages may address short term labour shortages in industries such as trucking, it can also result in higher delivery costs; and longer term challenges could remain with an aging workforce. Irrespective, both new and existing metrics must be harnessed to ensure supply chains remain in balance.

9. Safety and Disruption.

Ali Khaksar, Mehdi Nourinejad, Peter Y. Park - Dynamic resource optimization modelling in fire departments

Emergency response departments are facing growing concerns over scarcity of resources, including staff, fleets, and equipment. These departments face growing limitations over the scarcity of resources, including staff, fleets, and equipment. Among the factors contributing to these limitations is the static allocation of resources among stations. Consequently, this allocation causes the misuse of resources due to the uneven spatiotemporal distribution of emergency events. An alternative to static allocation is dynamic allocation, where resources are relocated between stations within a day or between days of operation. This study investigates the optimal location of new emergency stations added to an existing set while considering the role of dynamic resource allocation.

Ayobami Adewale, Chris Lee - Effects of road geometry on car-following behaviours and collision risk of human-driven vehicles and autonomous vehicles in a vehicle platoon

The objective of this study is to investigate the effects of road geometry on car-following behaviours of autonomous vehicles (AVs) and human-driven vehicles (HDV) in a vehicle platoon and rear-end collision risk. The study compares the observed car-following behaviours and the predicted collision risk using real-world trajectories of AVs in a AV-only platoon and HDVs in a HDV-only platoon on the roads with different slopes and curvatures in Europe. The result of this analysis will help understand the safety impacts of slopes and curvature on AVs and HDVs, and develop the advanced vehicle control strategy to reduce the collision risk based on road geometric conditions.

10. Urban Transport II.

Adelia Vu, Robin Lindsey - An economic assessment of the proposed rapid transit line extension in Vancouver to UBC

This paper provides a broad-brush assessment of the economic, environmental and social benefits and costs of the extension (Vancouver's rapid transit Millennium Line) using cost-benefit analysis tools. Potential knock-on effects on transit usage elsewhere on the network and benefits from agglomeration economies are also considered. Publicly available data on transit ridership, vehicle traffic flows and vehicle operating costs are used, as well as estimates of modal shifts, induced demand, and rates of population and economic growth over the envisaged lifetime of the project.

Sanjana Hossain, Patrick Loa, Felita Ong, Yicong Liu, Khandker Nurul Habib - Have the determinants of bike-share demand changed in response to the COVID-19 pandemic? A machine learning-based approach

The authors investigate whether the socio-economic, land use, built environment, and weather-related determinants of bike-share demand have changed due to the COVID-19 pandemic. The study utilizes Bike Share Toronto's open-source ridership data and machine learning (ML) methods to predict the daily number of trips originating from the bike-share stations in 2019, 2020, 2021, and 2022. Specifically, it applies extreme Gradient Boosting to train year-specific ML models and to identify the variables that have the greatest impact on daily bike-share demand. Using the variable importance values from the 2019 model as a reference, the values from subsequent years are used to examine the extent to which the determinants of bike-share demand have changed in response to the uncertainty caused by the pandemic.

Catherine Morency, Hubert Verreault, Jean-Simon Bourdeau - Understanding the interactions between taxi and transit: the case of Montreal

Transit is the key alternative to induce mode shift in urban areas. Other modes can assist in providing relevant sets of options to convince people to drop their cars. One of these options is the taxi. This research proposes to analyse the use of taxis in Montreal and assess if taxis are a complement or competitor to transit. Previous research looking into a set of options (bikesharing, carsharing, cycling) confirmed that taxis have quite a unique daily pattern of usage. It confirms that it plays a key role in the pool of transportation options.

11. Transportation Modelling II.

Eric J. Miller, Mausam Duggal - Agent-Based microsimulation of activity & travel: Canadian operational implementation experience

The Travel/Activity Scheduler for Household Agents (TASHA) is an agent-based microsimulation model of personal and household daily activity and travel developed at the University of Toronto. TASHA provides an attractive alternative to this narrative in terms of being based on a compelling behavioural framework, computationally very efficient, and having relatively modest data requirements. An equally persuasive feature of TASHA is its user-friendly graphical interface that is designed for a fast and transparent implementation of scenarios. Starting with its adoption by the City of Toronto in 2016, TASHA is now in operational use by most municipalities in the Greater Toronto Area and the Region of Niagara. It is also currently being implemented by ARTM in Montreal, including several research settings outside of Canada. This paper provides an overview of the TASHA model system, describes operational experience with it to date and discusses directions for its further development and application.

Mohammad Haghighi, Yousef Shafahi - Temporal transferability analysis of trip distribution models considering urban development patterns: The case of Shiraz

In this research, travel data from Shiraz Comprehensive Transportation Studies in 1990, 1999 and 2015 are utilized to explore the temporal transferability of different proposed trip distribution models while taking into account the urban development pattern over the study period. The results reveal that the generated trip distribution models based on the data observed in each year do not show satisfactory

strength in estimating the origin-destination matrices of the posterior years. However, certain levels of proportionality can be observed between the existing errors and the intensity and patterns of urban development during the transfer period. Such proportionality is applied to improve the performance of trip distribution models when it comes to forecasting future trip data.

Md Shahadat Hossain, Mahmudur Fatmi, Annesha Enam - Modeling vehicle type choice decisions within an integrated urban transportation modeling framework

The authors investigate households' vehicle ownership decisions; particularly, the type of vehicles. A joint model for vehicle type is developed that has the following four choice dimensions: body type, vintage type, fuel type, and advanced technology type. The authors adopt a life history-oriented approach, testing the influence of households' previous behaviour such as the existence of advanced vehicle technology and electric vehicles in the previous/existing fleet. In addition, the authors test the exposure to technology in other domains of life such as ownership of google home, and how that affects vehicle type choices. This model can be incorporated within an integrated urban model, which could be capable of testing the impacts of emerging transportation policies and their impacts on emissions.

Kristen Burns, Trevor Hanson - A tale of two bridges: Using the 4-step model to understand active transportation usage across the Wolastoq/St. John River in Fredericton, NB

Fredericton is connected by two river crossings (approx. 600 m in length, 1.6 km apart) that allow Active Transportation (AT) users: a former train bridge that is part of a dedicated AT trail system; a 4-lane highway bridge (approx. 51000 AADT) with a sidewalk separated from traffic by a concrete barrier. Daily AT users on the walking bridge outnumber the highway bridge by 10:1. Though the highway bridge is more direct to downtown, the user experience on the bridge is assumed to negatively impact demand. A calibrated 4-step demand model was created in VISUM to determine if it was possible to model AT demand and test whether AT users consider the bridges equivalent.

12. Electric Vehicles.

Ali Shehabeldeen, Ahmed Foda, Moataz Mohamed - Changing batteries or adding charging stations: Optimizing electric bus charging infrastructure life cycle with battery degradation

Electric transit is considered a sustainable means of mobility. Currently, some planning and operational challenges impede their full adoption. One critical issue for Battery Electric Buses (BEBs) is battery degradation. Current BEB infrastructure optimization assumes that BEBs deliver the same performance over the lifespan of the service. However, due to battery degradation, the performance and range of BEB changes over time. This study optimizes the impact of BEBs' battery degradation on infrastructure planning. In particular, the authors develop a multi-stage optimization model to optimize BEB infrastructure allocation for the 12 years life span of the service. The results indicate that additional charging stations are required to compensate the impact of battery degradation, and these are more cost-effective compared to replacing the batteries of BEB. Their findings are based on a small hub-and-spoke transit networks.

Palmer Lumb, Hasan Shahrier, Muhammad Ahsanul Habib - Identify the locations for electric vehicle charging stations utilizing multi criteria decision analysis (MCDA) approach

The authors aim to develop a better understanding of where to locate electric vehicle charging stations (EVCS) throughout Halifax Regional Municipality (HRM). They utilize data from Nova Scotia open data portal and 2018 Nova Scotia Travel Activity (NovaTRAC) survey. The prime contribution of this study is that the model utilizes accessibility and built environment characteristics, travel behaviour information, and vehicle ownership information. This study also contributes to the existing literature by identifying the top three traffic analysis zones (TAZs) to install EVCS, utilizing a geographic information system (GIS) - based multi-criteria decision analysis (MCDA) technique within the ArcGIS Pro software.

Amanda Holmes, Lawrence McKeown - The emergence of electric vehicles in Canada: Prevalence and factors that influence adoption

This paper begins with a profile of electric vehicle adoption from 2017 to 2021. While registrations are increasing across the country, British Columbia and Quebec lead the way. Using British Columbia as a case study, the authors examine the socio-demographics of electric vehicle owners and, building on this information and the registration counts, develop a model to predict the geographical areas associated with higher levels of electric vehicle adoption. Such studies could become essential to plan for rising electricity demand and refuelling infrastructure.

13. 2022-2023 Scholarship Recipient Research Papers.

Ahmed Foda, Hatem Abdelaty, Moataz Mohamed – The impact of electricity outage on e-bus operational robustness: An assessment framework

Motivated by the greenhouse gas (GHG) emissions reduction, the implementation of battery electric buses (BEBs) is gaining momentum. Scholarly, the implementation process is addressed as an optimization problem aiming to minimize the system's total cost of ownership. However, this approach is insensitive to accommodating any disruptions during operation. This study utilizes the concepts of network science theory to investigate, assess, and quantify the BEB transit system robustness under charging infrastructure disruption. As such, the authors propose a BEB robustness assessment framework and apply it to a real-world mid-size multi-hub transit network. The results show that the BEB transit system is robust against short-period disruptions (less than one hour). The authors recommend the integration of network robustness measures against perturbations in future BEB optimization models.

Md Asif Hasan Anik, Muhammad Ahsanul Habib - Examining preferences towards virtual activities over in-person activities: An ordered logit modelling approach

This research examines preferences towards participating in online activities over in-person activities using an ordered logit model (OLM) approach in the Halifax Regional Municipality (HRM), Canada. Three OLMs are developed investigating preferences for work from home, online shopping and virtual recreational/religious activity participation with respect to socio-demographics and travel characteristics during and after the pandemic. This study utilizes the data from Halifax Travel Activity Survey 2022-23 that collects information on individuals' demographics, mobility tool ownership, travel choices and preferences in HRM, Canada. The outcomes could help to better understand the factors affecting peoples' willingness to participate in online activities over in-person activities and could be useful for transport researchers and policymakers in developing post-pandemic travel demand management strategies.

Muntahith Mehadil Orvin, Mahmudur Rahman Fatmi, Mohamad Ali Khalil - Microsimulating the residential location component of an integrated urban model: validating and testing for Covid-19

This study presents the micro simulation of residential relocation decisions within an agent-based integrated urban model (IUM), validates the model over a multi-year period, and predicts housing market for socio-economic shocks like COVID-19 pandemic. To better represent relocation behavior, reduce computational requirement, and improve prediction accuracy, proposed IUM is an event-based model adopting a hybrid of continuous time and discrete micro simulation technique. The model is deployed for 100% population of Central Okanagan region of British Columbia for years 2011-2021. Testing for COVID-19, the model predicts a growing increase in housing prices for single-detached dwelling units in suburban neighborhoods during pandemic.

Md Asif Hasan Anik, Fariba Hossain, Muhammad Ahsanul Habib - How will activity participation change in the COVID-19 post-pandemic period? A Wilcoxon Signed Rank Test Approach

This research investigates the frequency of participating in online activities, such as work from home, online shopping, online food ordering and telemedicine as well as in-person activities, such as travel to work, shopping in-store, eating meal at a restaurant, and visiting recreational/religious places during and

after the pandemic. A Wilcoxon Signed Rank Test method is adopted to statistically analyze activity frequency difference between the two time periods (before and after COVID-19). The study area is selected as the Halifax Regional Municipality (HRM), Nova Scotia, Canada. This study uses the data from the Halifax Travel Activity (HaliTRAC) survey 2022-23 with more than 2,000 respondents. The outcomes of this paper could provide insights into how online and in-person activity participation may change in the COVID-19 post-pandemic period. The results could assist transport professionals to better understand the changing activity trends and help to estimate subsequent travel demand.

14. Connected and Automated Vehicles.

Pirooz Ghaleh, Chris Bachmann, Liping Fu - Automatically assessing the need for traffic signal retiming using connected vehicle data

In this study, a new index is developed using CV data to estimate the amount of delay which could be reduced by signal retiming. The index is calculated based on the difference between observed CV delays and estimated delays under an optimal signal timing plan determined directly from the CV data. The proposed index is expected to accurately detect suboptimal signal timing plans under different traffic scenarios. The accuracy of the index is investigated under different CV penetration rates using simulated data.

Joshua Dhaness, Mehdi Nourinejad, Sina Bahrami - Optimal automated vehicle piloting: Avoiding perfection being the enemy of the good

This paper seeks to create a model based on the idea of the "enemy of the good". That is, a model that addresses the concept of safety of Automated vehicles (AVs) while taking into account the diffusion of the technology into the public and future improvements via learning (machine learning and other improvements). Sample results include mass implementation of the pilots in an imperfect state leading to more pilot failures, but greater future improvements due to more usage contrasting a case of smaller pilots with less risk and less benefits. By creating a model that offers insight into the balance between these three concepts with factors such as failure rates, planning periods and AV demand, social planners are able to observe scenarios such as one where pilots may start below expectations and exceed expectations later. Various cases such as these allow for social planners to evaluate the cost of implementation.

Joshua Dhaness, Mehdi Nourinejad, Sina Bahrami - Autonomous vehicles: An analysis of Canadian regulations and pilot design

This analysis highlights issues seen in current AV pilots while showcasing where some places in Canada are currently with regard to policies at a municipal, provincial and federal level. General recommendations regarding policies involve some unique cases in Canada such as considering issues of insurance liability which can differ based on province, but also the case for improving communication and standardization of pilot information. AV pilots tend to have some distinct reason in why or how they are run, but parsing through the limited released information can make it difficult to obtain. Post pilot information improvements, such as pilot attribute standardization, may pave the way to allowing future pilots and the literature to obtain a solid foundation to build on.

15. Commercial Regulatory and Legal II.

Joseph Monteiro and Grace Castelino - Recent developments in conference-consortia legislation

A deterioration of supply-chains and an increase in shipping prices brought a renewed interest in conference-consortia legislation. It all began with Covid-19 which brought about closures and slowdown at ports and airports. A brief falling of trade followed by a tsunami accentuated by a government relief packages, shifting in consumer demand, and congestion at ports made things unpredictable. To add fuel to the fire, a new concern emerged on the horizon, the Russian-Ukrainian war. Then began a dramatic increase in consumer prices in the world, unseen for a decade. As usual, consumers called for relief and government leaders in the world became concerned, leading to the usual investigation – Who Did It and Where Did It Begin? So the investigation begins at the price of goods arriving at the ports. In this paper,

the shipping consortia-legislation in some of the major jurisdictions in the world in the last few years are examined.

Steve Pratte - Policy, regulatory reform and grain hopper cars: Bill C-11 and the “one time hopper car adjustment”

In the last half-century, the policy and regulatory landscape has evolved in its treatment of the hopper car, specifically those provided by governments to the railways to service Western Canadian grain (the ‘publicly-supplied’ fleet). Since coming into effect on August 1, 2000, the overarching regulatory framework that applies to the movement of grain and the treatment of hopper cars therein is the Maximum Revenue Entitlement (MRE). This paper examines the policy discussions of hopper car ownership in the five-year period of 2004–2009 and the way in which the governing policy and regulatory framework evolved. Specifically, it surveys the way in which the formation of a new government in January 2006 precipitated the reversal of the decision to divest the federal hopper car fleet and the events that led to the Canadian Transportation Agency issuing its ‘one-time hopper car adjustment’ decision to alter the MRE in 2007, and the legal aftermath of that process that extended into 2009.

Julia Loney, Joanna Dawson - Recent Canadian legal developments of interest to the marine transportation industry relating to renewable energy and energy transition

This paper is on renewable energy options for use in the marine transportation industry, including consideration of the relevant international, federal, and provincial laws governing the use of renewable energy. The topic is based on the transformation of energy sources over the past centuries, wherein wind and sails were replaced by coal, heavy fuels and eventually marine diesel, but now renewable energy sources are again in favour to support decarbonisation by 2050. Our discussion will focus on the existing Canadian regulatory regimes and how they need to be amended to support the relatively new introduction of energy sources such as hydrogen, methanol, natural gas and electricity. This paper highlights key considerations, including identifying obligations arising from statutory and common law, environmental protection and conservation, safety, and emergencies.

16. Ports and Marine.

Siyavash Filom, Saiedeh Razavi – Revisiting port demand prediction methods: A case study for the Port of Hamilton

This research attempts to propose a Long Short-Term Memory deep learning model for Ontario ports to provide reliable and precise forecasts that could benefit practitioners, port operators, and governments ranging from operational to strategic decision levels. The model is implemented using Statistics Canada trade data from 2016 to 2020. The outcomes of the model are compared to other state-of-the-art techniques such as Random Forest, XgBoost (extreme gradient boosting), and Support Vector Machines. The models are compared based on metrics including Mean Absolute Percentage Error (MAPE), R-Squared (R²), and Mean Absolute Error (MAE).

Adolf K.Y. Ng, Mark CP Poo, Tianni Wang, Austin Becker, Yui-yip (Joseph) Lau - A theoretical discussion on ports’ climate adaptation strategies and planning

The past decade has seen an increase in research on the climate adaptation strategies and planning of ports. However, there are still inadequate works explaining how scholars address this topic from different theoretical angles. This paper dissects climate adaptation strategies and planning of ports from the perspectives of institutional systems, path dependence, supply chain risk management, and stakeholder management. Based on the discussions, the authors argue that effective climate adaptation is not limited to engineering technicalities, but an ideological issue that requires shifting political, economic, and social paradigms.

Alain Richard - Optimization of the speed of merchant ships in a context of instability

The objective of this paper is to present a new approach that allows charterers and ship owners to mitigate market fluctuations by optimizing the speed of their vessels. The financial challenges facing merchant ship operators are numerous and complex, especially in times of economic instability. These operators must react quickly in order to perform in a competitive and ever-changing world. They must take into account the two predominant components in the operation of a vessel, namely the cost of fuel and the charter value. Knowing that the cost of fuel can represent between 50 and 60% of a vessel's operating costs, market fluctuations or regulations imposing a more expensive type of fuel have a major impact on the profitability of the voyage. The same is true for charter rates, which are also subject to significant fluctuations, particularly during periods of economic disruption. The proposed methodology takes into account the financial components in real time, allowing charterers and ship owners to mitigate market fluctuations by optimizing vessel speed.

Joseph Monteiro, Sanjay Castelino and Grace Castelino - Alliances, mergers, competition issues and recent developments in ocean shipping

Over the last thirty years, alliances, partnerships, mergers and acquisitions have occurred across the telecommunications, transportation and other sectors. Consolidation and concentration in key sectors of the economy have increased concerns about competition in the economy. These concerns were highlighted with a deterioration of supply-chains and an increase in prices. Set to resolve this concern, on July 9, 2021, the US President Joe Biden signed an Executive Order on Promoting Competition in the American Economy on July 9, 2021. This paper reviews the important developments in alliances, mergers and competition issues in Ocean Shipping.

17. Transportation Modelling III.

Mohamad Ali Khalil, Mahmudur Rahman Fatmi, Muntahith Orvin – Developing the demographic dynamics component of an agent based integrated urban model: a comparison between logistic regression and machine learning techniques

In this paper, the authors apply machine learning (ML) and logit models for the demographic simulator of an integrated urban model (IUMs), and compare the results of both based on parameter estimation and prediction accuracy. In addition, they apply an explainable AI technique (xAI) to explain the influence of the predictors and compare the findings with the logit model. The findings could help in understanding the applicability ML for IUMs.

Bijoy Saha, Nazmul Arefin Khan, Mahmudur Rahman Fatmi - Modelling destination, departure time and travel mode choice decisions of telecommuters, non-telecommuters and non-workers

This paper adopts a nested modelling structure to investigate destination, departure time and mode choices for telecommuters, non-telecommuters and non-workers, to understand impacts caused by COVID-19 travel restrictions. A mixed logit modelling technique is adopted for destination choice. One of the challenges for destination choice is the generation of choice set. This is tackled by adopting an activity space concept where potential destinations are assessed based on home and work/prioritized activity locations. A cross-nested logit model for departure time and mode choices is developed. The influence of destination choice is incorporated into joint departure time-mode choice model via logsum value. The findings shed insights on changes in travel decisions by work status/arrangement, which could assist in better planning for equitable, low-cost and sustainable travel options.

Renuka Mandlik, Saiedeh Razavi, Susan Tighe - Graph neural networks for freight transportation and logistics applications: A comprehensive review

Graph Neural Networks (GNN) offer a promising opportunity for analysis in freight transportation, supply chain, and logistics applications, given their capacity to harness the power of spatial and temporal dependencies inherent in the supply chain and transportation networks. This paper conducts a comprehensive analysis of different GNN models evolving through time and their applications in freight transportation and logistics. The review also categorizes the open data and source codes for each problem

and provides potential sources that may be used for further explorations. This paper is the first investigation to provide insights into current trends and state-of-the-art GNN models in freight transportation, related application areas, and opportunities for advanced studies.

Barry Riordon, Trevor Hanson - Operational planning for health transport of older adults in New Brunswick

Transportation to healthcare can often be a concern for older drivers (aged 65+) where the health effects of aging can result in increased demand for health access while also making driving difficult over time. This research extends previous work at the University of New Brunswick on the feasibility of administrative health data for transportation planning purposes, to investigate the temporal characteristics associated with these records, such as healthcare access by time of day, day of week, and month of year. Understanding these characteristics provides an opportunity for transportation engineers, planners, and healthcare policymakers to estimate demand for alternatives for driving to healthcare, including non-emergency medical transportation (NEMT). This paper presents aggregate results and descriptive statistics on healthcare access, and a use-case of temporal data to model an NEMT program.

18. Air Transportation II.

Josiah Jarvenpaa, Aya Hagag and Lawrence McKeown - Should I stay or should I go? Canadian long-distance travel patterns during COVID-19

This paper describes long-distance travel from the first quarter of 2018, before the pandemic, to the second quarter of 2022, when airports were struggling with a sudden surge in travel demand using data from the National Travel Survey. After outlining the restrictions and examining the impacts, the study concludes by attempting to distinguish between changes that are temporary and those that appear to be longer term in nature.

Barry E. Prentice, Norm Normand - Airship logistics circuit for arctic security and resupply

This paper explores the use of cargo airships inserving a combination of military security and commercial activities in the Canadian Arctic. The primary focus is military requirements with standby capacity being provided to improve the logistics to remote communities and mining operations. The analysis begins with a survey of existing transportation corridors to the North, and a proposal for a sustainment circuit to provide regular deliveries and surveillance. The discussion concludes with the need to combine public and private logistics missions in sparsely populated areas.

Shamik Pushkar, Elkafi Hassini - Impact of legislative restrictions on drone delivery

In this paper, the authors consider a truck-drone last mile delivery system. They investigate the impact of drone regulations, such as no-fly zone or high-density areas, on cost of operations and delivery performance. They compare this system with the truck-only system and discuss some managerial insights and policy ideas that facilitates drone-based logistics. Their analysis provides insight on comparative advantages of truck-drone systems over truck only systems. In addition, the authors examine at the competitiveness of cities in attracting truck-drone delivery operations given the implications of regulation on their transport infrastructure.

Kirk Goodlet, Solomon Wong – The technologies future of universal access for air passengers

How will air travel evolve with the growth of diverse mobility needs while staying the course with a range of digital tools available for customers? Based upon work on universal accessibility and the future of travel, this paper outlines the evolving directions airports, airlines, and mobility service providers need to advance to create an improved journey within Canada, and from Canada to destinations around the world. From the way passports, visas, and electronic documentation are dealt with to case studies of service provision at airports, the authors outline major trends and use cases that could help inform the coming years of evolving mobility.