

Rail Analytics and Simulation Research at the Transit Analytics Lab

Workshop on Rail Analytics and Simulation Research

Jan. 26, 2023

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UNIVERSITY OF
TORONTO



Land Acknowledgment

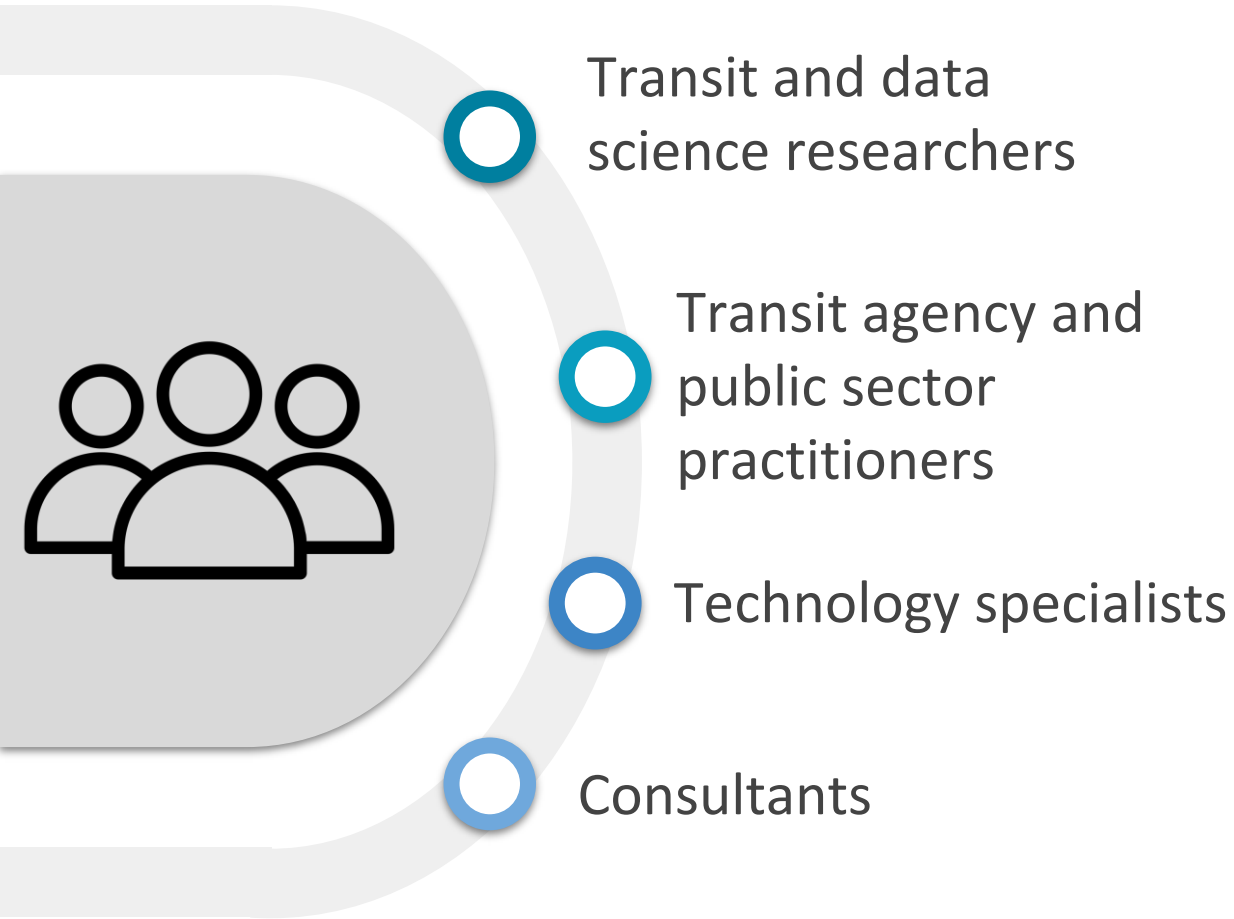
Wish to acknowledge the land on which the University of Toronto operates. For thousands of years, it has been the traditional land of the Huron-Wendat, the Seneca, and most recently, the Mississaugas of the Credit River. Today, this meeting place is still the home to many Indigenous people from across Turtle Island and we, at the University of Toronto, are grateful to have the opportunity to work on this land

Purpose of Workshop

- Share research activities and results in urban rail transit
- Stimulate discussions on research needs and priorities
- Foster collaborations

Workshop Agenda

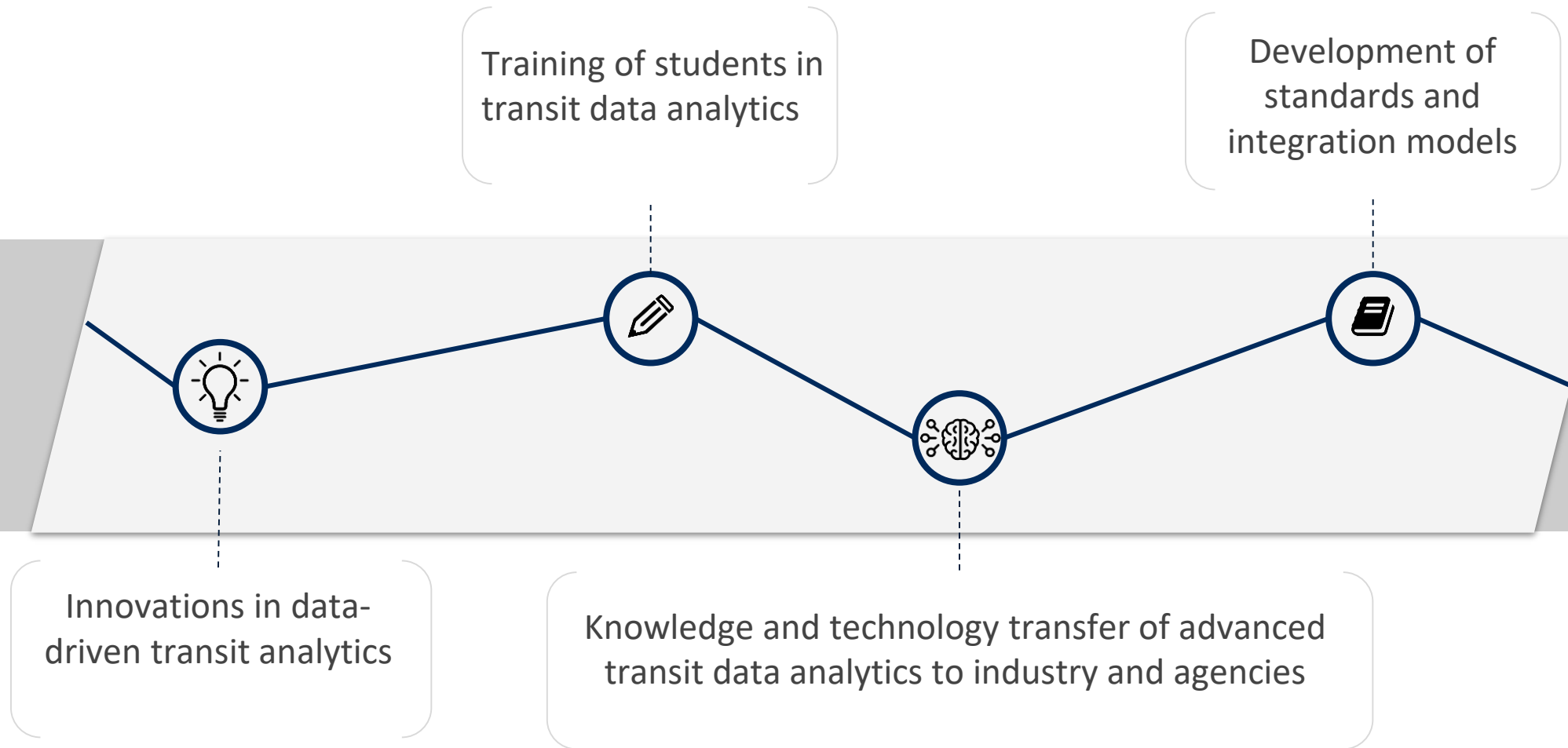
		Moderator
9:00	Introduction to the Transit Analytics Lab (TAL) and Rail Analytics Research	
9:20	Operations Analytics to Improve Rail Performance	Brendon Hemily
10:40	Break	
10:55	Other Rail-Related Research	Amer Shalaby
11:40	A Discussion of Future Rail Research Needs	Brendon Hemily
12:30	End of Workshop	



TAL

**a common forum
to promote transit
decision making using
data analytics**

TAL aims to foster



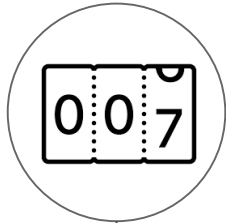
Surveys



Automatic
Vehicle
Location



Automatic
Passenger
Counts



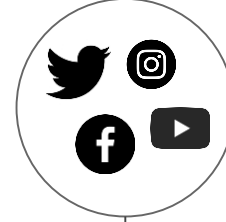
Automatic
Fare
Collection



Mobile data



Social
Media



Network and
Schedule
(GTFS)

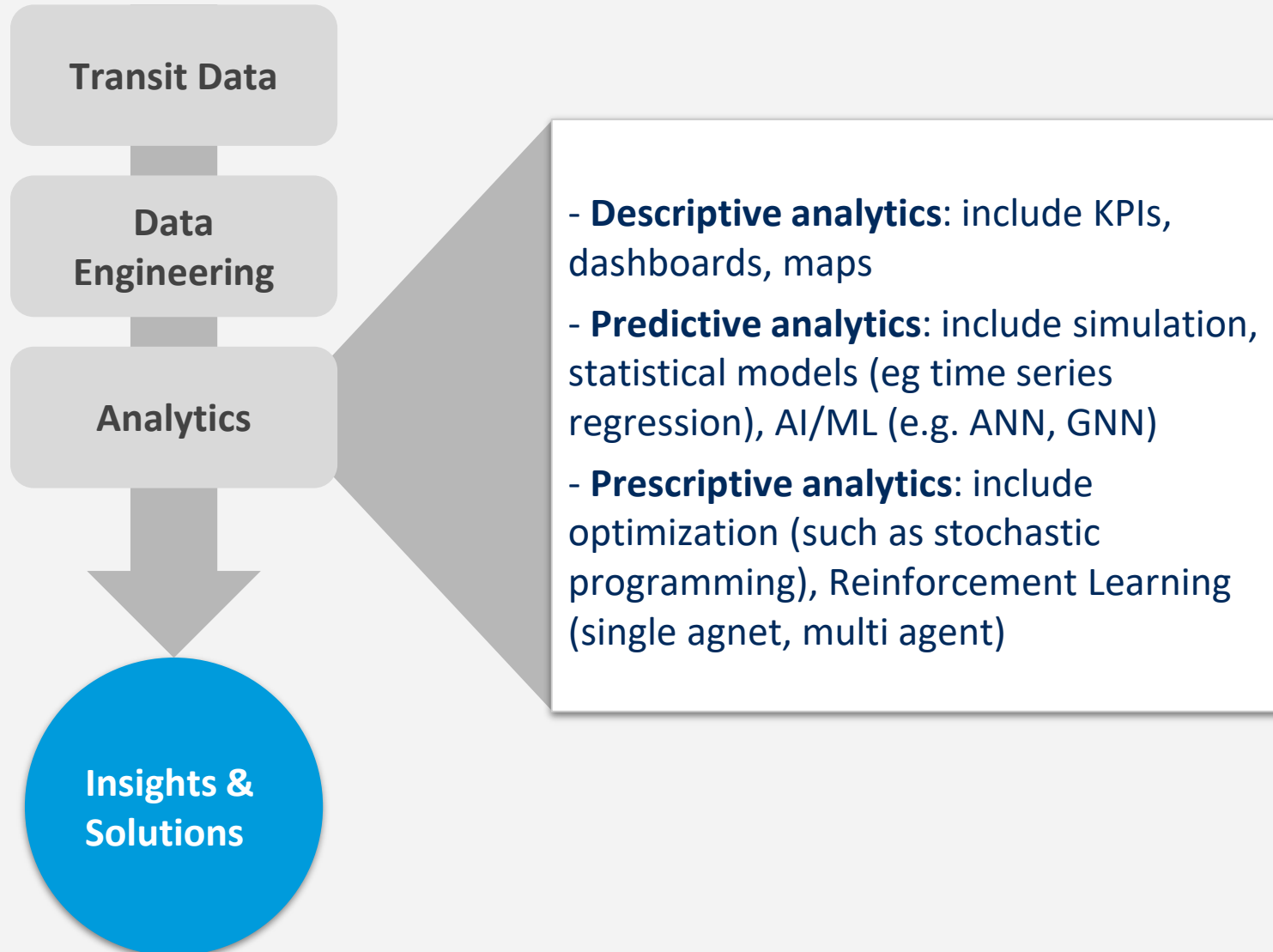


Other

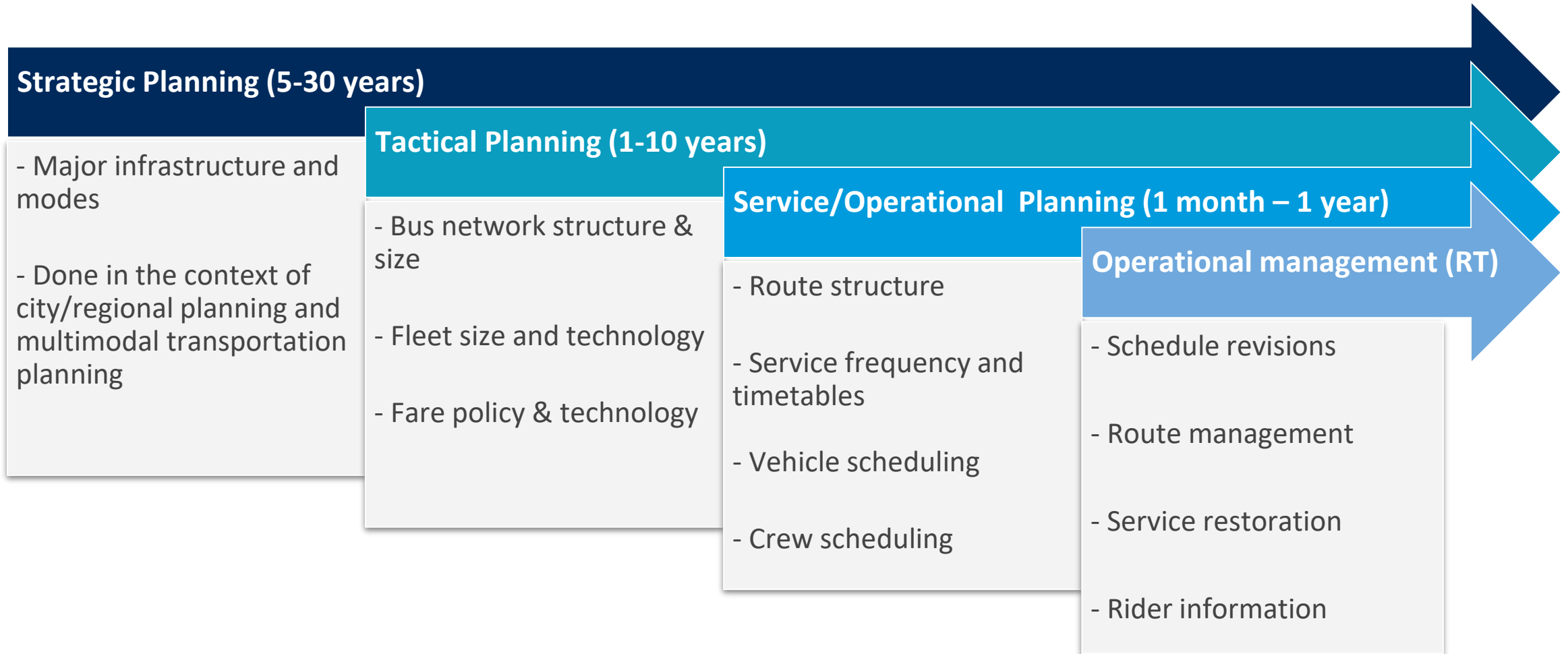


Era of Big Transit Data

Our approach



Hierarchy of transit decision making



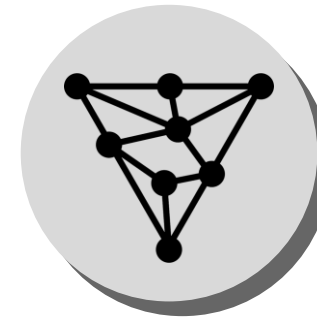
TAL Research Program



Bus



**On-demand
Transit**



Multimodal



Rail

Bus, ODT and Multimodal Research

Bus



Service Planning and scheduling

- Transfer optimization
- MDVSP
- Route and service design
- ZEB scheduling

Real-time operational management

- AI-based control
- ETA and Bunching prediction
- ZEB rescheduling
- Absenteeism and spare-board mgmt

ITS and Emerging Technologies

- TSP
- Dynamic lanes & Driver advisory
- Platooning
- AV shuttles

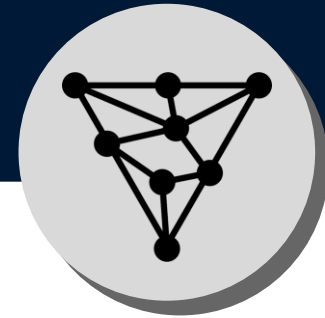
On-demand Transit



- Planning framework
- Ridership prediction
- Network design

- Real-time demand prediction

Multimodal



- Ridership forecasting
- Accessibility and equity
- Rider satisfaction via Twitter analytics

- Bus bridging
- Resilience
- Mobility hub flow management

- Integrated transit-traffic signal control
- Interaction with ride hailing



Rail Research

Advanced Analytics

Simulation

Innovative Operating Strategies

Real time

Delay prediction; resilience analysis; automated communication

Digital twins; near-future scenarios; incident response planning

Control of passenger and vehicle flow in multimodal hubs and networks; disruption resolution

Short Term

Schedule optimization (single and multi-yard); fuel management; fleet management; throttle control

Feasibility testing with randomness; Yard and corridor capacity

Mixed-corridor operations and planning; alternate operations optimization

Medium Term

Performance measurement; demand analysis and prediction; equipment sizing and cycling analytics

Feasibility testing; proof-of-concept demonstration; simulation of potential capacity changes

Fleet sizing optimization; adaptive operating schemes

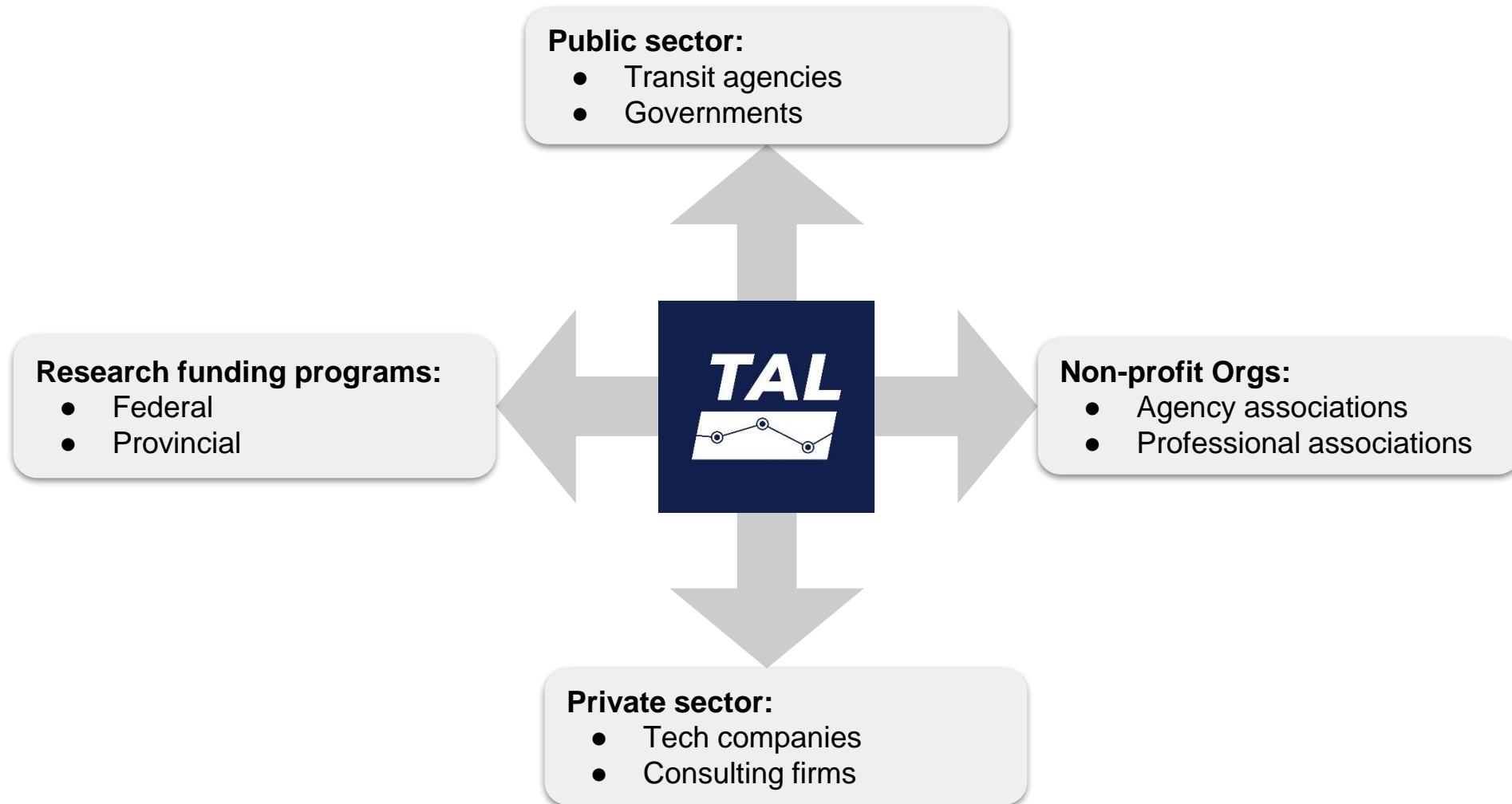
Long Term

Demand modelling; Accessibility and equity impacts

Corridor expansion prototyping; rapid feasibility testing; proof-of-concept demonstration

Collaborative passenger and freight movements

Research through partnership



Symposium, Workshops and Much More



International
Symposium

<https://transitdata2020.ca/>



2020 Workshop, Annual Research Days,
Thesis Presentations, Papers, etc.

<https://uttri.utoronto.ca/tal/>

TAL's YouTube Channel

TAL Transit Analytics Lab
37 subscribers

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Annual TAL Professional Courses



A Practical Guide to Public Transit Planning, Modelling and ITS Applications



Two Short Courses on Public Transit

Public Transit Planning & ITS
August 9-10, 2022

Public Transit Modelling
August 11, 2022

Galbraith Building, Room 202
35 St. George Street

Presented by:

Transit Analytics Lab at the University
of Toronto Mobility Network



Two courses Serving as a Practical Guide to Public Transit Planning, Modelling and ITS Applications

High quality public transit is the linchpin of liveable cities. Not only does it enhance mobility, accessibility, economic productivity, and help address climate change, but the COVID pandemic also illustrated its critical role in public health and ensuring the mobility of essential workers. Transit has always faced challenges in our auto-dominant society, but now faces an environment that is increasingly uncertain and turbulent. The last few years have highlighted the strategic importance of data, sophisticated analytics, and advanced technology such as Intelligent Transportation Systems (ITS), that enabled transit systems to respond more nimbly to the dynamic situation and the changing needs of customers. These tools are playing an increasingly critical role in the planning and operations of public transit, and need to be fully integrated into internal business processes.

The Transit Analytics Lab at the University of Toronto Mobility Network is offering two back-to-back courses designed to provide participants with knowledge on key concepts and best practices related to public transit service planning and technology. The first course, **Public Transit Planning and ITS**, provides an overview of key concepts and best practices related to transit planning, network and service design, service standards, transit and land use, and the application of ITS technologies. The second course, **Public Transit Modelling**, provides a complementary but more focused and advanced exploration of tools that can be used for forecasting demand at both the system and route levels, transit assignment, and microsimulation-based analysis. The courses will be taught by leading transit planning researchers and practitioners and will provide a balanced perspective on transit systems planning and ITS, including both state-of-the-art techniques and practical perspectives.

Public Transit Planning and ITS

Tuesday, August 9, 2022

8:30-8:45am Welcome and Course Introduction - Hemily
8:45-10:00 Setting the Context for Transit Planning - Hemily
10:00-10:20 Coffee Break
10:20-11:45 Transit Lines and Networks: Types and Operations - Shalaby
Lunch
11:45-12:45 Fundamentals of Line Analysis and Scheduling - Shalaby
12:45-2:00pm Coffee Break
2-2:15 Transit ITS: Developments, Challenges, Opportunities and Future Directions - Hemily
2:15-3:30

Wednesday, August 10, 2022

8:30-10am Transit Signal Priority - Shalaby
10-10:20 Coffee Break
10:20-12 Transit Performance Monitoring Using ITS Data - Wilson
12-1pm Lunch
1-2:30 Transit Cost Modelling - Wilson
2:30-2:45 Coffee Break
2:45-4:15 Transit Fare Policy and Collection Technology - Hemily
4:15-4:30 Closing Session: Attendance Certificate Presentation

Public Transit Modelling

Thursday, August 11, 2022

8:45-9am Welcome and Course Introduction - Miller
9-10:30 Introduction to Transit Ridership Forecasting & System Level Methods - Miller
10:30-11 Coffee Break
11-12:30pm Transit Assignment Models - Shalaby
12:30-1:30 Lunch
1:30-3 Route-Level Ridership Forecasting Methods - Miller
3-3:15 Coffee Break
3:15-4:45 Microsimulation Models of Transit Operations - Abdelgawad
4:45-5 Closing Session: Attendance Certificate Presentation

Short Course Leaders

Dr. Hossam Abdelgawad has 17 years of experience in developing simulation models using a wide range of traffic software/tools. He has ample experience in building models using ADMSUN, Paramics, UAF, Vissim, DynusT, HCS, Synchro, SimTraffic, EMMME and Dynameq.

Brendon Hemily, PhD, is an independent consultant with 39 years of experience working with the transit industry in Canada and the US, and he serves as Senior Advisor for the Transit Analytics Lab. He has been involved in a wide range of projects related to the implementation of innovative service concepts and the effective use of advanced technology. Previously, he was Manager of Research and Technical Services at the Canadian Urban Transit Association where he worked for 15 years.

Professor Eric Miller is the director of the Mobility Network and a recognized expert in integrated land use transportation modelling and demand forecasting. He is the developer of *GLAModel*, a "best practice" regional travel demand modelling system used widely to forecast travel demand in the Greater Toronto Area. He is co-author of the textbook *Urban Transportation Planning: A Decision-Oriented Approach*.

Amer Shalaby is Bahen-Tanenbaum Professor in Civil Engineering and Founding Director of the Transit Analytics Lab at the University of Toronto, with 30 years of research and consulting experience in Canada and internationally in the areas of transit planning and intelligent transportation systems. His research has been published widely in peer-reviewed journals and international conference proceedings. He has served on various transit committees of the Transportation Research Board, and he sits on the editorial boards of multiple scientific journals.

Nigel Wilson is Emeritus Professor of Civil and Environmental Engineering at MIT focusing on urban public transport. He is Founding Director of the MIT Transit Lab, a major long-term collaborative research program with leading global public transport agencies including Transport for London (UK), MTR (Hong Kong) and the MBTA (US) which focuses on making better use of smart card and other automatically collected data to support decision-making throughout the agency. During sabbatical leaves from MIT, Professor Wilson worked in three large transit agencies, the MBTA, Metro Transit and TFL, and has served as consultant to a number of other North American transit authorities. He taught a short course in transit planning at MIT for twenty years which had a cumulative enrollment of over 400 transit professionals.

**Thank you
and enjoy the
Workshop!**