

travel
modelling
group



ANNUAL REPORT, 2019-20

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March, 2020



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UTTRI

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1. INTRODUCTION

This document describes the activities of the Travel Modelling Group (TMG) during its 9th year of operation, 2019-20 (April 1, 2019 through March 31, 2020).

Section 2 summarizes and comments on TMG activities and outcomes during the reporting period. Section 3 then describes the TMG budget and resources that enabled these activities.

2. 2019-20 PROJECTS & ACTIVITIES

Table 2.1 presents the 2019-20 work plan as approved by the TMG Steering Committee. As indicated in this figure, the work plan tasks divided into 10 primary tasks. TMG activities in each of these areas are discussed in the following Sections 2.1 through 2.10, inclusive.

Table 2.1: 2019-20 Work Plan

TMG 2019-20 Work Plan		MONTH												Days Allocated	
No.	TASK	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Total ¹	%
1	Auto Ownership / Mobility Tool Modelling	2	2	2	2	2	2	2	2	2	2	2	2	96	18.2%
2	Parking Supply: Data & Modelling ²	1	1	1	1	1	1	1	1	1	1	1	1	48	9.1%
3	Passenger mode modelling	2	2	2	2	2	2	2	2	2	2	2	2	96	18.2%
4	DTA				2	2	2	2	2	2	2	2	2	72	13.6%
5	GTAModel V4.1 Maintenance & Support	2	2	2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	42	8.0%
6	TMG Toolbox improvements	1	1	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	30	5.7%
7	XTMF: Upgrades/ Maintenance & V2.0	2	2	2	2	2	2	2	2	2	2	2	2	96	18.2%
8	Documentation of TMG products	1	1	1	1	1	1	1	1	1	1	1	1	48	9.1%
9	Outreach & Training (3 workshops)		W1				W2					W3		528	Total
10	Meetings: TMGSC (2) & TMGTAC (5)	TAC		TAC		TAC		SC	TAC		TAC		SC		
TMG Staff Average Weekly Time Allocation (Days) ³		11	11	11	11	11	11	11	11	11	11	11	11		
Suggested Workshops⁴															
W1	GTAModel V4.1 Hands-On Training														
W2	Parking Data & Modelling: Progress to Date & Next Steps														
W3	Mobility Tool Modelling														
Legend															
n	Lighter, on-going effort	n = approximate, average number of TMG days per week for this task													
n	Heavy, focussed effort														
	"Research" activity														
	"Maintenance & support" activity														
Notes:															
1 Estimated total days of staff time allocated to the task, assuming 48 working weeks per year (staff take 2 weeks vacation and the University closes for 2 weeks/year during the Christmas Break).															
2 An undergraduate summer research assistant will work full-time on this task, supervised by Bilal Yusuf.															
3 5 days/week for Brendan Reilly & Luna Xi. 1 day/week for James Vaughan. Undergrad summer researcher time not included in this table.															
4 Provisional. Topics may change.															

2.1 Auto Ownership / Mobility Tool Modelling

Mobility tool decisions include: how many and what type of cars to own; acquisition of driver's license; and purchase of transit pass. These are critical decisions that fundamentally influence travel behaviour. They will become even more critical (and change in nature) as autonomous vehicles and new mobility services fundamentally change the means by which people can travel within the urban region, including their need to own personal automobiles.

Two new mobility tool models were introduced in operational use in GTAModel V4.1:

1. A model of driver's licence possession. A binary logit model has been developed based on 2016 TTS data that predicts the probability of possessing a driver's licence for every person 16 years of age or older in the GTHA. Explanatory variables include the person's

gender, age, occupation and employment status, distance and transit time to work or school, household income, and residential zone population density.

2. A model of household auto ownership levels. An ordered logit model has been developed based on 2016 TTS data that predicts the probability of the number of autos owned or leased by each GTHA household. Auto ownership levels in the model are 0, 1, 2, 3 and 4 or more vehicles. Explanatory variables include the number of adults, children, workers and drivers in the household, household income level, residential zone population and employment densities and auto and transit time accessibilities to work locations.

Documentation of these models is available on the TMG website. These models were also presented at the February 5, 2020 TMG workshop “Mobility Tools & Services”.

2.2 Parking Supply Data & Modelling

As a first step towards developing improved travel demand model sensitivity to parking in the region, a major task in 2019-20 was to assemble as comprehensive a dataset as possible from public data sources of parking supply (number and type of parking spaces) and prices, by location, throughout the GTHA. This task was undertaken by an undergraduate summer research assistant, Arnab Rahman. The assembled database is documented in a TMG report, available on the TMG website.¹

These data have also been used to upgrade the parking fare data used in the GTAModel V4.1 mode choice model.

2.3 Passenger Mode Modelling

Auto-based passenger travel is a complex but generally not well-modelled component of travel demand. This includes intra-household ridesharing, inter-household carpooling, “passenger-access-transit” (PAT, being dropped-off / picked-up at transit stations) and an increasing variety of commercial “ride-hailing” and “ride-sharing” services (conventional taxis, Uber/Lyft type services, etc.).

Incremental improvements in passenger-related modelling implemented in GTAModel V4.1 include:

1. Implementation of an operational model of “passenger access-transit” (PAT), a key component that had been missing from V4.0.
2. Introduction into the mode choice model of an explicit taxi/Uber (aka “ridehailing”) mode, separate from inter-household carpooling, which is now also a separate travel mode.

In addition, TMG staff supported a major UTTRI research project assisting the City of Toronto Transportation Services Division in analyzing their “Private Transportation Company” (PTC, Uber/Lyft/etc. ride-hailing companies) data in support of their submission to the City’s Vehicle for Hire (VfH) By-Law review. This work generated seven reports investigating a wide range of issues associated with PTC impacts on transit ridership, on taxi usage and roadway congestion,

¹ Xi, Y., A. Rahman, J. Vaughan and E.J. Miller (2019) *Parking Report #1: Data*. Toronto: University of Toronto Transportation Research Institute, September.

as well as the development of prototype models of mobility service provision and performance. Table 2.2 lists the reports generated, which will be posted in the near future on the UTTRI website. Some of the results of this work were also reported in the February 5, 2020 TMG workshop “Mobility Tools & Services”. This work will influence future TMG model development work as we develop improved methods for the operational modelling of current and emerging mobility services. We also view this work as an important prerequisite for the eventual modelling of autonomous vehicles (AVs), which are anticipated to be heavily used in ride-hailing and ride-sharing services.

Table 2.2: VfH Project Reports

Ozonder, G. & E.J. Miller, <i>Report No: 1, Analysis of PTC Usage as Recorded in the 2016 TTS</i>
Ozonder, G. & E.J. Miller, <i>Report No: 2, Comparison of PTC 2016 and TTS 2016</i>
Ozonder, G. & E.J. Miller, <i>Report No: 3, Taxi Time-Series Analysis</i>
Loa, P., J. Hawkins & K.M. Nurul Habib, <i>Report No: 4, Evaluating the Impacts of Private Transportation Companies on Travel Behaviour through a Stated Preference (SP) Survey</i>
Li., W., A. Shalaby & K.M. Nurul Habib, <i>Report No: 5, The Relationship Between PTC and Public Transit: Descriptive Analysis</i>
Calderón, F. & E.J. Miller, <i>Report No: 6, Analysis of Network Impacts: PTC Trip Chaining</i>
Ozonder, G. & E.J. Miller, <i>Report No: 7, Persona Analysis</i>

2.4 Dynamic Traffic Assignment (DTA) Modelling

Over the past few years, TMG has been promoting the discussion of DTA methods and their strengths and weaknesses for use in regional travel demand modelling. Accelerating the importance of this discussion, the Region of Peel has committed to adopting the commercial software package Aimsun for use within a GTAModel implementation as their next generation travel demand model system for the region. The primary motivation for Peel’s decision is to be able to use Aimsun’s new “macro-meso” hybrid road assignment that permits DTA modelling of Peel Region while using a conventional, macro static equilibrium model in the rest of the GTHA.

This planned GTAModel-Aimsun model system requires that TMG create the same sort of seamless interface between GTAModel and Aimsun’s road and transit assignment models as currently exists for Emme. During 2019-20 considerable work has occurred towards this objective. This has included:

1. Porting the base 2016 Emme network into Aimsun.
2. Testing the Aimsun macro road assignment algorithm in comparison to standard Emme road network assignment results.
3. Testing the Aimsun transit assignment capabilities in comparison to Emme transit assignment methods as implemented within GTAModel. This is a non-trivial task, since Aimsun handles transit network coding and transit assignment quite differently than Emme. This work is on-going at the time of the preparation of this annual report.
4. Providing advice to the Region of Peel in the writing of their Terms of Reference for retaining a consultant to undertake the actual model implementation work, to ensure that all GTAModel-related technical aspects of the work are understood, as well as to determine an appropriate role for TMG support of this project as it proceeds.

In addition to this Aimsun-based work, TMG staff continue to support research projects in Helsinki, Finland and Melbourne, Australia that involve GTAModel implementations (for research, not operational planning, purposes) using MATSim as the road and transit network modelling software.

The TMGTAC has recommended that a “DTA Working Group” be established to share agency’s experiences with DTA testing and applications and to provide guidance to TMG’s future activities in this area. This will be an immediate action item in TMG’s 2020-21 activities.

2.5 GTAModel V4 Maintenance & Operational Support

Roll-out and continuing testing and incremental improvements to GTAModel V4.1 continued throughout the 2019-20 work year. A TMG workshop “unveiling” V4.1 was held May 15, 2019, and a V4.1 user’s manual is available on the TMG website.

Various versions of GTAModel V4 are now being used or are in the process of being adopted by the Cities of Toronto, Mississauga, Brampton and, most recently, Vaughan, and by the Regions of Durham, Halton and Peel. In addition to regular work plan activities, TMG provided additional support to the Mississauga implementation on a service contract basis.

2.6 TMG Toolbox Improvements

A primary rationale for the TMG is to develop standard tools, procedures and templates for general use by member agencies. These tools have been primarily of two types: XTMF-based modules and Emme/4 Modeller procedures. As noted above, TMG is also developing procedures for interfacing with and running Aimsun procedures and assignments. It has also been developed V2.0 Toolbox modules to work with XTMF 2.0.

2.7 XTMF Upgrades/Maintenance & V2.0 Development

Similarly, XTMF, as a primary software system for TMG work, is constantly being upgraded, it needs to be maintained, and technical support needs to be provided for its use by member agencies, their consultants, etc. Incremental additions and improvements (and associated updating of documentation) occurs continuously as needed, and as they are generated by continuing development of the TMG Toolbox and other TMG modules and models. V1.7 is the most recent release of XTMF.

A significantly upgraded and redesigned V2.0 has been under development throughout the 2019-20 work year. A beta release of V2.0 is expected later in 2020. In addition to a major refactoring of the XTMF design, this new version will include a major rewrite of major TASHA components that are at the core of GTAModel. V2.0 is also essential to support the expected major upgrade of GTAModel to V5.0 (a similarly major upgrade and redesign of the model system), which is anticipated to commence in 2021.

2.8 Documentation of Software & Models

Up-to-date documentation of GTAModel V4.1, XTMF and Emme Toolbox modules is available on the TMG website. Website improvements and updating are on-going tasks.

2.9 Outreach & Training

A critical component of TMG activities in all phases of its work must be training, technology transfer and outreach. In order to succeed, TMG must be responsive to its collaborating partners' needs. It must also get the tools that it is developing into the hands of its partners for their use. The TMG's role is intended to be one of tool developer, not to be the user of these tools on behalf of its partners in operational applications (except in special cases). In addition to Task #* documentation and website maintenance activities, 2019-20 activities included:

- Five meetings were held with TMGTAC to discuss work in progress, next steps in the work plan and to disseminate work plan results.
- Two training workshops were held to present and discuss in greater detail recent TMG work and products:
 - May 15/19: "Introduction to GTAModel V4.1".
 - February 5/20: "Mobility Tools & Services".

2.10 Steering Committee Meetings

In addition to the TMGTAC meetings discussed in Section 2.9, two meetings with the TMG Steering Committee (TMGSC) were held (on October 2/19 and March 4/20) to discuss work plan progress, budget, overall TMG directions for work and other administrative and supervisory matters

2.11 Additional TMG Activities

TMG is increasingly being called upon to support additional research activities within UTTRI that require access to GTAModel and/or TMG networks or other data. In all cases, TMG participation in these research activities did not interfere with the execution of the approved TMG work plan. In addition to the planned activities listed in Table 2.1 and discussed above, TMG staff supported the following UTTRI research projects.

- City of Toronto Vehicle For Hire Bylaw Review project, discussed in Section 2.3.
- City of Toronto sponsored project, *Transportation Accessibility Advice*.
- Toronto Regional Board of Trade and MITACS sponsored project, *Modelling the Current & Future (2025) State of Travel Demand In The Toronto-Waterloo Innovation Corridor*.
- Support for various unfunded student-based projects. A notable example is support for analysis undertaken by Prof. Steven Farber's research group that has led to a 2020 TRB Annual Meeting presentation and acceptance of the paper by *Transportation Research Records*: "Office Commuting Patterns in the Greater Toronto and Hamilton Area: The Importance of Automobile Mode Share in Understanding the Full Impact of Urban Form on Vehicle Kilometers Travelled".

3. 2019-20 BUDGET & REVENUES

Table 3 1 presents the 2019-20 TMG expenditures and revenues. This budget supported two full-time technical staff persons (Luna Xi,² Network Modeller/Analyst and Brendan Reilly, software programmer/designer), one day a week of UTTRI's Senior Software Architect, James Vaughan, and one graduate summer student research assistant (Arnab Rahman).

² Luna joined the TMG team in April, 2019 on a half-time basis while she was completing her MSc degree. She went full-time in September, 2019 upon completion of her thesis.

Table 3.1: 2019-20 Expenditures & Revenues

TMG Budget	2019-20				
Expenses	Amount				
Salaries ¹	\$175,652.12				
Supplies, Misc. Expenses	\$250.00				
Emme Licence Maintenance	\$3,000.00				
Contingency	\$0.00				
Overhead (@40%)	\$70,000.00				
Total Expenses	\$248,902.12				
<i>Percent increase in expenses over previous year</i>	<i>3.79%</i>				
Revenues	2019-20				
Member Contributions	Amount				
Metrolinx	\$65,000.00				
MTO	\$33,000.00				
City of Toronto	\$33,000.00				
City of Hamilton	\$20,000.00				
Region of Durham	\$20,000.00				
Region of Halton	\$20,000.00				
Region of Peel	\$20,000.00				
Region of York	\$20,000.00				
City of Brampton	\$7,000.00				
City of Mississauga	\$7,000.00				
Total Member Contributions	\$245,000.00				
<i>Carry-Forward from Previous Year³</i>	<i>\$13,000.00</i>				
<i>Additional Revenue (UofT Subsidy)</i>	<i>\$0.00</i>				
Total Revenues²	\$258,000.00				
<i>Percent Increase in contributions over previous year</i>	<i>3.8%</i>				
<i>Total Revenues-Total Expenses</i>	<i>\$9,097.88</i>				
<i>Contributions-Actual Expenses</i>	<i>-\$3,902.12</i>				
Notes:					
1. 2 full-time TMG staff salaries + benefits + 1 undergraduate summer research assistant plus 1 day/week of James Vaughan. TMG staff salary increases based on an assumed increase of 4% per annum as of July 1 each year.					
2. "Total Revenues" include carry-forward from the previous year.					
3. Carry-forwards in Years 2020-21 & 2021-22 best current estimates. Exact amount may vary.					
University of Toronto In-Kind Contributions					
Principal Investigator Time	\$45,000.00				
Co-Investigators' Time	\$15,000.00				
Post-Doctoral Fellow Time	\$15,000.00				
PhD Graduate Research Assistant Time	\$5,000.00				
Office Space & telephones	\$6,194.26				
Total	\$86,194.26				
This excludes other UofT in-kind contributions to TMG that are very difficult to quantify. These include:					
Data Management Group support of TMG					
Internet access					
University of Toronto library access					
Administrative support					
TMG computers & software					