Greetings to friends and colleagues! With 2015 rolling around the horizon, it might be a good opportunity to reflect on the accomplishments that our research group has made this past year and share them with everyone. Hopefully we will make this into an annual update that is worth updating.

A new space…

2014 was a busy year for the Ryerson Urban Transportation Lab. We are now into the second year of both the Canada Research Chairs (CRC) program and the NSERC Discovery Grant. One of the major milestones was the completion of our lab space located at 110 Centre for Urban Energy (CUE) back in early spring. The space was funded by the Canada Foundation for Innovation, which serves as a test bed for evaluating embedded, intelligent transportation systems for “smart” vehicles and fleets. The facility includes an 8-panel video wall from Mitsubishi, 30 Google Nexus 7 tablets, and half a dozen workstations that allow our team to conduct field experiments of advanced transportation technologies. For example, a public agency, traffic information provider, or car manufacturer may want to evaluate a new algorithm for connected or autonomous vehicles, but does not want to take the risk of investing in the full technology nor rely on the simplified environment of a pure computer simulation.

Our facility allows one to develop a “surrogate system” to mimic the technology using our tablet devices and deploy them in the field to collect in-situ performance data. We expect to roll out an online repository for such surrogate systems in 2015, which will be open to the public to download, upload, and share data and open source code.

In addition to the use of the equipment to evaluate technologies, the facility is designed for real time monitoring of traffic patterns as well as travel demand momentum at the city-scale level. In our recent publication (Liu et al., 2014) sponsored by the CRC, we developed a new GIS interface that can monitor large scale data feeds from the public and visualize/quantify changes. This is important as we encounter more large scale events or disasters that warrant a means of quantifying and communicating their real-time (or before/after) effects on people’s travel patterns to policymakers. The research was presented at the NSF “Big Data and Urban Informatics Workshop” hosted at the University of Illinois at Chicago, and we plan to implement this interface for our facility in 2015.

Research progress highlights…

One of the key objectives of the CRC during this five year period is to develop mechanisms to design “smarter”, data-driven urban transportation systems that can leverage Big Data. For the NSERC Discovery Grant, we are studying
multimodal transit systems, particularly how multiple transit operators may have to interact with one another to improve service quality for travelers. Specific problems that these research topics address include the last mile transit problem, flexible transit services, and new mobility systems like vehicle sharing, ridesharing, and demand responsive transit services driven by information and communications technologies (ICTs).

One of our biggest breakthroughs supported by both grants was inventing a new class of forecast models. These models allow decision-makers to measure the effects of multimodal system designs on people’s travel and activity schedules (what we call social logistics). People’s choices of whether to drive or to take transit do not depend only on single trip characteristics like length of commute or costs within a network; rather, there are many dependencies on multiple trips and activities conducted by the travelers throughout the day. For example, if one leaves their car at a park-and-ride facility to take a train into downtown, they would need to return to that facility later in the day to pick up that car. These issues relate to the last mile problem, which is bound to grow with increasing urbanization and mega-region development.

What if we have abundant data from travelers that capture their routes throughout the day? Can this data be used to forecast how these routes may change if different design configurations were introduced? In order to forecast these effects, it is necessary for a model to capture “activity schedule elasticity” in multimodal systems design. With this new class of models, policymakers can now evaluate more complex service options that were difficult to evaluate in the past. We hope it will drive the investment of more multimodal service options and business models. The work has been selected amongst 36 topics to be presented at the highly prestigious 21st International Symposium on Transportation and Traffic Theory to be held in 2015 at Kobe, Japan.

Another key research product this year is related to the Discovery Grant. In Chow and Sayarshad (2014), we studied the interactions between two or more transport system operators. Many examples of such interactions exist, such as regional coordination between transit operators, competition between airlines, or bike share services co-existing within a transit network. While some cases may be reasonable to assume some form of game theoretic setting, in many others (like the bike share example) such assumptions are not realistic. We defined a broader setting to evaluate such interactions and designed a new decision support tool to evaluate specific interaction strategies like subsidy and fare bundling. We illustrated the use of this tool with the BIXI bike share system in Toronto, which has since been subsidized and re-branded by the City of Toronto. The work was presented at the INFORMS Annual Meeting and TRB Annual Meeting.

Several other research efforts have been published this past year (see below). One such study involved collaboration with researchers from University of California, Irvine, and the Korea Transport Institute (KOTI). We developed a decision support tool for KOTI to support investment decisions in charging infrastructure to plan for electric shared taxi deployment in Seoul. In other collaborative initiatives, we invited Professor William Lam from HK Polytechnic to come speak at Ryerson over the summer, and I have given talks at New York University (“Inverse transportation problems in an urban Big Data world”) and University of Southern California (“Welfare effects of multimodal and flexible transport services”). These knowledge sharing experiences have already opened new collaborative opportunities, as Professor Kaan Ozbay shared his NYC taxi data with us and we are collaborating with Professor Maged Dessouky and his students at USC.

Looking forward…

With increasing urbanization, environmental volatility, and rise of ICTs, transport business models like Uber and Zipcar, and autonomous vehicle technologies, there are many exciting research opportunities to look forward to in 2015. We plan to continue building up the digital infrastructure to support the lab space and test bed, which is one of the primary roles of Dr. Xintao Liu. Future collaboration with the Ryerson Institute for Infrastructure Innovation may involve connecting the lab facility to remote sensing tools and the cloud services available at Ryerson Centre for Cloud and Context-Aware Computing (RC4) to continuously collect transport infrastructure and travel demand momentum health data, particularly around major events like the upcoming Pan Am Games being hosted in Toronto in 2015.

Hamid Sayarshad continues his PhD thesis research on dynamic optimization and informatics for flexible transit services. He developed a joint vehicle routing and pricing algorithm for demand responsive fleets that was presented at the IFORS conference in Barcelona this summer and is currently under review for publication. We also developed a benchmark for dynamic network optimization models, which was presented at the 3rd INFORMS TSL Workshop on “Handling uncertainty in planning logistics and transportation systems” at Chicago, IL. Shadi Djavadian just submitted
work that she was conducting this past year on a new simulation-based forecast model to evaluate the social welfare effects of flexible systems in anticipation of public agency interest in business models like those of Uber and the demand responsive shuttle service in Helsinki, Finland. With such a tool, we would be able to support deployment of such services to a city or regional level, which could be of interest to public agencies like Metrolinx. This work was presented at the INFORMS Annual Meeting. Anchor Chin is finishing up his MASc thesis on smart card-based transit network fare pricing design for the city of Toronto. Matthew Harvey is working on regional timetable coordination between transit operators using cooperative game theory. Ahmed Amer is working on a newly funded project from the Ryerson Centre for Urban Research and Land Development to develop a new forecast model to evaluate the effects of downtown truck parking policies. We are also collaborating with Professor Matthew Roorda and his student Mehdi Nourinejad at University of Toronto on energy and urban logistics topics.

We believe 2015 will be a fruitful year; whereas 2013 – 2014 have focused primarily on theory development and system design, 2015 will see more applications and collaborations with local policymakers and industry. Until then, we wish everyone a Happy New Year and for many more exciting new discoveries!

Sincerely,

Joseph Chow, Ph.D., P.E.
Canada Research Chair in Transportation Systems Engineering
Assistant Professor, Department of Civil Engineering
Ryerson University
https://ryerson.academia.edu/JosephChow

***********************************************************************************

Sponsors of research grants in 2014:
Canada Research Chairs program
Canada Foundation for Innovation and Ministry of Economic Development and Innovation
NSERC Discovery Grant
Ryerson Centre for Urban Research and Land Development

Our research team in 2014:
Principal Investigator: Dr. Joseph Chow
Postdoctoral Fellow: Dr. Xintao Liu
PhD Research Assistants: Shadi Djavadian; Hamid Reza Sayarshad
MASc Research Assistants: Ahmed Amer; Anchor Chin; Matthew J. Harvey
Undergraduate Research Assistants: Teba Al-Ansari; Alex Chan; Adel E. Nurumbetova (now a Master’s student at University of Toronto)

Journal publications in 2014 with support from mentioned grants (research team bolded):
Chow, J.Y.J., Djavadian, S., 2015. Activity-based market equilibrium for capacitated multimodal transport systems, ISTTT 21, accepted for presentation and publication in Transportation Research series with minor revision.