MEMORANDUM

Date: April 8th 2019

To: Miriam Novick

From: Student Writer

Subject: Research Progress Report for WRIT 220

Report Title: Greater Toronto Area Intelligent Transportation Systems

Purpose:

The purpose of this technical research report is to find efficient and safe solutions of transportation within the Greater Toronto Area (GTA) through the use of Intelligent Transportation Systems (ITS). With a growing population in the GTA, individuals are required to commute from outside of the downtown core resulting in increased traffic congestion, carbon dioxide emissions and vehicular accidents. By analyzing ITS through sensor systems and GPS tracking this research looks forward to creating reliable transportation for GTA residents.

Source #1:

Guerrero-Ibáñez, J., Zeadally, S., Contreras-Castillo, J. (2018). Sensor Technologies for Intelligent Transportation Systems. *Sensors*.18(4):1212.DOI: https://doi.org/10.3390/s18041212

Written by authors with PhD credentials ranging from the University of Colima to the University of Kentucky, this journal article focuses on ITS through the integration of sensors and transportation infrastructure. The use of graphics for in-vehicle sensors and in-road sensors can be used within the report to provide a visual comprehension of how data is gathered. Furthermore, the article provides key details on categories of sensors ranging from safety, diagnostic, traffic, assistance, environment and user sensors which can be used within the report to highlight the range of ITS and how it can be used within the context of the GTA (Guerrero-Ibáñez et al. 2018).

Source #2:

Viti, F.,& Tampère, C. (2014) Editorial: Models and Technologies for Intelligent Transportation Systems: New Challenges and Metaheuristic Solutions for Large-Scale Network Applications. *Journal of Intelligent Transportation Systems*.18:1, 1-4. DOI: https://doi.org/10.1080/15472450.2013.774678

Written in 2014, this article written by Viti and Tampère highlights the uses of Intelligent Transportation Systems to collect traffic data to adjust operational and management methods. Both authors have obtained PhD qualifications at the Engineering Department at the University of Luxembourg, and have written other journal articles focusing on transit and large scale networks. This journal article summarizes information from several contributions published at a similar time, providing layers of insight into the process of ITS. The relevance of the article touches base on electronic ticketing systems which provide quicker tracking of technological

information to systems such as GPS, therefore alerting commuters of congestion (Viti and Tampère, 2014). Overall this source provides summaries of several topics pertaining to ITS, which can be used to elaborate on efficient transportation methods

Source #3:

Kamel, I.R., Abdelgawad, H., Adhulhai, B. (2016). Transportation Big Data Simulation Platform for the Greater Toronto Area (GTA) *Smart City 360°*. 443-454. DOI: https://doi.org/10.1007/978-3-319-33681-7_37

Written by authors at the Civil Engineering Department at the University of Toronto and Cairo University, this journal article provides ample information regarding how data collected through intelligent systems can be applied through proposed models, taking steps towards smart city incorporation (Kamel et al. 2016). With focus on the GTA area, this article discusses volume, speed and spread of congestion across areas such as Lake Shore Boulevard and the Gardiner Expressway (Kamel et al. 2016). As two major routes of transportation in Toronto, information from this article can be used to elaborate on how ITS data can be used to enhance commuter experience in relevant locations within the GTA.

Current Progress and Next Steps:

Overall, the process of ITS involves collaboration between in-vehicle and in-road sensors which collects data in an attempt to coordinate traffic, and enables commuters to make informed decisions while driving. Since the proposal of this report, the progression of research has evolved

to specifics on how ITS works, data collection in large scales, and Toronto route analysis. However, for next steps I look forward to analyzing the plans of smart cities, especially Sidewalk Toronto, in order to provide an example of how ITS will be incorporated on a local level and in future applications. Although there is public hesitation in regards to data privacy for Sidewalk Labs, I anticipate analyzing the ITS of the smart city through an optimistic lens that will focus on the safety of commuters and reliability of real time data.

Outline:

1.0 Purpose of Report - Transportation in the GTA

- Introducing why reliable, efficient modes of transportation are essential to the infrastructure of large cities.
- Introducing how the report will focus on the GTA area.

1.1 Background on the city of Toronto

- Explaining how the city is expanding, inflation rates are increasing and therefore more commuters are coming to and from the city during peak hours.
- Mentioning how traffic is a safety concern, providing stats of accidents from 2018 (Toronto Star Article)
- Providing statistics on average time commuted to and from city, highlighting the dissatisfaction of commuters and the impact on quality of life. (Stats Canada)

- Brief introduction on what ITS is and its goals to inform commuters of "intelligent" modes of transportation.

2.0 Examining the Problem

2.1 Explaining why traffic keeps growing, for example bottleneck effects, roadside accidents. (More research needed)

- Provide key statistics on congestion of the city, on average how many people commute daily.

2.2 Providing insight on the city of Toronto, specifically congested areas such as Lakeshore Boulevard and the Gardiner Expressway. (Kamel et al. 2016)

2.2.1 Discussing urban planning behind both routes of transportation, and how it came to be. (More research needed)

2.2.2. Mentioning public perception of both modes of transportation.

2.2.3.Discussing the average volume, speed and spread of congestion (Kamel et al. 2016)

2.3 Current Technology used to combat the issue of traffic.

2.3.1 Discuss the use of GPS, carsharing apps, and alternate modes of transit (Basu 2019)

2.3.2 Compare with information from source in Kolkata city in India on urban transit and cab-apps (Basu 2019)

3.0 Presenting the Solution: Intelligent Transportation Systems

3.1 In depth discussion of what ITS is (Guerrero-Ibáñez et al. 2018)

3.1.1 Parts description using visual aids (Guerrero-Ibáñez et al. 2018)

- In-Vehicle Sensors
- In-Road sensors

- Sensor Categories: safety, diagnostic, traffic, assistance, environment and user

3.1.2 Process description (Guerrero-Ibáñez et al. 2018)

- Collecting data from sensors both in-vehicle and in-road to relay information to drivers

- Discussing electronic ticketing systems, for example GPS. (Viti and Tampère, 2014)
- Data distribution and implementation across larger cities (Kamel et al. 2016). 3.3 Impact of ITS on GTA area
- Mentioning how it could enhance time and congestion on routes such as Gardiner Expressway or Lakeshore (Kamel et al. 2016)

- Brief summary of ITS and how its sensors are used to provide real time information to commuters.

4.1 Future Innovations

- Discussing Sidewalk Toronto integration of ITS, and how it will be used on a local level. (Research needed)
- Focusing on safety and reliability, brief mention of public perception

4.2 Summarise the report

- Mentioning the impacts of ITS on the well being of commuters, especially through time, safety, air quality and saving money.

- Discussion of final solutions between in-vehicle/in-road sensors, carsharing apps, GPS and autonomous vehicles.

4.3 Final thoughts on the future of GTA traffic and efforts to prevent further disruptions