Writing Sample

Shruti Misra

Context

This writing sample is adapted from a part of the final commercialization plan I wrote for Entrepreneurship 541: Technology Commercialization practicum at the University of Washington's (UW) Foster School of Business. The purpose of the course was to provide students a hands-on experience in technology commercialization. This was achieved by having student teams work with researchers from UW and draft a commercialization plan for their technology. In the process, students learned various tools such as Cloverleaf Analysis, Lean Canvas and data sources such as PitchBook, BCC Research etc.

My team worked on a Mobility Unit for Sensing (MUST) integrated sensor technology developed by researchers at Smart Transportation Applications and Research lab (STAR Lab) at the University of Washington's department of Civil and Environmental Engineering. The technology was designed to be applied in smart cities applications, specifically for monitoring traffic and addressing congestion problems that cities face.

To preserve Intellectual Property and the terms of my NDA, I will not provide details about the technology or the commercialization plan that our team developed. Instead, this writing sample will demonstrate my communication skills at relaying the primary and secondary research my team and I conducted for the project.

Inventor/Research Team[1]

The Mobility Unit for Sensing (MUST) device was developed by the Smart Transportation Applications and Research lab (STAR Lab) at the University of Washington's department of Civil and Environmental Engineering. The founding director of the lab is Dr. Yinhai Wang. The MUST research team consists of Dr. Wang, his research associate, and our main point of contact Dr. Wei Sun.

Dr. Yinhai Wang (yinhai@uw.edu): Dr. Wang is a professor in transportation engineering and the founding director of the STAR Lab. His research spans fields including traffic sensing, e-science of transportation, big-data analytics, traffic operations and simulation, smart urban mobility, transportation safety and more.

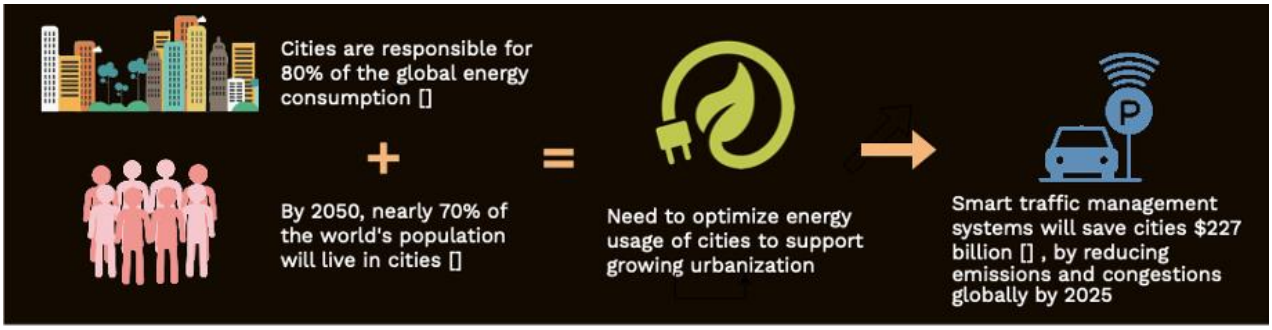
Dr. Wei Sun (wsum91@uw.edu): Dr. Sun is a research associate at the STAR Lab and the main point of contact for the team. His areas of expertise include transportation data analytics and software engineering.

Brief Technology Overview

MUST is a sensing and communication technology that can be used for a range of applications such as parking lot management, vehicle counting, roadway monitoring etc. The device consists of a variety of integrated sensors and bundles multiple functions into one unit: road surface, weather data, traffic sensing, data fusion and computation and communication.

The Potential User Problem

Currently, cities are responsible for most of the global energy consumption [6]. This is coupled with the fact the nearly 70% of the world's population will live in cities in the next 30 years has motivated cities to seek intelligent data-driven solutions to address energy challenges that accompany growing urbanization [7].



An aspect of the smart cities' effort consists of optimizing traffic management, transportation, and transit systems by adopting new technologies such as Internet of Things (IoT), smart sensors and data analytics. Intelligent transportation solutions (ITS) consist of technologies that enhance the safety, mobility, and environmental efficiency of the transportation infrastructure. The need for ITS is evidenced by a study, which found that smart traffic management systems will save cities $227 billion, by reducing emissions and congestions globally by 2025, of which 95% of the savings will be due to congestion reduction [8].

ITS Segments of Interest

The ITS market can be further broken down into segments pertaining to different use cases such as parking management, traffic management, passenger information management, security and surveillance, smart ticketing, and others [9]. Of the different segments, parking management and traffic management are of particular interest for MUST.

Parking Management

Recent research found that, U.S drivers spend 17 hours/year looking for parking at an average cost of $345/driver in wasted time, fuel, and emissions, with drivers spending a total $72.2 billion annually on parking [10]. Smart parking applications have the potential to benefit users by optimizing the parking search process resulting in savings from lower fuel usage and time. This is exemplified by tangible benefits from San Francisco's SFPark smart parking system, which resulted in 30% fewer miles travelled on average, and resulted in a 30% decrease of greenhouse gas emissions [11].

Our conversation with Sound Transit, a prominent public transportation organization in the Seattle region, highlighted a concrete use case of smart parking. Their goal is to optimize parking spaces in Park & Rides. An ideal smart parking ecosystem should be able to monitor and recognize travel patterns of Park & Ride users and optimize their commute time. The key metric in this and most parking applications is the accuracy of the sensing system in detecting distinct humans and vehicles. Currently, this is done by human observers and individual sensors embedded in parking spots that may not fulfil accuracy needs. Technologies such video analytics combined with other sensors can enable efficient real-time analysis of key metrics. For example, one camera can observe more vehicles than one human observer.

A key pain point for smart parking is the prediction accuracy in structured parking spaces. Structured parking includes facilities that contain obstructions such as walls and columns and can obscure the view of camera-based sensors like MUST. Moreover, according to one expert (John Reece), higher levels of accuracy are required at higher levels of occupancy. Consider that there are 100 parking spaces available, and the sensor shows that 110 spaces are available (90% accuracy). However, when there are 5 parking spaces available and the sensor shows that there are 6, maintaining its accuracy level, the user is likely to be more dissatisfied due to the significantly reduced number of options. Knowing and minimizing this

error rate is important to Sound Transit as they can then have parking spots in reserve. Brian Brooke from Sound Transit alluded to an ideal accuracy of 99% in this case. Therefore, structured parking combined with high accuracy needs is a key problem in this application.

Traffic Management

A recent report found that the average American wastes 54 hours a year in traffic delays due to congestion, wasting $1,080 in wasted time and fuel. This amounted to urban Americans spending a total of $8.8 billion hours in delays, purchasing an extra $3.3 billion gallons of fuel for a congestion cost of $179 billion. While there is no single solution to this problem, smart traffic management via sensors and analytics provide a promising option [12].

A concrete example of smart traffic management comes from the City of Bellevue. Bellevue has a Smart Mobility Plan to incorporate ITS into the Traffic Management Center at City Hall and elsewhere. Part of the plan is to enhance shared-use mobility by monitoring curbside activity. The key metric is the accuracy of prediction of curbside availability and peak times of curb usage. In this case, the City of Bellevue was looking for an accuracy of 95%. This need has partly emerged from the rise of ride-sharing apps that cause increased curbside usage and street congestion due to their start and stop motion of picking up and dropping off passengers. Currently, traffic monitoring is either conducted by in-ground sensors, human observers, and street cameras. Since, curbside monitoring is an emerging application, there is no standardized way to predict curb usage, however various sensor and camera-based solution are being tested.

Key Drivers

We have identified four common key drivers that are fueling the growth and adoption of smart parking and smart traffic management technologies [9],[13].

1. Government policies, and initiatives to optimize the efficiency of transportation systems to cope with the growing population, address driver and pedestrian safety and enhance mobility.
2. A need to reduce fuel consumption and deliver environmental benefits by maximizing roadway capacity to reduce construction of new roadways, promote efficient driving and enable smoother traffic flow.
3. Boosting the economic wellbeing of the population by enabling productivity and saved time and money that comes from enhanced mobility
4. Growth in the number of IoT and smart devices, with the number of IoT devices expected to rise from around 10 billion in 2020, to 16.4 billion in 2025[14].

Key Challenges

We have identified five common key challenges to implementing smart parking and traffic management technologies [9], [13]

1. Smart devices such as MUST need “always-on” reliable data connectivity which is a challenge. Such connectivity is best offered by cellular solutions which can be expensive.
2. Optimization, storage, and analytics of large volumes of data collected from multiple sensing devices is challenging. Brian Brooke from Sound Transit mentioned that they preferred vendors that use their own data storage and cloud services.
3. Accuracy of prediction is a critical factor in determining the value of devices like MUST. Obtaining high accuracy in constrained environments as mentioned previously is difficult.

4. A common theme in all our conversations was the need for data privacy. Both government and private partners such as Sound Transit and Microsoft are wary of collecting identifiable data as it leaves them open to libel.
5. Integration with existing infrastructure is a key challenge as a lot of city infrastructure tends to be old and can be expensive to modernize, making government customers hesitant to invest in new technology.

See Appendix A for segment-specific drivers and challenges.

Market Opportunity

In 2020, the global ITS market was $90.4 billion, with the North American market at $24.4 billion. The market is expected to grow globally to $183 billion by 2025 (at 15% CAGR)[9] (See Appendix B)

The rising market trends and the parallel growth in the adoption of IoT signals a growing opportunity for the adoption of devices like MUST in ITS settings. Given below are global and North American market trends for smart parking and smart traffic applications for hardware and software solutions.

Global Trends (2020)	Smart Parking Management	Smart Traffic Control
Market for hardware (including cameras and sensors)	$700 million	$12.3 billion
Market for software (including video recording and analytics and database management systems)	$700 million	$11.6 billion
Projected global industry growth (next 5 years)	15.2%	14.3%
Major companies	Bosch, Siemens, Streetline, Kapsch TrafficCom	Siemens, Cisco, Hitachi, Cubic Corporation, Kapsch TrafficCom AG, Q-Free ASA, TomTom

Component	North American Market (2020)	CAGR (2020-2025)
Hardware (including cameras and sensors)	$10.9 billion	15.5%
Software (including video analytics)	$10.4 billion	19.7%

Application	North American Market (2020)	CAGR (2020-2025)
Smart Parking	$600 million	12.9%
Smart Traffic Control	$9.7 billion	13.7%

In North America, smart parking and smart traffic control present a total of $10.3 billion dollar opportunity. Overall, the smart traffic management market offers the bulk of the opportunity. This maybe because smart traffic management covers a broader set of applications and use cases as compared to parking. According to Trilogy Equity Partners, a VC, parking management offers a low profit margin and may not be as lucrative. While we suggest further validating this claim, it offers a word of caution that reflects the relatively smaller market opportunity for parking in North America. We also note that a higher growth rate is anticipated in software applications for parking and traffic management in North America. This trend validates what we were hearing about customer needs from experts and potential partners at Oracle, Google, Microsoft, and Sound Transit about the needing to have a software platform to make products like MUST more compelling.

References

[1] Uwstarlab.org. 2021. STAR Lab Members. [online] Available at: <http://www.uwstarlab.org/members.html> [Accessed 25 May 2021].

[2] Silva, B.N., Khan, M. and Han, K., 2018. Towards sustainable smart cities: A review of trends, architectures, components, and open challenges in smart cities. Sustainable Cities and Society, 38, pp.697-713.

[3] Ke, R., Zhuang, Y., Pu, Z. and Wang, Y., 2020. A smart, efficient, and reliable parking surveillance system with edge artificial intelligence on IoT devices. IEEE Transactions on Intelligent Transportation Systems.

[4] City of Bellevue. 2021. 106th Ave Curbside Pilot. [online] Available at: <https://stage.bellevuewa.gov/city-government/departments/transportation/projects/neighborhood-projects/106th-ave-curbside-pilot> [Accessed 25 May 2021].

[5] Wood, M.S., 2011. A process model of academic entrepreneurship. Business horizons, 54(2), pp.153-161.

[6] T. Nam, T.A. Pardo. Smart city as urban innovation: Focusing on management, policy, and context. Proceedings of the 5th international conference on theory and practice of electronic governance, ACM (2011), pp. 185-194

[7] World urbanization prospects: The 2014 revision, highlights Department of Economic and Social Affairs, Population Division, United Nations (2014)

[8] Juniperresearch.com. 2021. Smart Traffic Management to Significantly Reduce Congestion and Emissions. [online] Available at: <https://www.juniperresearch.com/press/smart-traffic-management-to-significantly-reduce> [Accessed 21 May 2021].

[9] Publishing, B.C.C, Smart Transportation: Technologies and Markets. Smart Transportation Market Size, Share and Trends Analysis Report. Available at: https://www.bccresearch.com/market-research/information-technology/smart-transportation-market.html [Accessed May 25, 2021].

[10] Inrix. 2021. Searching for Parking Costs Americans $73 Billion a Year. [online] Available at: <https://inrix.com/press-releases/parking-pain-us/> [Accessed 25 May 2021].

[11] Sfmta.com. 2021. [online] Available at: <https://www.sfmta.com/sites/default/files/pressreleases/SFpark%20Evaluation%20Presentation%206.19.14.pdf> [Accessed 25 May 2021].

[12] Schrank, D., Eisele, B., and ., Lomax, T. 2019. 2019 urban mobility report. Texas Transportation Institute,[ONLINE]. Available: http://mobility. tamu. edu/ums/report.

[13] Gaurav, S.G., Intelligent Surface Transport Management System (ISTMS): Global Markets. Intelligent Surface Transport Management System Market Report. Available at: https://www.bccresearch.com/market-research/instrumentation-and-sensors/intelligent-transportation-systems-report.html [Accessed May 22, 2021].

[14] Statista. 2021. IoT connected devices by region 2030 | Statista. [online] Available at: <https://www.statista.com/statistics/1194677/iot-connected-devices-regionally/> [Accessed 25 May 2021].

[15] Saldivia, G., 2018. Stuck In Traffic? You're Not Alone. New Data Show American Commute Times Are Longer. NPR. Available at: https://www.npr.org/2018/09/20/650061560/stuck-in-traffic-youre-not-alone-new-data-show-american-commute-times-are-longer [Accessed May 22, 2021].

APPENDIX

Table of Contents

Appendix A. Specific Drivers and Challenges

In addition to the common key drivers and challenges in the smart parking and smart traffic management space, given below are drivers and challenges specific to each segment[9],[15]

Segment	Key Drivers	Challenges
Parking	Increasing number of vehicles with limited availability of parking spaces	High price of cameras and sensors Determining vehicle type Field of View
Traffic Delays and Congestion	Rise in demand for ride sharing services that add to traffic congestion	High cost of implementation and initial investment Data processing

Parking

The key specific driver is that growing urbanization is leading to an increase in the number of vehicles and the city only has so much space to accommodate for that growth. Therefore, optimizing how the parking space is used, incentivizing users to use garages at specific times, monitoring occupancy patterns prevents building new parking spaces and thus can save money. Therefore, there is a growing demand for real-time data to determine and monitor the availability of parking spaces,

The specific challenges are:

1. Cost: cameras and sensors are still quite expensive.
2. Infrastructure: concerns such as power often prevents cameras from being placed in optimal locations which can hinder their field of view and prevent good detection. (Insight from Suzanne Schreck from Sound Transit)
3. Technology: detecting distinct people and modes of transportation (buses, cars, bicycles) from each other is still not optimal (Insight from Brian Brooke of Sound Transit and City of Bellevue)

Traffic Delays and Congestion

One of the key specific drivers here is the rise of ridesharing services such as Uber and Lyft. The start and stop motion of these vehicles for pick-up and drop-off causes street congestion, takes up space on the curb. These vehicles have a greater impact on congestion than a car that is parked on the curb or garage and does not move much during the day.

The specific challenges are:

1. Cost: implementing the cameras and sensors can be expensive
2. Data: the large volume of data in this specific case can be challenging to process.

Appendix B. Global Market Trends for Smart Transportation Technologies[9]

In this report we only focused on the smart parking and smart traffic management of smart transportation solutions as that was most amenable to MUST on-going data collection efforts. However, the smart transportation market is bigger than that and can be broken down into:

- Parking management solutions
  - Based on a combination of technology and human beings to increase the availability of parking spaces in urban areas

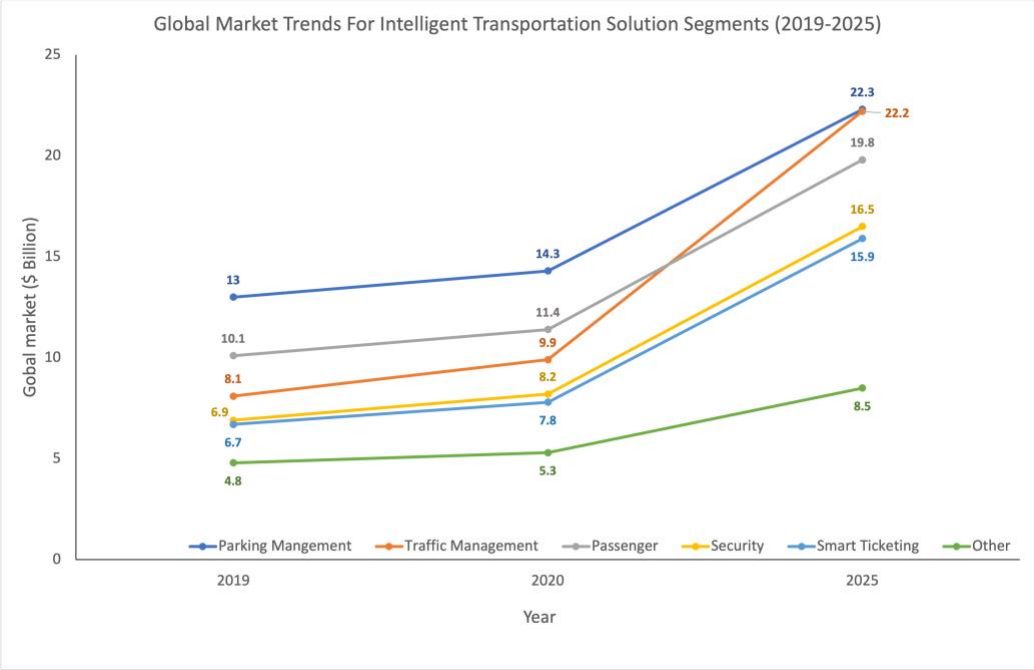
- Traffic management solutions
  - Use of smart traffic lights, sensors, and embedded detectors to detect congestion, synchronize activity between traffic lights, update traffic lights in real time and inform drivers of ideal speeds to make traffic flow more efficient.

- Passenger information management solutions
  - Supplies users of public transportation with information about the nature and state of a public transportation service through visual, voice or other media, statically or in real-time

- Security and surveillance solutions
  - Use of smart technologies to track people's movement and analyze this movement to compare it to the behavior of the entire crowd. Applications include video camera recordings by law enforcement.

- Smart ticketing solutions
  - System that electronically stores travel tickets on a microchip embedded on a smartcard which can then be scanned by a transportation operator and can be used to authorize travel

- Others
  - Fleet management: Use of AI, IoT and data analytics to enhance fleet management services such as vehicle budget, driver management and fuel management and real-time fleet data.
  - Vehicle Telematics: Use of cellular technologies such as 4G and 5G embedded in vehicles to prevent drivers from getting lost and being able to call roadside assistance.
  - Automatic Number Plate Recognition: technology that reads vehicle registration plates used by the police force and traffic management agencies.



The above figure shows global trends for each of the smart transportation solutions discussed. Note that smart parking and smart traffic management solutions will have close to half the market share by 2025.

Segment	CAGR% (2020-2025)
Parking Management	9.3
Traffic Management	17.5
Passenger Information Systems	11.7
Security and Surveillance	15.0
Smart Ticketing	9.9
Others	13.1

The table above shows the compounded annual growth rate (CAGR) for each of the segments for 2020-2025. Note that smart traffic solutions have the highest growth rate followed by security and surveillance.