Literature Review

Smart Transportation

Urban planners are constantly deriving and evaluating new strategies to satisfy desires for futuristic and sustainable transportation systems. Some of the most successful transportation initiatives are emerging from wealthy and developed European cities such as Amsterdam, Copenhagen, and Stockholm [1]. Culture and infrastructure around transportation within these European cities set the status quo for biking to be a reliable mode of transportation [1]. A common characteristic that distinguishes cities with sustainable transportation systems is their initiatives to grow as a smart city that fosters sustainable development. A smart city is composed of several components, attributes, and themes; this research study specifically focuses on the transportation component of a smart city, also known as smart transportation [2]. Smart transportation, or smart mobility, in the context of this research study will be defined as transportation that is offered on demand and is presented as efficient, sustainable, flexible, and eco-friendly [3].

The transition from a traditional transportation system in a city that priortizes cars to a multifaceted, technology-enhanced transportation system can be understood through the notion of socio-technical systems [3]. Socio-technical systems are systems comprised of hardware, software, data, laws, and citizens [4]. *Will continue to add pieces here*

Barriers and Their Imapcts on Demand

Improving transportation systems' design and infrastructure can lead to be an overwhelming task accompanied with an exorbitant cost but in the long run the benefits will distinctly present themselves. Smart transportation initiatives specifically relating to biking and bike sharing systems are growing rapidly within cities. Some cities, as Deliotte points out, are lacking in infrastructure to foster a well-established commuter population comprised of bikers [1]. Deliotte acknowledges from a study they did on smart mobility across cities

in the United States that, "Slightly more than a quarter of current commuters could switch to biking as one of their main modes of commuting if barriers to biking were substantially reduced" [1]. These barriers mentioned signifcantly affect the use and demand of a bike sharing system in any given city and there are several variables that contribute to this [5]. Certain variables such as slope and elevation related to topograpy and the city's built environment highlight unique trends amongst the individuals that use the bike sharing system. For example, open data from the Western Pennsylvania Regional Data Center highlights that users of the bike sharing system in Pittsburgh, PA, USA tend to rent bikes from stations at higher elevations and end at lower elevations [6]. Evidently, every city's landscape and built environment is unique, but the design and implementation of the bike sharing system seems to remain homogenous. This specific research seeks to identify the views of the bike sharing system in Manizales, Colombia. By understanding how citizens assess and view the safety and quality of their city's bike sharing system, urban planners will be able to better design a system that is a safe, efficient, and reliable.

Manizales, Colombia & Its Current Transportation Landscape

Manizales, Colombia is the capital of the department Caldas in Colombia with a population of 400,436 people in 2018 with 71% of the population being between 15 and 64 years old [7]. The city of Manizales is topographically very mountainous naturally presenting barriers that need to be considered when planning for a successful smart mobility presence. To provide a strong case to implement smart mobility in Manizales, Colombia, it is necessary to understand these barriers and the current transportation cutlure. In 2018, it was recorded that there was 445 vehicles per 1000 people which is equivalent of saying that there was one vehicle per every two people [7]. Despite the report of 445 vehicles per 1000 people, another model shows that 56% of the population's main mode of transportation is by bus [7]. This model however points out the only 12% of the population reported their main mode of transportation to be walking or biking. To summarize here, the primary modes of transporation

offered in Manizales, Colombia include public buses, personal vehicles, bicycles, walking, taxis, or the Cable Aereo which is similar to a sky lift [7]. *Will continue to add pieces here*

Sustainability & Mobility

Ever since the United Nations released the seventeen sustainable development goals (SDGs) for the world, countries have been consistently integrating these goals into initiatives and projects within their cities. Manizales has been working on smart mobility initiatives for a few years now, but only recently have they been making significant progress. Their projects and initiatives for smart mobility are targeted towards advancing eleven of the seventeen SDGs [8]. The bike sharing system in Manizales, Colombia is particularly interesting because a company called CityBioBike has developed a biometric loaning system for bike renting [9]. CityBioBike partners with the Bike Office at the Universidad Católica de Manizales to provide a bike sharing system to the city [10]. *Will continue to add pieces here*

Future Improvments to bike sharing systems in general

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References

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