

Promoting Cycling as a Form of Transportation Among University Students in Cuenca, Ecuador

Interactive Qualifying Project

In collaboration with:
La Empresa Pública Municipal de Movilidad, Tránsito y Transporte de Cuenca

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WPI



Abstract

Cities value sustainability as a way to combat undesirable effects of urbanization such as atmospheric pollution and traffic congestion. Specifically, Cuenca, Ecuador has experienced these problems as a result of a large increase in population over several years. In response to population growth and traffic issues, La Empresa Pública Municipal de Movilidad, Tránsito y Transporte (EMOV EP), the governmental transportation division of Cuenca, has initiated a variety of bike promoting programs including a bike share to encourage cycling within the city's historic center. To gather support for the future advancement of this bike share, EMOV EP is focusing on the overall promotion of cycling in the city. Thus, the goal of this project is to create resources that EMOV EP can utilize to further promote cycling as a form of transportation in Cuenca. After narrowing our focus to university students, we determined that the most prominent barriers to cycling are concern for safety, lack of accessibility to bikes, and culture and mentality. To make cycling more appealing to students, we created a map of safe bike routes to use in the city. We designed various features of the map specifically to combat the found barriers.

Resumen en español

Ciudades valoran sostenibilidad como una manera a contrarrestar los efectos indeseables de urbanización como contaminación atmosférica y congestión de tráfico. Específicamente, Cuenca, Ecuador ha experimentado estos problemas como resultado de un gran incremento de población por varios años. En respuesta a crecimiento demográfico y problemas de tráfico, La Empresa Pública Municipal de Movilidad, Tránsito y Transporte (EMOV EP), la división de transporte gubernamental de Cuenca, ha establecido un programa de compartir bicicletas para fomentar transporte alternativo en el centro de la ciudad. Para recibir apoyo para los avances del futuro del programa, EMOV EP está enfocando en la promoción general del ciclismo en la ciudad. Por lo tanto, la meta de este proyecto es crear recursos que EMOV EP puede utilizar para promocionar el ciclismo como una forma de transporte en Cuenca. Después, restringimos nuestro enfoque a los estudiantes de la universidad, determinamos que las barreras más prominentes a ciclismo son preocupación por seguridad, falta de accesibilidad a las bicis, y cultura y mentalidad. Para hacer ciclismo más atractivo a los estudiantes, creamos un mapa de rutas de bicicleta seguras a usar en la ciudad. Varias características en el mapa además de nuestras sugerencias por su implementación fueron creado específicamente para combatir las barreras.

Acknowledgements

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We also thank all of the individuals who directly participated in our project. This includes the experts we interviewed as well as the students who participated in surveys, interviews, bike rides, and focus groups. The collection of our data would not have been possible without your participation.

We lastly would like to thank WPI, especially the Interdisciplinary and Global Studies Division (IGSD) for making this Interactive Qualifying Project experience possible.

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Authorship

Alexander Cruz contributed an equal share of the abstract and introduction. For the background chapter, Alexander contributed to the Promotion of Biking section. For the Findings and Development of Cycling Map section, Alexander contributed equally to the writing and editing. Alexander created maps and took pictures of the bike infrastructure at all the university campuses and administered student surveys. Alexander contributed an equal share to reviewing current programs, conducting bike shop and other expert interviews, and bike rides with students.

Mateo Frare contributed an equal share of the abstract and introduction. For the background chapter, Mateo contributed to some of the Benefits of Biking section, the Public Opinion section, the Key demographics that influence biking section, and some of the Cycling in Cuenca, Ecuador section. Mateo contributed to the majority of the Methodology chapter. For the Findings and Development of Cycling Map section, Mateo contributed equally to the writing and editing. Mateo lead student focus groups and administered student surveys. Mateo contributed an equal share to reviewing current programs, conducting bike shop and other expert interviews, and bike rides with students. Mateo contributed to part of the Conclusions and Recommendations section.

Lauren Souza contributed an equal share of the abstract and introduction. For the background chapter, Lauren contributed to some of the Promotion of Biking section and some of the Cycling in Cuenca, Ecuador section. For the Findings and Development of Cycling Map section, Lauren contributed equally to the writing and editing. Lauren conducted student interviews and created and administered student surveys. Lauren contributed an equal share to reviewing current programs, conducting bike shop and other expert interviews, and bike rides with students. Lauren contributed to the development of the final cycling map by creating the network of current bike paths and suggested safe routes.

Jeffrey St. Hilaire contributed an equal share of the abstract and introduction. For the background chapter, Jeff contributed to the sections on the Benefits of Biking, the Infrastructure and impact on safety, and Intermodality. For the Findings and Development of Cycling Map section, Jeff contributed equally to the writing and editing. Jeff rode and mapped the current bike paths in the city. Jeff contributed an equal share to reviewing current programs, conducting bike shop interviews, administering student surveys and partaking in expert interviews. Jeff contributed to the development of the final cycling map by adding symbols denoting the facilities and signage. Jeff contributed to part of the Conclusions and Recommendations section.

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Executive Summary

Introduction and Background

Although urban living is often associated with positive social and economic advancement, the trends of rising city populations can lead to housing issues, slum development and overcrowding which, in turn, can increase traffic congestion and automobile emissions (“Causes, Effects and Solutions to Urbanization”, 2016; Cox, 2000). The realization of centralized cities is increasingly sought after in part because it allows for the use of alternative transportation, such as cycling (“New Urbanism Provides...”, 2017). Increased cycling can aid a city in combating the issues of traffic congestion and the associated emissions of greenhouse gases. In an expert survey, 87 percent of urban transport researchers feel bicycling plays an important role in reducing city traffic (Koska & Rudolph, 2016). Additionally, with the current bike usage in the European Union, there has been an estimated emission reduction of around 11 million tons of carbon dioxide per year (Blondel et al., 2011).

Although cycling has many noticeable benefits to cities facing consequences of urbanism, the popularity of cycling as a form of transportation depends on a variety of factors such as culture, infrastructure and safety. For example, in some regions like Latin America, there is skepticism regarding the potential of bike transportation, as biking is sometimes viewed as a symbol of poverty. Some other cycling deterrents include inexperience, physical activity, and fear of theft or assault (Gutiérrez, 2013). As ways to overcome cycling barriers, municipalities have employed a variety of promotional strategies such as educational events, bike share programs, and route planning resources (Savan et al., 2017).

In Cuenca, Ecuador, issues with the popularity of cycling are being addressed. To promote cycling, the government transportation division, La Empresa Pública Municipal de Movilidad, Tránsito y Transporte (EMOV EP) offers educational and recreational programs that increase awareness of cycling and enable citizens to feel more comfortable cycling in a city setting. En Bici Por El Centro, a bike loan program, is one of the initiatives that encourages alternative transportation within the city’s historic center. As the government of Cuenca tries to popularize its bike share system, the focus of EMOV EP is to assess the public’s opinion on biking and encourage its use as a form of transportation.

The goal of this project is thus to provide EMOV EP with resources to further promote cycling in Cuenca. To accomplish this, we achieved the following objectives:

1. Assess the current framework of biking resources, programs, and bikeways in the city
2. Determine a target audience
3. Investigate the most significant cycling barriers to tailor incentives for promoting biking within the target audience
4. Plan and develop resources that EMOV EP can use to assist the target audience in overcoming these barriers

Methodology

In order to accomplish these objectives, we needed to first familiarize ourselves with the current programs and infrastructure that affect Cuenca's bike culture. This was accomplished by mapping the city's bike infrastructure, interviewing bike shop workers, and reviewing some of EMOV EP's cycling programs. Next, we conducted several expert interviews for insight into cultural tendencies, leading us to our target audience of university students.

With our target audience determined, we investigated barriers preventing students from biking regularly. We conducted surveys and interviews, to better understand student transportation habits. These interactions helped us to determine three major barriers to focus on with our bike-promotion resources; concern for safety, lack of access to bicycles, and mentality and culture. To provide a resource that could eventually allow students to overcome the found barriers, we created a guided cyclist map of safe bike routes, based on the data from survey and interview responses. As shown in Figure 1, we rode bikes with students from the University of Cuenca to learn their opinions on our recommended routes. After biking along these routes and taking notes and photos, we determined areas of safety concern and finalized our recommended network of safe routes.

Results and Analysis

From our interview with Dr. Daniel Orellana, we learned that students make up about 30 percent of Cuenca's bike commuting population, making it one of the city's largest cycling demographics (D. Orellana, personal communication, January 29, 2018). Additionally, our project coordinator from EMOV EP, Mrs. Hormazabal Andrade, suggested we focus on college students as they are underrepresented by their current programs (M. Hormazabal, personal communication, February 5, 2018). After observing many unoccupied university bike racks and discovering that only 9.7 percent of the surveyed student population ride bikes to school, we concluded there is room for growth in ridership within this demographic. Among students, we determined three prominent barriers to cycling.

Determining lack of safety as a barrier: From our experience using the bike share program in el Centro, we unanimously discerned that the city center is not conducive to cycling due to traffic congestion and negligence of drivers. In addition, from our interviews with local bike shop staff, 10 of the 14 workers answered that the biggest problem for cyclists in the city is a lack of respect from drivers. Similarly, according to our student interviews, we found that students also identified a lack of respect from drivers as a major problem with cycling in the city.

Determining lack of accessibility as a barrier: Out of 84 student respondents, 31 claim the reason they do not bike is because they do not own a bicycle. From our bike shop interviews, we found all 13 included stores sell bikes, but only two provide rentals, which are intended for recreational use. These results show that there are a lot of students who do not own a bike and there are few opportunities to rent them within the city.



Figure 1: Our Team with Students from the University of Cuenca During a Bike Ride

Determining mentality and culture as a barrier: During our student interviews, we noted that many students felt there is not a prominent cycling culture in Cuenca, implying a tendency to favor other means of transport. Additionally, the second most frequent survey response as to why students do not use a bike is that the distance they need to travel is too long. However, we found many students that do not bike take the same routes to and from school as the reported bikers. This supports that the perception of a far distance to commute by bicycle is subjective and depends on the student, backing the idea that the distance barrier may be influenced by the culture of the city and its tendency to favor other forms of transportation.

To provide a resource that could eventually allow students to overcome these three barriers, we created a cyclist map of safe bike routes highlighting many aspects of Cuenca's cycling infrastructure, including current bikeways, bike shops, and parking facilities. Figure 2 is the finalized cyclist map. The various colored routes signify the level of safety and the type of bike path. For example, the green routes indicate the routes that we determined to be the safest for cyclists. Also, there are only two red points on the map that indicate the presence of dangerous intersections and rotaries. Finally, the black routes indicate the presence of bike paths and the purple routes indicate recreational paths for cyclists.

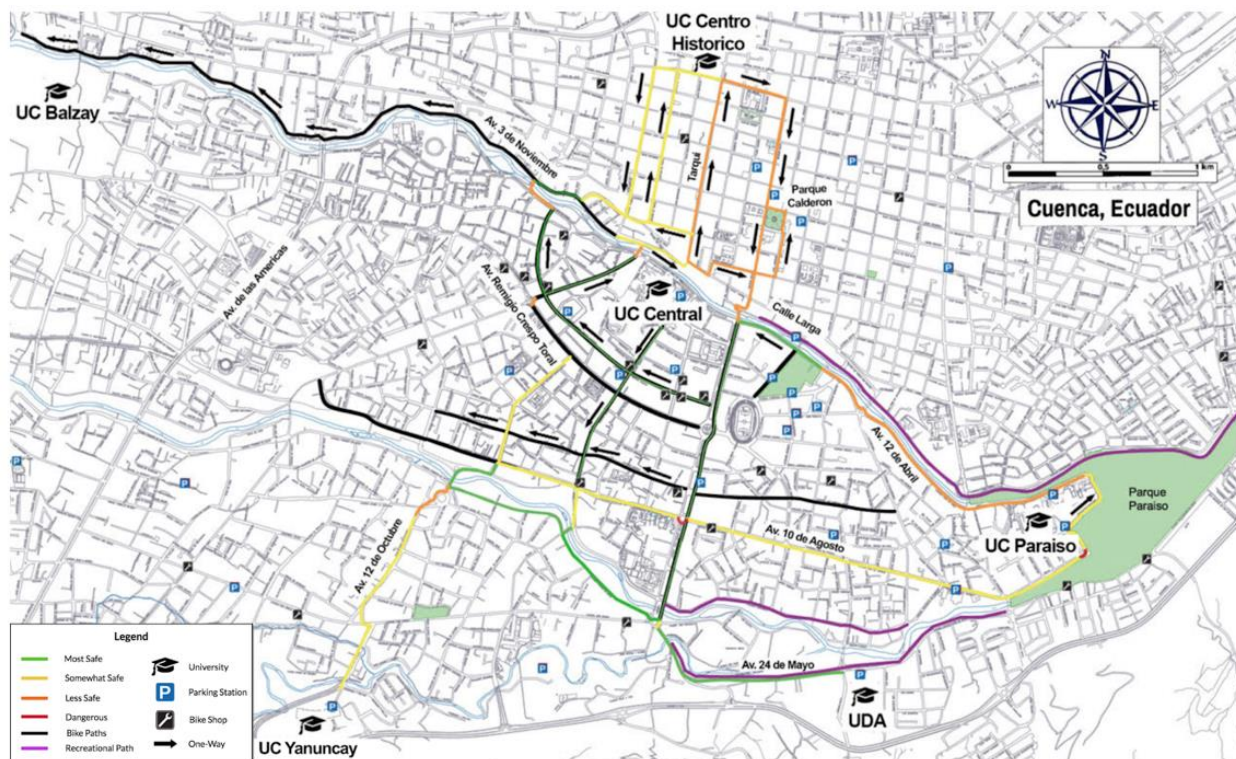


Figure 2: Final Guided Cycling Map

We included this final map in a biking guide that contains several added features tailored to some of the three found barriers, including key points of interest throughout the city, university infrastructure, and approximate bike times for certain routes.

Conclusions and Recommendations

Through our personal experiences as well as our conversations with locals, we have learned that though the presence of cycling has grown with the implementation of new bikeways, the streets of Cuenca are principally dominated by other means of transportation. As a way to overcome the found barriers, we decided to focus on creating a guided cycling map of a recommended network of bike routes in Cuenca. To address the barrier of safety concern, we included calm, less trafficked roads in the established network and color-coded the streets to highlight various levels of safety and the presence of bike lanes. To promote accessibility to cycling resources, we included the locations for local bike maintenance shops and parking facilities. As a way to overcome the issue of mentality regarding potentially misinformed perceptions of general travel times and distances, we included average times for riding to various parts of the city.

In addition to the distribution of the guided map and the encouragement of bike usage on the included routes, we recommend the following short-term and long-term approaches to further popularize biking based on our findings:

- EMOV EP should add a bike share station close to the University of Cuenca's central campus.
- *In the future*, EMOV EP should limit car traffic in the city's center
- *In the future*, EMOV EP should connect all the bike paths in the city

By adhering to these suggestions, we believe that EMOV EP will see an increase of cycling in the city in the coming years. An increase in biking would decrease the traffic as well as promote active transport in the city. By beginning with university students, we hope our guided map will serve as a resource to encourage cycling among people who do not consider biking a daily form of transportation.

Resumen Ejecutivo

Introducción y Antecedentes

Aunque vida urbana se asocia con un avance social y económico positivo, las tendencias de poblaciones urbanas han crecido poder causar los efectos de problemas de vivienda, desarrollo del barrio bajo, y la superpoblación que puede aumentar congestión de tráfico y las emisiones de autos (“Causes, Effects and Solutions to Urbanization”, 2016; Cox, 2000). La comprensión de ciudades centrales tiene una demanda muy alta porque permite para el uso de transporte alternativo, como el ciclismo (“New Urbanism Provides...”, 2017). El aumento del ciclismo puede ayudar a combatir los congestionamientos del tráfico y la emisión de gases invernaderos. En una encuesta profesional, 87 por ciento de los investigadores transporte urbano sienten se ciclismo tiene un papel vital en la reducción del tráfico en la ciudad (Koska & Rudolph, 2016). Adicionalmente, con el uso actual de bicicletas en la Unión Europea, ha habido una reducción estimada del rededor de 11 millones de toneladas de dióxido de carbono por año (Blondel et al., 2011).

Aunque el ciclismo tiene muchos beneficios notables a las ciudades enfrentando problemas y consecuencias de urbanismo, la popularidad del ciclismo como una forma del transporte depende en una variedad de factores como la cultura, infraestructura, y la seguridad. Por ejemplo, en unas regiones como América Latina, hay escepticismo en cuanto al potencial del uso de bicicletas como transporte, debido a que está asociado con la pobreza. Otros obstáculos del ciclismo incluyen la inexperiencia, actividad física, y miedo de ser robado o asaltado (Gutiérrez, 2013). Con el fin de sobrepasar estos obstáculos se han destacado el establecimiento de programas de bike share y la planificación de las rutas (Savan et al., 2017).

En Cuenca, Ecuador, el problema de la popularidad del ciclismo se están abordando. Para promover el ciclismo, la división del transporte del gobierno, La Empresa Pública Municipal de Movilidad, Tránsito y Transporte (EMOV EP) ofrece programas educativos y recreativos que aumente la conciencia sobre ciclismo y permitir los ciudadanos sentirse más cómodos montando bicicleta en la ciudad. En Bici Por El Centro, un préstamo de bicicletas es una de las iniciativas que promueve transporte alternativo dentro del centro histórico de la ciudad. A medida que el gobierno trata de hacer el sistema de préstamo de bicicletas, el enfoque principal de EMOV EP es asesorar la opinión del público en cuanto a las bicicletas y promover el su uso como una manera principal de transporte.

La meta de este proyecto es para proveer EMOV EP con recursos para promover el ciclismo en Cuenca. Para lograr esto, nosotros cumplimos con los siguientes objetivos:

1. Evaluar la infraestructura actual de los recursos y programas del ciclismo, y las ciclovías en la ciudad
2. Determinar la audiencia
3. Investigar los obstáculos que son más significado del ciclismo para adaptar los incentivos para la promoción del ciclismo dentro de la audiencia específica
4. Planear y desarrollar recursos que EMOV EP pueda utilizar para ayudar la audiencia a vencer estos obstáculos

Metodología

Para lograr estos objetivos, necesitamos familiarizar nosotros mismos con los programas actuales y la infraestructura que impactar la cultura del ciclismo en Cuenca. Esto fue cumplido por trazar el mapa de la infraestructura de bicis, entrevistar las tiendas de bicis, y revisar unos programas del ciclismo de EMOV EP. Luego, hicimos encuestas de expertos para recibir una perspectiva en cuanto a las tendencias culturales, conduciéndonos a nuestra audiencia específica de estudiantes universitarios.

Con nuestra audiencia específica determinada, nosotros investigamos los obstáculos que no permiten que los estudiantes montan en bicicleta más a menudo. Nosotros condujimos encuestas y entrevistas para entender los hábitos de transporte de los estudiantes. Estas observaciones e interacciones nos ayudaron determinar tres obstáculos principales en los que nos pudimos enfocar para nuestros recursos para promover el ciclismo; preocupación por seguridad, falta de acceso de bicis, y percepción. Para proveer un recurso que eventualmente permita a los estudiantes sobrepasar está barreras nosotros creamos un mapa guiada para ciclistas de rutas seguras, basado en datos de sus respuestas. Como se muestra en Figura 1, montamos en bici con los estudiantes de la Universidad de Cuenca a aprender sobre sus opiniones de nuestras rutas recomendadas. Después de que nosotros montamos bici por estas rutas y tomamos fotografías y apuntes, nosotros determinamos las áreas de preocupación y finalizamos nuestra red de rutas seguras recomendadas.



Figura 1: Nuestro equipo con los estudiantes de la Universidad de Cuenca durante un paseo en bicicleta

Resultados y Análisis

De nuestra entrevista con Dr. Daniel Orellana, nosotros aprendimos que los estudiantes componen 30 por ciento de la población de Cuenca que viajar diariamente al trabajo por bici, convirtiéndolo en uno de más grande de los demográficos del ciclismo en la ciudad (D. Orellana, personal communication, January 29, 2018). Adicionalmente, nuestra coordinadora del proyecto de EMOV EP, Sra. Hormazabal Andrade, ella nos sugerí a enfocar en los estudiantes universitarios porque ellos son poco representados por los programas actuales de EMOV (M. Hormazabal, personal communication, February 5, 2018). Después de nosotros observamos muchos parqueaderos de bicis vacíos a las universidades y descubrimos que solo 9.7 por ciento de los estudiantes que nosotros entrevistamos monta en bici a la universidad, concluimos hay espacio para aumentar el ciclismo entre los estudiantes. Entre los estudiantes, determinamos tres obstáculos prominentes del ciclismo.

Determinación de la falta de seguridad como una barrera: De nuestras experiencias cuando usamos el préstamo de bici en el Centro, discernimos unánimemente que el centro de la ciudad no es conducente por ciclismo debido a la congestión de tráfico y la negligencia de los

conductores. Además, de nuestras entrevistas con los trabajadores de las tiendas de bicis, 10 de 14 trabajadores responden que el principal problema para ciclistas en la ciudad es una falta de respeto de los conductores. Igualmente, según a las entrevistas con los estudiantes, encontramos que los estudiantes identificaron una falta de respeto de los conductores como un problema grave con el ciclismo en la ciudad también.

Determinación de la falta de acceso como una barrera: De los 84 estudiantes encuestados, 31 dicen la razón que no montar en bici es porque ellos no poseerlas. De nuestras entrevistas con las tiendas de bicis, encontramos que todas 13 tiendas venden las bicis, pero solo dos proveer alquileres, la mayoría de los cuales están destinado al uso recreativo. Estos resultados muestran que hay muchos estudiantes que no posean una bici y hay algunas oportunidades a alquilarlas en la ciudad.

Determinación de la mentalidad y la cultura como una barrera: Durante de nuestras entrevistas con los estudiantes, notamos que muchos estudiantes sienten no hay una cultura del ciclismo prominente en Cuenca, implicando una tendencia a favorecer otros modos del transporte. Adicionalmente, la segunda respuesta de la encuesta más frecuente por qué los estudiantes no usar una bici es que la distancia que ellos necesitan viajar es demasiada larga. Sin embargo, encontramos que muchos estudiantes que no usan las bicis viajar en las mismas rutas a y de la universidad como los ciclistas reportados. Esto apoya que la percepción de una distancia lejana a viajar diariamente por bici es subjetivo y dependiente en el estudiante, apoyando la idea que la barrera de distancia puede ser influenciado por la cultura de la ciudad y su tendencia a favorecer otras formas del transporte.

Para proveer un recurso que eventualmente permitiría los estudiantes a vencer estas tres barreras encontradas, nosotros creamos un mapa ciclista de las rutas seguras destacando muchos aspectos de la infraestructura del ciclismo de Cuenca, incluye ciclovías actuales, tiendas de bicis, y los parqueaderos. Figura 2 es el mapa final. Los varios colores de las rutas significan el tipo y el nivel de seguridad de las rutas. Por ejemplo, las rutas verdes son las rutas que nosotros determinamos como las más seguras para los ciclistas. También, sólo hay dos puntos rojos en este mapa que indican las áreas más peligrosas para los ciclistas y esas son las rotondas que tienen mucho tráfico. Finalmente, las rutas negras indican la presencia de ciclovías y las rutas moradas indican paseos recreativos para bicis.

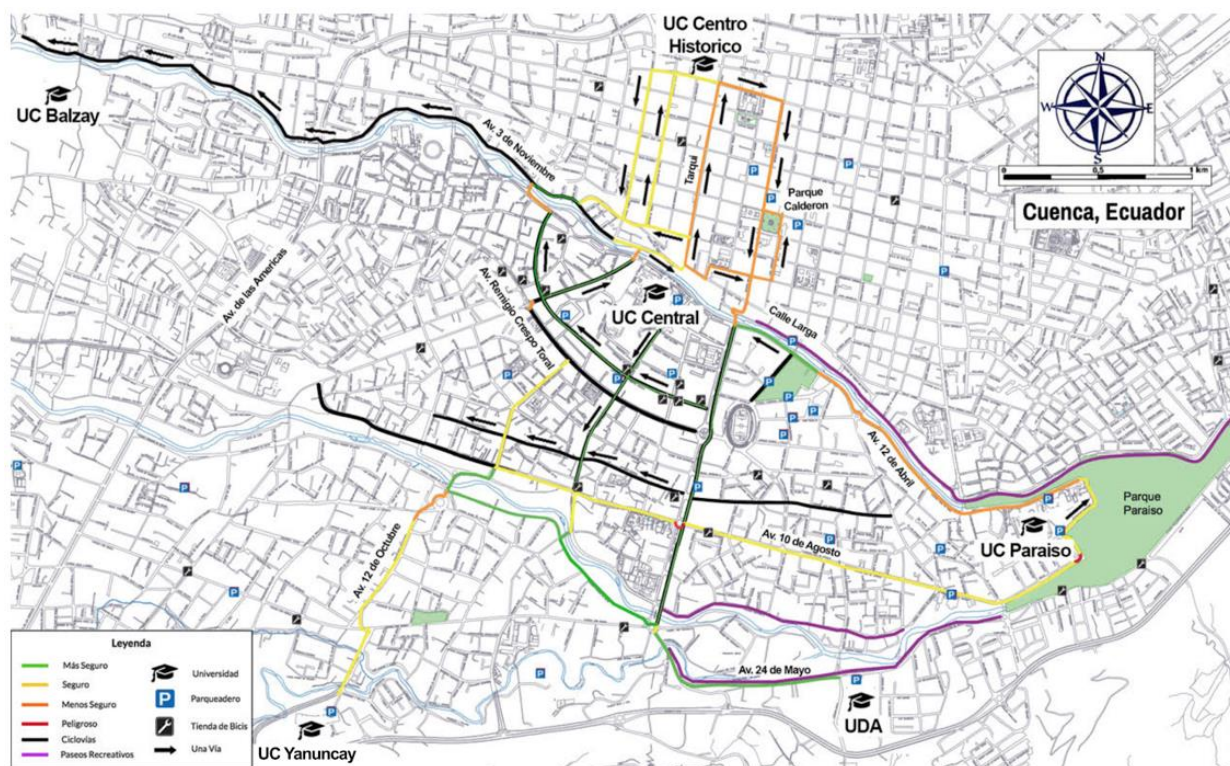


Figura 2: Mapa final de ciclismo

Incluimos este mapa final en un guiado del ciclismo que contiene varias características agregadas que abordan las tres barreras encontradas, incluyendo puntos de interés por toda la ciudad, infraestructura universitaria y los tiempos aproximados para ir en bici en las rutas específicas.

Conclusiones y Recomendaciones

A través de nuestras experiencias personales además de nuestras conversaciones con ciudadanos, nosotros entendemos que, aunque la presencia del ciclismo ha crecido con la implementación de las nuevas ciclovías, las calles de Cuenca están principalmente dominadas por otros modos de transporte. Como una manera a vencer las barreras encontradas, decidimos enfocar en la creación de un mapa guiado para los ciclistas de una red de rutas recomendadas en Cuenca. Para abordar la barrera de la preocupación por la seguridad, incluimos tranquilo, carreteras menos traficadas en la red establecido y utilizamos un código de colores para destacar los varios niveles de seguridad y la presencia de las ciclovías en las calles específicas. Para promover la accesibilidad a los recursos del ciclismo, incluimos las locaciones de los mecánicos y parqueaderos de las bicis. Como una manera a vencer los problemas de mentalidad en cuanto a la percepción potencialmente mal informada de los tiempos y distancias generales de viaje, incluimos los tiempos medios a montar a las varias partes de la ciudad.

Adicionalmente, la distribución del mapa guiado y el ánimo del uso de bicis en las rutas incluidas, recomendamos los siguientes enfoques a corto y largo plazo para popularizar el ciclismo basado en nuestras investigaciones.

- EMOV EP debe añadir uno o más estaciones de su préstamo de bicicletas cerca de los campus universitarios
- *En el futuro*, EMOV EP debe limitar el número de carros en el centro de la ciudad
- *En el futuro*, EMOV EP debe conectar todas las ciclovías en la ciudad por lo que no comienzan abruptamente ni terminan

Siguiendo estas sugerencias, creemos que EMOV verá un aumento del ciclismo en la ciudad en los próximos años. Un aumento en el ciclismo disminuiría el tráfico además de promocionar transporte activo en la ciudad. Comenzando con los estudiantes universitarios, esperamos nuestro mapa guiado servirá como un recurso para animar el ciclismo entre las personas quienes no consideran el ciclismo ser una forma diariamente de transporte.

1 Introduction

With continued world-wide urbanization, many cities have developed into focal points of economic activity, governmental affairs, and active social atmospheres. For these reasons, “urban living is often associated with higher levels of literacy and education, better health, greater access to social services, and enhanced opportunities for cultural and political participation” (“United Nations”, 2014, p. 3). The many benefits of urbanization have prompted a noticeable population increase in cities around the world. From 1900 to 2014 the proportion of the world’s population living in and around urban areas has increased by 54 percent, which is projected to grow to an estimated 66 percent by 2050 (Alexiades & Peluso, 2015). This rise can lead to housing issues, slum development and overcrowding which, in turn, can increase traffic congestion and automobile emissions (“Causes, Effects and Solutions to Urbanization”, 2016; Cox, 2000). As a potential solution to these problems, an increasingly popular phenomenon, known as new urbanism, has arisen. This phenomenon proposes the modification of architecture and infrastructure to promote dense city centers dotted with green spaces, housing, and businesses all within a close proximity. The realization of centralized cities is increasingly sought after in part because it allows for the trendy, urban aesthetic of alternative transportation (“New Urbanism Provides...”, 2017).

Habitual use of alternative transportation, such as bicycling, can help to combat many of the issues associated with urbanization including excessive automotive traffic and greenhouse gas emissions. An increase in cycling reduces the number of cars on the road, allowing for lower emissions and a decrease in a city’s carbon footprint. For instance, in Copenhagen, biking has aided in the total reduction of carbon emissions by 90,000 tons per year, the equivalent to the annual emissions from approximately 19,000 passenger vehicles (“City of Cyclists...”, 2011). Furthermore, biking is an excellent form of exercise that utilizes all major muscles groups and can help individuals stay fit and healthy (“Cycling - Health Benefits”, 2013).

Although bicycle transportation as a whole is growing in popularity in Latin America, this green transportation trend may not be accelerating as fast as possible. Potential dangers involved in the use of bicycles in cities stand as a potential driving force for this slowed acclimation to a new form of transportation on the streets. In this region, there are approximately 130,000 road fatalities each year and “Latin America ranks number one in the tragic global ranking of regions with the highest number of deaths from road traffic accidents” (“Latin America: Time...”, 2013, para. 1). As cities in South America continue to urbanize, bikes and alternate forms of transportation become more practical. Due to this diversification, transportation becomes dangerous when roads and infrastructure, which were designed for homogenous traffic consisting mainly of automobiles, are not modified accordingly (Mohan & Tiwari, 2005, p. 88).

In Cuenca, Ecuador, a city following the urbanization trend, the population has risen around 12 percent since 2011 from approximately 530,000 to over 600,000 people. If the population continues to grow at this rate, Cuenca could see its size swell to over 1.1 million people by 2050 (“The Population Development”, 2017). Although buses and automobiles are a very popular form of transportation in the city, the narrow streets of the city’s historic center are not conducive to high concentrations of motorized transportation. To promote a new form of transport, the government transportation division in Cuenca, La Empresa Pública Municipal de Movilidad, Tránsito y Transporte (EMOV EP) has implemented multiple cycling programs, including their own bike share system established in March of 2017 (V. Hormazabal, Email Communication, 12/4/2017).

As the government of Cuenca tries to popularize its bike share system, the focus of EMOV EP is to assess the public's opinion on biking and encourage its use as a form of transportation. Currently, safety concerns, social disconnects, and lack of access to bicycles may be restricting the public's willingness to bike in the city. To overcome these issues, EMOV EP continually seeks new and innovative ways to promote non-motorized transport through new programs and infrastructure.

The goal of this project is to create resources that EMOV EP can utilize to further promote cycling as a form of transportation in Cuenca. To accomplish this goal, we first assessed the current framework of cycling in the city and established a target audience. Then, we investigated the most significant incentives and barriers to promote cycling within the determined audience. After analyzing our collected data, we planned and developed resources that EMOV EP can use to overcome the barriers.

2 Background

Popularizing non-motorized transport is one approach to improving urban sustainability. Specifically, cycling as a form of transportation has several benefits although many factors, such as public perception, bike infrastructure, and bike promotion, can influence a culture's willingness to accept cycling. When promoting biking, it is important to consider the tendencies of various demographics and how they can influence biking within a community.

2.1 Benefits of Biking

Cycling is both a mode of transportation and a recreational hobby that has a variety of benefits not only directly affecting the biker but also the community. One of the greatest effects of public biking is its positive impact on city traffic. Increased levels of cycling aid in alleviating traffic congestion (McKibbin, 2011). In an expert survey, 87 percent of urban transport researchers feel bicycling plays an important role in reducing city traffic (Koska & Rudolph, 2016). In Copenhagen, average commute times have decreased by seven percent, coinciding with a 25 percent increase in bike trips from 2012 to 2015. ("Copenhagen City of Cyclists...", 2015). Additionally, as a result of the implementation of bike lanes in Midtown Manhattan, GPS data show that traffic speeds have since increased by 6.7 percent (Leber, 2013). When automotive traffic dominates a city's transportation, air quality worsens, which can have potentially harmful effects on agriculture, climate and the ozone (Baklanov et al., 2016). With current bike usage in the European Union, there has been an estimated emission reduction of around 11 million tons of carbon dioxide per year (Blondel et al., 2011). Regarding health benefits, regular cycling increases cardiovascular fitness, muscular strength, flexibility, and joint mobility. Routine biking can improve circulation in the heart and lungs, reducing the risk of cardiovascular diseases such as strokes and heart attacks. In addition, riding a bike for a half-hour every day has the potential to burn nearly five kilograms of fat over a year ("Cycling - Health Benefits", 2013).

2.2 Public Opinion

The variety of benefits linked to cycling can aid in the development of a positive public perception. According to a survey conducted by *Bicycling Magazine*, respondents view fitness, enjoyment, stress relief, efficiency, environmental concerns and financial appeal as motivators for using a bike to get around (“The Way You Roll”, 2013). Opinion on public biking, however, is not all positive. Some major deterrents include inexperience, physical activity, and fear of theft or assault. Though society accepts biking in many regions, in some areas like Latin America for example, there is skepticism regarding the potential of such transportation, as biking is sometimes viewed as a symbol of poverty (Gutiérrez, 2013). Additionally, concern for safety is a major drawback that affects the positive outlook of biking in many different parts of the world especially if there is a lack of biking infrastructure (Fishman et al., 2012).

2.3 Bike Lanes and Impact on Safety

Biking in a city can be dangerous when cyclists must travel in the same lanes as cars, especially during peak traffic hours when congestion is at its highest (Ferenchak & Marshall, 2015). Forty-one percent of “... leisure-cyclists and over one quarter (27 percent) of cycling motorists stated that one of the main problems of using a bicycle was the threat of accidents.” (“Share the Road”, 2001). To combat this issue, many cities have created separate lanes for cyclists to travel in (Ferenchak & Marshall, 2015). The style and implementation of such biking infrastructure can affect the overall safety of cyclists.

There are four different styles of bike lanes, including sharrows, striped lanes, buffered lanes, and protected lanes, each with their own safety benefits. Sharrows are different from all the other forms of lanes because they allow cars to travel within them. This style of bike lane serves as a visual reminder that the space on the road is meant to be shared by both bikes and cars (Ferenchak & Marshall, 2015). Striped bike lanes are marked with painted lines to indicate where bikers should travel without interference from automobiles. Buffered bike lanes take the ideas set by striped lanes and pair it with a designated buffer space that separates the cyclists from automobiles (“Buffered Bike Lanes”, n.d.). To provide a physical barrier from vehicles, plastic bollards, curbs, or medians separate protected lanes from the street (“One-Way Protected”, n.d.).

Exemplifying safe integration of bike lanes with surrounding traffic, a study conducted by the New York City local government outlined an effective way to modify its infrastructure. Its old system was dangerous because it allowed bikers to ride alongside the parked cars leaving bikers in danger of getting “doored” by someone exiting a vehicle. In addition, the buffer area was next to moving traffic, so it offered no protection from a car veering out of control. The new system, as exemplified in Figure 3, involves moving the cycling lane to separate the cyclists from traffic. By doing this, the parking lane provides a physical barrier that protects the cyclist. In 2013, when the new bike lanes were put into effect, the city calculated a 75 percent decrease in average risk of serious injury to cyclists. (Noe, n.d.)

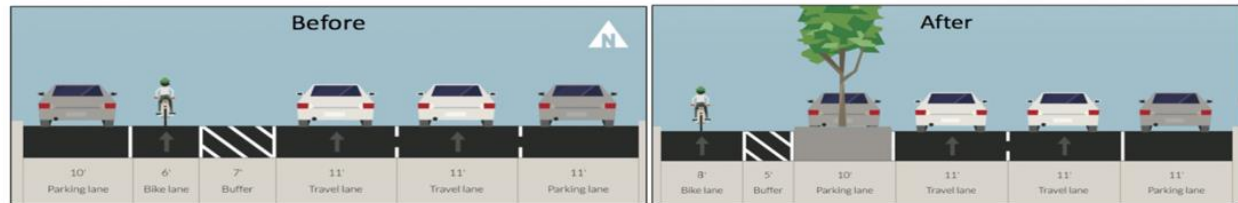


Figure 3: New York Bike Path Scheme (Noe, n.d.)

The linkage and continuity of bike lanes is another important design characteristic that can affect safety. Connecting bike paths to create a safe cycling network can decrease traffic congestion while increasing safety for cyclists. Discontinuities of any sort, including at intersections and rotaries, disrupts bike travel adding an element of danger. (“Bikeways and Intermodality...”, 2013)

2.4 Intermodality

With proper infrastructure for desired forms of active transportation, biking and walking can become a competitive and valid alternative to cars and can be integrated into a city’s network of transportation. The concept of intermodality, or the linking of various means of transportation to encourage multiple modes of transport used in one trip, can make travel more efficient and attractive, and is thus sought after by government planning groups. For example, in the published government document titled, the *White Paper 2011*, the European Union highlights intermodality as a key feature in its plan to achieve an efficient, wide-spread transportation system (Intermodality: Bus and Train..., n.d.). Another advantage of intermodality involving non-motorized and motorized public transportation is its economic benefits for the systems’ users since taking multiple bus lines routinely can get expensive (Shinkle & Teigen, 2008).

There are many strategies, often referred to as “last-mile solutions”, that aim to make different transportation options conveniently accessible to those whose destination is farther than a mile walk from the nearest public transit stop (“Richmond First Mile/Last Mile...”, 2017). Many such solutions commonly implemented in cities involve bike use. One example strategy is simply connecting the networks of desired transportation methods. This could include, for example, linking the bus and bike infrastructure in a city by positioning well-marked bikes lanes, parking areas, and bike stations close to major bus routes and terminals (“Bikeways and Intermodality...”, 2013). Some companies, such as Brompton and Dahon, market bikes known as folding bicycles, that can collapse down to a more compact size. Further promoting intermodality, these models allow for bikes to be easily stored in buses, on other modes of transportation, and at most office or work settings (Hon, 2015).

2.5 Promotion of Biking

There are many ways to promote urban cycling and further develop a sustainable bike culture. In addition to government advocacy regarding the implementation of cycling infrastructure and legislation, there are many varieties of initiatives implemented in cities as strategies to promote this sustainable mode of transportation. Such initiatives include promotional and educational events, bike share programs, and route planning resources (Savan et al., 2017).

One common type of program is bike education within schools, which teaches children about bike equipment, maintenance, how to ride, and how to safely navigate traffic (City of Berkeley Transportation, n.d.). Some schools have begun to integrate bicycle training and safety into their physical education curricula. For example, the Winston Salem/Forsyth county schools of North Carolina have implemented a Bike Smarts course consisting of in-class and on-bike teachings that have been found to increase student confidence when riding in a public setting (Wallace & Sutton, 2015). By teaching this to students, biking can be perceived as commonplace and can be practiced more safely (City of Berkeley Transportation, n.d.).

Bike sharing, the shared use of a bicycle fleet, is another common form of bicycle promotion offering bikes as a means of public transportation. Often for a small fee or deposit, people can rent bikes from stations placed throughout a city or region. Thus, affordability and accessibility are two key features of bike shares. For example, *Ofo*, a station-less bike share that has achieved great success in many cities such as Beijing, China, disperses GPS-equipped bikes throughout cities for people to easily access and ride for only \$1 per hour (Pan, 2017). “The establishment of bike share programs has prominently enabled cities to demonstrate their commitment to addressing climate change, population health issues, traffic congestion, oil dependence and livability...” (Fishman et al., 2013, p. 150). In 2010, there were about 100 bike shares in 125 cities, with over 139,000 bikes (Shaheen et al., 2010). One of the largest bike share programs to date, *Vélib'*, has operated in Paris, France since 2007. According to a survey gauging public opinion, 95 percent of Paris locals believed the program helps to convey a more positive image of the city (Tironi, 2015).

To endorse the switch from automotive modes of transportation to greener options such as cycling, many cities have blocked off streets to cars to allow for ample biking and walking space (Stanley, 2015). Bogotá, Colombia, for instance has initiated a program called *Ciclovía*, for which the government closes down 121 kilometers of active roadways for seven hours on Sundays and holidays (Cervero et al., 2009). With this program, in accompaniment with other bike-promoting initiatives, the city has seen an increase in cycling, with the average overall commute time decreasing by 34 percent and the number of total traffic fatalities falling by 88 percent (Andersen & Hall, n.d.).

Another way to promote cycling is through spreading awareness of the resources and opportunities available to cyclists. Bike programs often advertise through newspapers, radio, and television to not only directly promote biking, but also inform people of possible events. An additional method for spreading awareness of local biking resources is through the



Figure 4: Portion of Denver Bike Map
 (“Bicycling in Denver...”, 2017)

distribution of electronic or print cycling maps. These maps usually display features such as bicycle facilities, connectivity of the street network, topography, and physical barriers. Highlighting these map elements can help a user to travel through a city safely and efficiently (Greenstein, 2015). The city of Denver's bike map, for example, provides locations of various bike lanes, bike share stations, bike shops, and other transportation stations as shown in Figure 4 ("Bicycling in Denver...", 2017).

2.6 Key Demographics that Influence the Popularity of Biking

There are several demographics, such as women, children, and students, that play an influential role on the popularity of biking within a community. For instance, in all Latin American cities, women make up 40 percent or less of the cyclist population. Some cities such as Medellín have a female contribution of only five percent. This lack of female participation could be a result of societal expectations or fear of harassment (Tello et al., 2016). Women's participation in cycling, especially a mother's, however, is very important and can have lasting effects on a community due to their influence on their children. Mothers often provide a child with its first emotional relationship while establishing trust and safety (Raja, 2017). Additionally, children tend to learn from the teachings and examples set by their mothers ("A Powerful Connection...", 2011).

Children, also play a key role in a community's bicycle use. As children develop hobbies, they acquire physical, social, educational, and moral skills that are fine-tuned with growth (Loh, n.d.). Adults can draw upon the abilities learned through adolescent hobbies, which supports the notion that teaching common skills to children can ingrain habits that influence their lifestyles in later years ("Importance of Hobbies...", n.d.).

Another important demographic regarding community cycling is students. For the majority of schools in the United States, however, only 10 percent of students bike to class according to a 2014 study conducted by the Centers for Disease Control and Prevention's School Health Policies. This figure rises on average to 26 percent among schools with crossing guards, bike racks and other promotional materials (Jones, 2016). Many college campuses provide a bike-encouraging environment due to their localized points of interest consisting of educational and recreational facilities. In addition to this, college students are often burdened with debt and loans that make cheap transportation such as bicycles more appealing. Safety concerns do however, arise even within university campuses as a result of the diversity of transportation, consisting of bikers, walkers, and drivers ("Pedestrian and Bicycle...", n.d.).

Universities have employed a variety of strategies to overcome some of the drawbacks that deter students from cycling. For example, Table 1 displays a set of infrastructure-related barriers and ways universities can solve them. Ultimately, an open line of communication between the university and its students to spread awareness of bike-promoting programs, is pivotal in overcoming these barriers (Acton et al., 2015). In many cases, university bike shares are popular and in high demand among students. The bike share at Princeton University, for example, grew from 140 to 300 members upon improvement of its facilities including the addition of 60 new bikes (Kelly, 2016).

Table 1. Infrastructure related barriers with possible solutions (Acton et al., 2015).

| Barriers | Solutions |
|---|--|
| Lack of cycle lanes and lack of connectivity/consistency | Cycle network - more well-connected cycle lanes, clearer cycle paths that are well signposted, away from main roads, and more lanes off major roadways (Meadows good example). |
| Busy roads and traffic. [Tram lines] | Increased awareness of current infrastructure. The Council is working to improve roads and cycle paths (in terms of quality, visibility, accessibility, connectivity and quantity) with their Active Travel Plan. |
| Cycle lanes and paths not well signposted | Improve signage in optimum areas and consider dynamic information such as journey times. |
| Perception that the city is designed for cars rather than bicycles | Give cyclists more priority on roads over cars and increase responsibility of cars compared to cyclists. Change on-road parking so that it doesn't interfere with cycle lanes. |
| Poor road conditions (Potholes and lack of dropped kerbs) | Council should improve road quality with cyclists in mind. |
| Confusing junctions | Implement a traffic light system for cyclists similar to that in Amsterdam. |
| Poor lighting on certain routes (e.g. Sighthill) | Improve lighting (e.g. along the canal) |
| Lack of adequate storage and secure parking (in city and some key areas on campus, links to bike theft) | More information on where they are. Council could designate more space to put safe cycle parking facilities in. Universities should offer these facilities on campus. (More bicycle accessories e.g. pumps by storage). Investment needed. |
| Lack of facilities and getting sweaty e.g. Lockers, showers, drying racks etc. | Awareness of existing. Provide more according to demand. |
| Lack of current information on good access points | Universities could share data on access points so that students and organisations are more aware – with the potential to create maps. |
| Cycling may only be part of a journey | In the United States almost all buses have bike racks on the front of them, allowing people to take the bus in combination with cycling to. [Not enough was known about restrictions of attaching racks to buses, so viability need further analysis.] |
| Cannot cycle after drinking alcohol | In Copenhagen taxis have bike racks for people on nights out. |

2.7 Cycling in Cuenca, Ecuador

Cuenca currently has about 38 kilometers of bikeways. However, 25 kilometers of these are recreational paths, leaving only 13 kilometers designed for transportation use (“Ciclistas Corren Riesgo”, 2016). Much of the negative opinion on public biking in the city stems from a lack of safety. Some bikers complain that drivers do not respect nor pay attention to cyclists on the road (“Ciclistas Claman Respeto...”, 2017). Furthermore, a study from the Lacta Labs at the University of Cuenca found that local bikers would feel safer if the city’s bikeways were wider, continuous, and better confined (Hermida et al., 2016).

Hermida et al suggests the city’s biggest issues are traffic jams and pollution. Between 1992 and 2012, the percentage of Cuenca’s total population using cars and taxis as their primary mode of transport increased by 23 percent, while the percentage using public bus transport decreased by 18 percent (Sander et al., 2015). Figure 5 displays the rise in motorized transportation use in Cuenca. This, combined with a rising population, has led to more congestion, especially in the streets of the city’s historic center (“The Population Development...”, 2017).

In response to traffic and safety issues, the government transportation division in Cuenca, EMOV EP, has initiated a plan of mobility to promote non-motorized transport. The vision of the plan is to introduce multimodal transport into the city's basic transportation network in order to reduce routes that are specifically dominated by motorized traffic ("La Visión Clásica...", 2015). One of the approaches highlighted in the plan is the installation of a public bike share system. In order to promote intermodality, the locations of the bike share stations have been designed to span the city and connect with many of the bus stations, as well as the future stops of the Tranvía, the city's new light rail. The bike share system would also provide citizens with free access to this form of non-motorized transport in hopes to serve as a basis for the reduction of traffic seen on major roadways in the city.

In an effort to gather support and encourage this transition to non-motorized transport, EMOV EP offers educational and recreational programs that increase awareness of cycling and enable citizens to feel more comfortable cycling in a city setting. En Bici Por El Centro, a bike

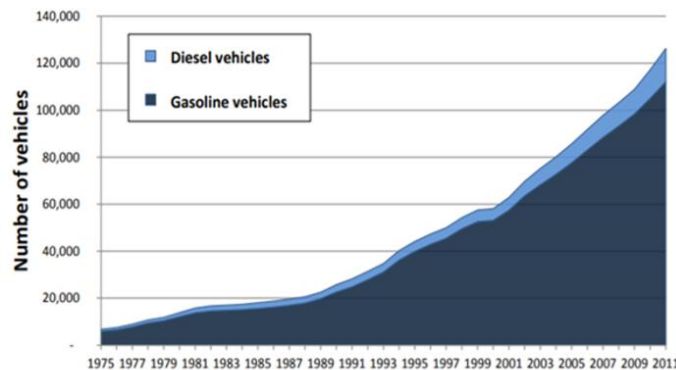


Figure 5: Demonstration of Increased Quantity of Registered Motorized Traffic in Cuenca (Sander et al., 2015)

loan program, is one of the initiatives that encourages alternative transportation within the city's historic center. The bike loan has two stations offering free bike rentals to the public for a maximum duration of two hours on Fridays and Saturdays. Each bike station is equipped with 15 bicycles for loaning (V. Hormazabal, Video Interview, 11/14/2017). This program acts as a preliminary step in a plan to increase support for a future large-scale bike share system.

Though there are hurdles to overcome, the demand for biking in Cuenca is evident. According to a local survey, 58 percent of the respondents claim

willingness to stop driving and 32 percent declare biking as their ideal mode of transportation ("Ciclistas Corren Riesgo", 2016). Thus, with a better understanding of the appropriate strategies for popularizing the current state of biking, EMOV EP can work toward a system with the potential to improve the efficiency of transportation in Cuenca.

3 Plan for Creating Resources to Promote Cycling

Given this emergent demand, a careful consideration of Cuenca's current bike culture and the desires of its people can aid the city in widely adopting cycling as a form of transportation. The goal of this project is thus to provide EMOV EP with resources to further promote cycling in Cuenca. To accomplish this, we achieved the following objectives:

1. Assess the current framework of biking resources, programs, and bikeways in the city
2. Determine a target audience
3. Investigate the most significant cycling barriers to tailor incentives for promoting biking within the target audience

4. Plan and develop resources that EMOV EP can use to assist the target audience in overcoming these barriers

3.1 Assessing the Current Framework of Biking Infrastructure and Services

The purpose of this objective was to familiarize ourselves with the current programs and infrastructure that affect Cuenca's bike culture. This includes mapping the city's bike infrastructure, interviewing bike shops, and reviewing some of EMOV EP's cycling programs. An outline of the interview questions and descriptions of the cycling programs can be found in Appendix A1 and Appendix B respectively. By gaining an understanding of the physical aspects of cycling within the city, we were able to further contextualize and better comprehend our findings from a point of view specific to the project site.

3.2 Determining a Target Audience

To acquire detailed information from a population that is realistic for the allotted time frame of our project, we focused our studies on a specific demographic of people in Cuenca. In order to determine this target audience, we conducted a series of semi-structured expert interviews. We interviewed Maria Veronica Hormazabal Andrade, a representative of EMOV EP, Dr. Daniel Orellana, a geographical and environmental scientist working in the Lacta Lab of the University of Cuenca, and Alexandra Velasco who works with sustainable, urban development for *Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH* (GIZ). These interviews provided insight of informed opinions and cultural tendencies in a context specific to cycling in the city. As a result of these interviews, we affirmed that focusing primarily on university students would provide the most opportunity for promoting cycling. An outline of each interview with topics and summarized responses is shown in Appendix C.

3.3 Investigation of Cycling Barriers for University Students

After determining our target audience, we conducted surveys to assess the student perception of cycling in the city, including students from both the University of Cuenca and the University of Azuay in our sample. In the surveys, we asked students to disclose their daily routes and modes of transportation to and from campus, to describe their perception of cycling in Cuenca, and to explain their reasoning for choosing to use or not use a bicycle. A flow diagram of the survey questions can be seen in Appendix D. Following a similar format as the surveys, as can be seen in Appendix E1, we conducted 15 semi-structured interviews with students to gather more concrete and in-depth responses surrounding their perceptions of cycling and their thoughts regarding possible solutions to predominant cycling barriers. Additionally, we observed the bike infrastructure present at the university campuses. Photos and maps from these observations can be seen in Appendix F.

These observations and interactions with university students helped us to determine three major barriers to focus on with our bike-promoting resources: concern for safety, lack of access to bicycles, and culture and mentality.

3.4 Developing Resources for EMOV EP to Overcome the Known Barriers

To provide a resource that could eventually allow students to overcome the found barriers, we created a cyclist map of safe bike routes, primarily tailored to university students. Using data collected from the student interviews and surveys we mapped out routes commonly traveled by students as well as common neighborhoods and other points of interest. We later biked along these routes, taking notes and photos as we determined areas of safety concern and approximate travel times. Examples of these photos can be found in Appendix G. After biking the routes with university students and eliciting feedback, we finalized a set of recommended routes for students to use. We later demonstrated our findings and deliverables to our sponsors to receive further suggestions and feedback to make final adjustments.

4 Findings and Development of a Cycling Map

To accomplish our goal of creating useful resources for EMOV EP, we first need to understand the cycling tendencies of the city and narrow our scope to a target demographic. Corporate workers and students are the two largest groups of current bike commuters in Cuenca, where students make up approximately 30 percent of the total commuting population (D. Orellana, personal communication, January 29, 2018). Though our project coordinator expressed the societal

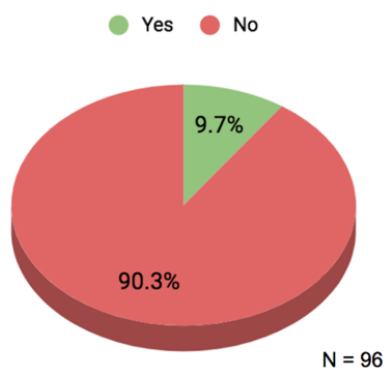


Figure 6: University Student Survey:
Do you use a bicycle to ride to the university?

importance of promoting cycling to women, children and tourists, she suggested we focus on college students, a demographic underrepresented by their current programs (M. Hormazabal, personal communication, February 5, 2018). To further justify focusing on college students as our target audience, Dr. Orellana informed us of an impending public bus fare increase of about five additional cents per ride (D. Orellana, personal communication, January 29, 2018). This alongside the alleged claim that many students in Cuenca are struggling financially, supports the idea of a likely demand for cheaper transportation, such as cycling, among this demographic. Figure 6 shows that only 9.7 percent of the student population we surveyed claim to ride a bike to school. Additionally, many of the bike racks observed at college campuses, had unoccupied space leading us to believe there is room for growth in ridership among university students. After conducting field work specifically targeting university students, we determined three prominent cycling barriers to focus on: safety concern, lack of accessibility, and mentality and culture.

4.1 Determining Safety Concern as a Barrier

As a part of our program review, we biked around the city center for a personal experience with the bike share, En Bici Por El Centro. Pictures, along with descriptions and observations, of the program can be seen in Appendix B1. From this experience, we unanimously discerned that the city center is not conducive to cycling due to traffic congestion and negligence of drivers. We felt a lack of comfort whether we were biking on the street or the sidewalk. In addition, the streets

are too narrow to provide ample space for both moving and parked vehicles as well as cyclists. Similarly, from the survey administered to current bike share users, seen in Appendix B3, we found that a lack of respect from drivers is the biggest issue with cycling in the city center. For these same reasons, Ms. Velasco expressed that reducing the motorized traffic in the historic center is the best way to enhance biker safety (A. Velasco, personal communication, February 5, 2018). Thus, with current levels of traffic, driving habits and lack of biking infrastructure, the city's historic center is unsafe for cycling.

According our interviews with local bike shop staff, 10 of the 14 workers feel that the biggest problem for cyclists in the city is a lack of respect from drivers. Additionally, four out of six interviewed university students, felt danger was the major deterrent preventing them from biking in the city. This recognition of a lack of safety for cyclists aligns with the findings of Dr. Orellana's transportation study, which affirms that the two greatest cycling barriers in Cuenca are lack of respect from drivers and dangerous intersections. Use of bike lanes, which provide a barrier from other traffic, is one way to overcome this lack of safety.

As can be seen in Figure 7, which shows the layout and respective photographs of the Cuenca's bikeways, all the city's bike lanes are situated outside of the city center below or along the Tomebamba River. For a more detailed list of street names see Appendix H. Additionally, the images demonstrate that the barriers provided by the city's bikeways vary greatly from one to the next. For example, most bikeways, are entirely separated from the sidewalk and street whereas the bike path in image 10 lies directly on a walkway. Also, some bikeways, labeled 1, 2, 3, 5 and 6, are painted red to visually separate the lane from the rest of the street while others, 9 and 11, are not painted. Thus, the use of bikeways providing the most obvious separation from lanes utilized by other forms of transportation should be favored and recommended to cyclists. Also apparent in Figure 7, many of the bikeways, such as lanes labeled 1 and 9, are not connected nor joined to other bike lanes which could hinder safe transportation. Well-linked bikeways can provide an added level of safety when turning from one street to another and should thus, be emphasized for safe bike travel.

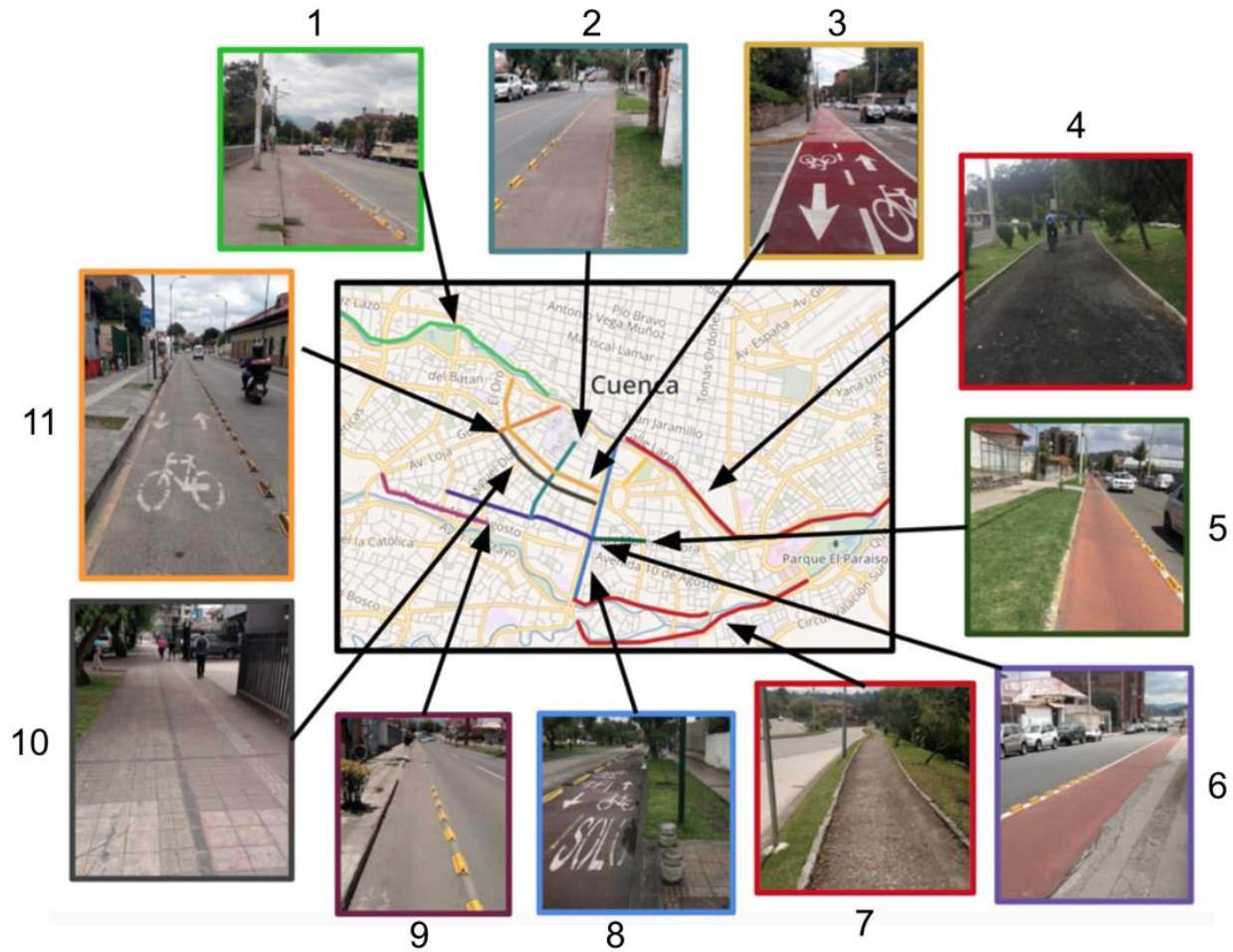


Figure 7: Map of Bike Lanes in Cuenca with Photographs of the Streets

4.2 Determining Lack of Accessibility as a Barrier

Safety, however, was not the only barrier that repeatedly surfaced from the collected data. As displayed in Figure 8, of the 84 university students we surveyed who do not ride a bike to school, 31 claimed it was because they do not own one, making this the most common response. The lack of bicycle ownership among students demonstrates that there is either a scarcity of available resources or an inability to afford bikes among students.

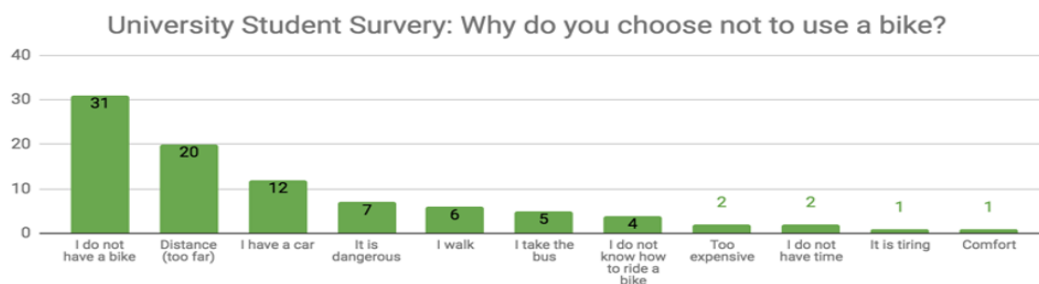


Figure 8: Responses for Why Students Choose Not to Use a Bicycle

As we inquired about the services provided by local bike shops, we found that all 13 locations sell and fix bicycles. As displayed in Figure 9, however, only two shops additionally offer rental services to clients. The rentals are intended for recreational use, including mountain biking and touring popular attractions on the city's outskirts. From this, we gathered that there are limited resources for renting bikes in Cuenca and that of the resources available, most are recreational, further supporting the notion that biking is viewed and practiced more as a hobby than as a mode of transportation. The summarized responses from the interviews are tabulated in Appendix A2.

Though EMOV EP provides a free bike loan service, the fact that it only operates on Fridays and Saturdays, makes using this program as a regular form of transportation difficult. Thus, Cuenca has few rental services that encourage cycling for transportation meaning there are minimal resources that offer students who are unwilling or financially unable to buy a bike, a chance to use this form of transport.

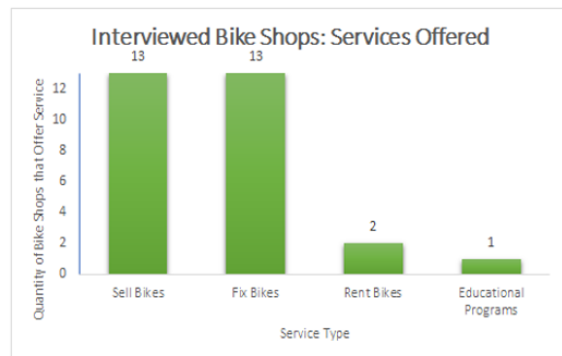
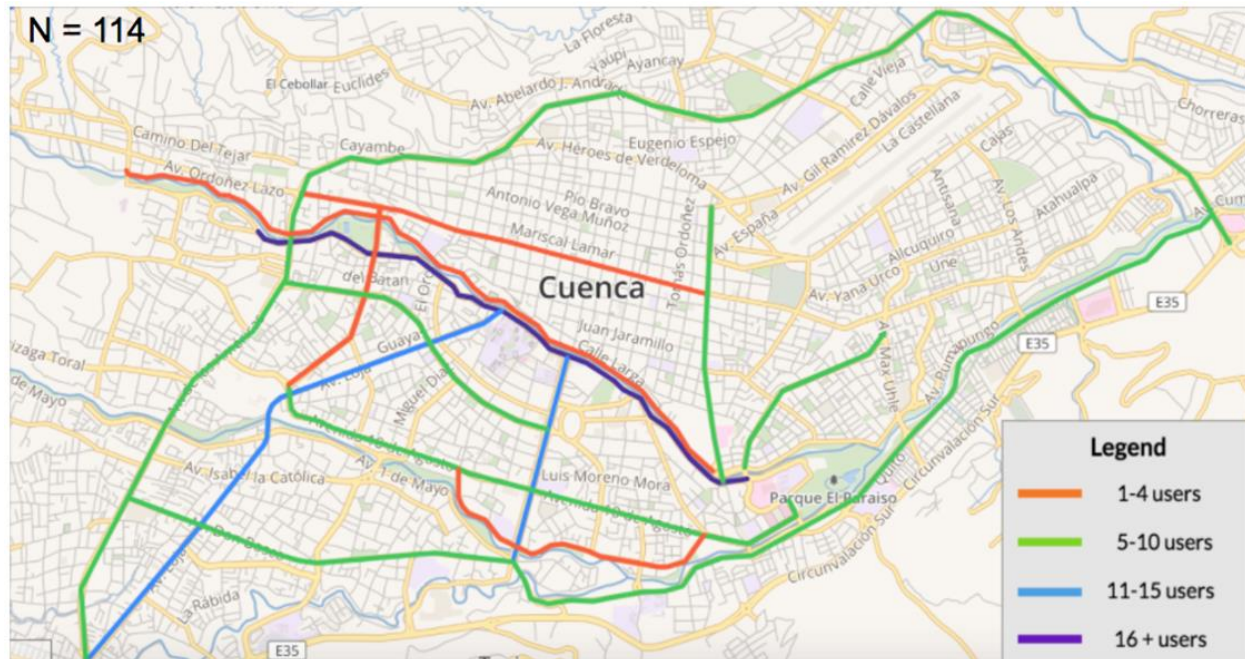


Figure 9: Services Offered at 13 Interviewed Bike Shops

4.3 Determining Mentality and Culture as a Barrier

Although a lack of accessibility is a major hindrance to student ridership, we learned from a variety of conversations and interviews that much of the reluctance to accept cycling as a form of transportation in Cuenca likely stems from culture and mentality. As previously mentioned, in Cuenca the practice of cycling is viewed more as a hobby for sport or recreation than it is a mode of transportation. Ms. Velasco informed us that with Cuenca's new bikeways and close-knit layout, the major barrier the city needs to overcome is a lack of cultural acceptance of adopting alternative transportation (A. Velasco, personal communication, February 5, 2018). Additionally, during our student interviews, we noted that many students felt that the city's issues with cycling stem from the lack of a prominent bike culture, which includes habit of choosing other forms of transportation and an overall lack of respect for biking. The summarized responses from the student interviews are tabulated in Appendix E2.

As shown in Figure 8, after lack of bike ownership, the second most frequent survey response as to why students do not use a bike is that travel distance is too long. Using student survey and interview responses, we created a map that depicts the frequently traveled routes among both bikers and non-bikers as seen in Figure 10.



This figure highlights that many of the streets on which people choose not to bike, already experience cycling traffic. The map proves that cycling on these streets is a possibility. This compiled map also reveals that streets, such as Av. de Las Américas which is situated on Cuenca's northwestern border, is used by both bikers and non-bikers. This proves that the perception of a far distance to commute by bicycle is subjective and depends on the student. The fact that non-bikers commute on many of the same streets as bikers further supports the idea that the distance barrier may be influenced by the culture and tendency to favor other forms of transportation.

Through further inquiry into the barrier of distance, the results from our surveys support the notion that a person's understanding of distance is often skewed. Three students stated that the distance between the university and their home is too large to use a bike as their main form of transportation to school. However, they claimed to be willing to bike a maximum distance of 3, 10, and 19 kilometers respectively to get to the university. After calculating a rough estimate of the distance from their homes to their campus, we found that in two of the three cases, the distance they travel is less than the maximum distance they claim willingness to ride. These results affirm that mentality and misconceptions of distance among students act as an obstacle to the growth of cycling in the city. For the maps created from these responses and other general responses from this survey, see Appendix D4.

4.4 Development of an Effective Cycling Map

We created a cycling map specifically tailored to the demands of student tendencies and desires. Though we focused our data collection on university students, we avoided producing a map entirely exclusive to student use, aiming for enough versatility to be used by other demographics as well. Results from our student-specific surveys and interviews generally agreed with the information supplied from our initial observations and expert interviews encompassing Cuenca's general population. This leads us to believe that a focus on overcoming student cycling barriers, will result in a versatile final product.

To determine what elements to include in the cyclist map, we took advice and suggestions from our sponsors and other interviewed experts as well as findings from our surveys and research. Though the primary focus of the map is to highlight safe routes for biking in Cuenca, we incorporated a variety of other helpful features. These features include key points of interest throughout the city, common neighborhoods, current bikeways, bike shops, and parking facilities.

Based on the student surveys, we created a map of commonly frequented routes and destinations, shown in Figure 11. The most commonly mentioned areas included the city's historic center, parks, and avenues with many restaurants and shops. The areas we chose to include in our network of recommended routes are the three most frequent responses: Parque Calderon, Parque El Paraíso, and Av. Remigio Crespo Toral. In addition to these locations, we included the five University of Cuenca campuses as well as the University of Azuay campus to further incorporate and promote bike use among students looking to travel to or from campus.



Figure 11: Points of Interest of University Students

From asking students in our survey for a point of reference close to their neighborhoods, we also mapped general areas of residency as shown in Figure 12. From this map we noted that the three reference points with the highest density of students were Av. Don Bosco, sector Totoracocha, and Parque El Paraíso. Considering Dr. Orellana and several of the university students from our interviews felt there would be a great interest in leaving campus to go home by bike, we decided to tailor the network of recommended routes to include some of these areas.



Figure 12: Indication of general locations of where surveyed students live, denoted by blue markers. Areas emphasized in red show the densest regions

Our principal conclusions from our observational bike rides are that the city center is more dangerous for biking, intersections and rotaries lack safety and are difficult to navigate, and protected bike lanes are the safest options. With these factors in mind, we modified our map to follow the safest possible roads on bike paths and highlighted dangerous intersections. This modified map was used for bike-riding with university students to gain insight on their perceptions of biking in the city and any other suggestions for our routes. During focus group sessions which followed the bike rides, students first advised us to remove the streets that they considered too dangerous due to high traffic. They suggested alternate streets that, in their opinion, are safer. Refer to Appendix I2 for summarized responses from the focus groups. From their proposals, we were able to further refine our map of recommended routes. To view the progression of our maps resulting from the bike rides with students, see Appendix J. After riding with representatives of EMOV EP, we finalized the network of routes based on their final suggestions.

The final map of recommended routes is displayed in Figure 13. As can be seen in the figure legend, the map includes bike repair shops, parking facilities, and one-way streets. The various colored routes signify the level of safety and the type of bike path. For example, the green routes indicate the streets that we determined to be the safest for cyclists. Also, there are only two red points on the map that indicate the presence of dangerous intersections and rotaries. Finally, the black routes mark streets with current bike paths and the purple routes mark recreational paths for cyclists.

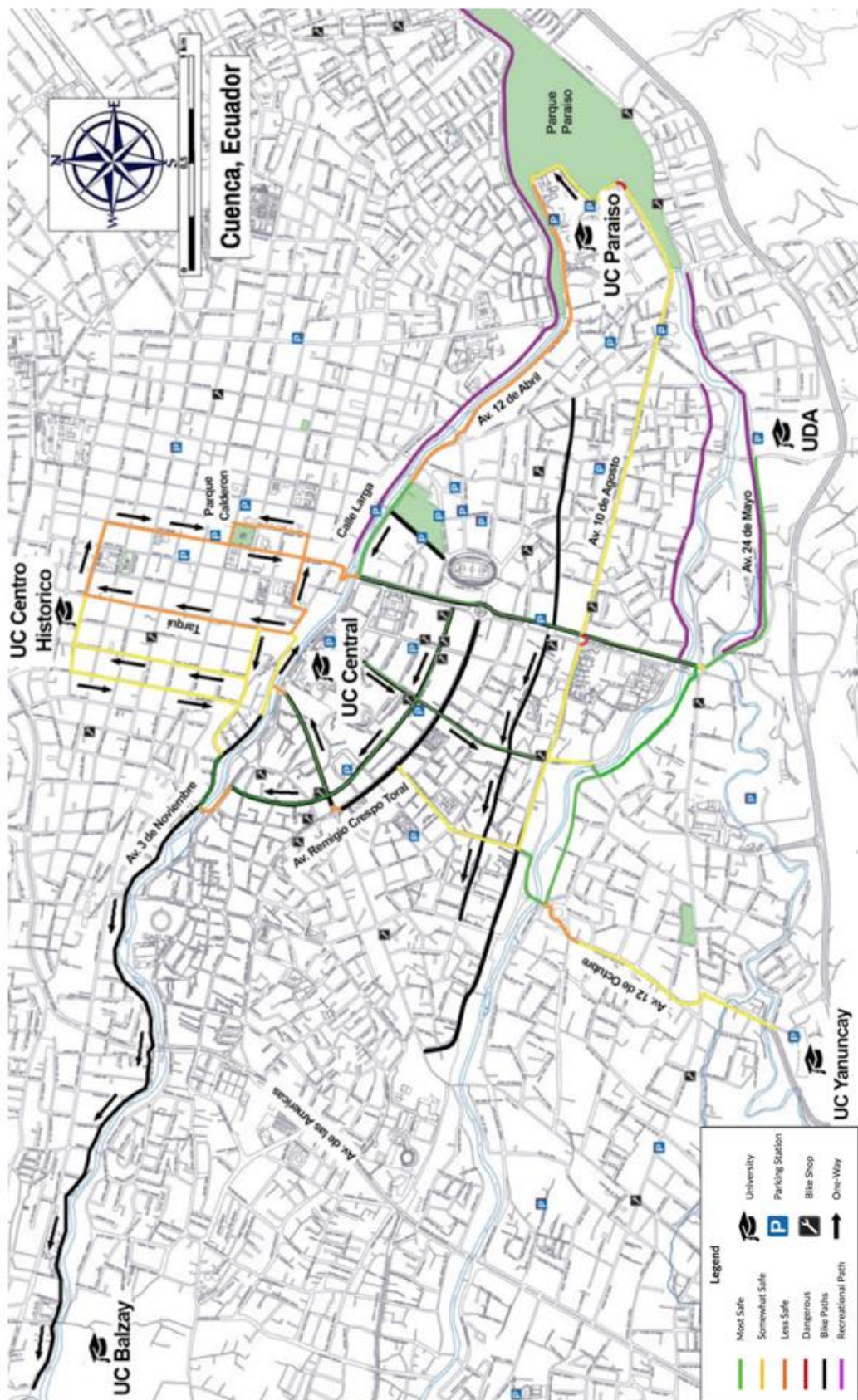


Figure 13: Final Guided Cycling Map

To supplement the map of safe routes with other features to promote cycling among students, we incorporated the map into a biking guide. The panels of the biking guide are shown in Figure 14 and the various components of the guide are labeled. The component labeled A depicts and describes a few of the points of interest for students as determined by our student surveys. All of these attractions are accessible using the recommended network of routes on the guided map. The component labeled B shows a map of bike racks present on the central campus of the University of Cuenca. We incorporated this feature to assist people in finding places to park bikes on campus. The component labeled C displays the approximate time durations for biking from one university campus to another. The guide includes this feature to increase awareness of biking times to overcome barriers related to a perception that bike routes are too long. Because students suggested during our bike ride group discussions that an electronic map would be more useful to them, we incorporated the component labeled D, a QR code that students can scan with a phone application to acquire an electronic version of the map. The component labeled E depicts the various types of bike paths present in the city and the component labeled F serves as a written warning to take caution at the rotaries labeled in red on the map.

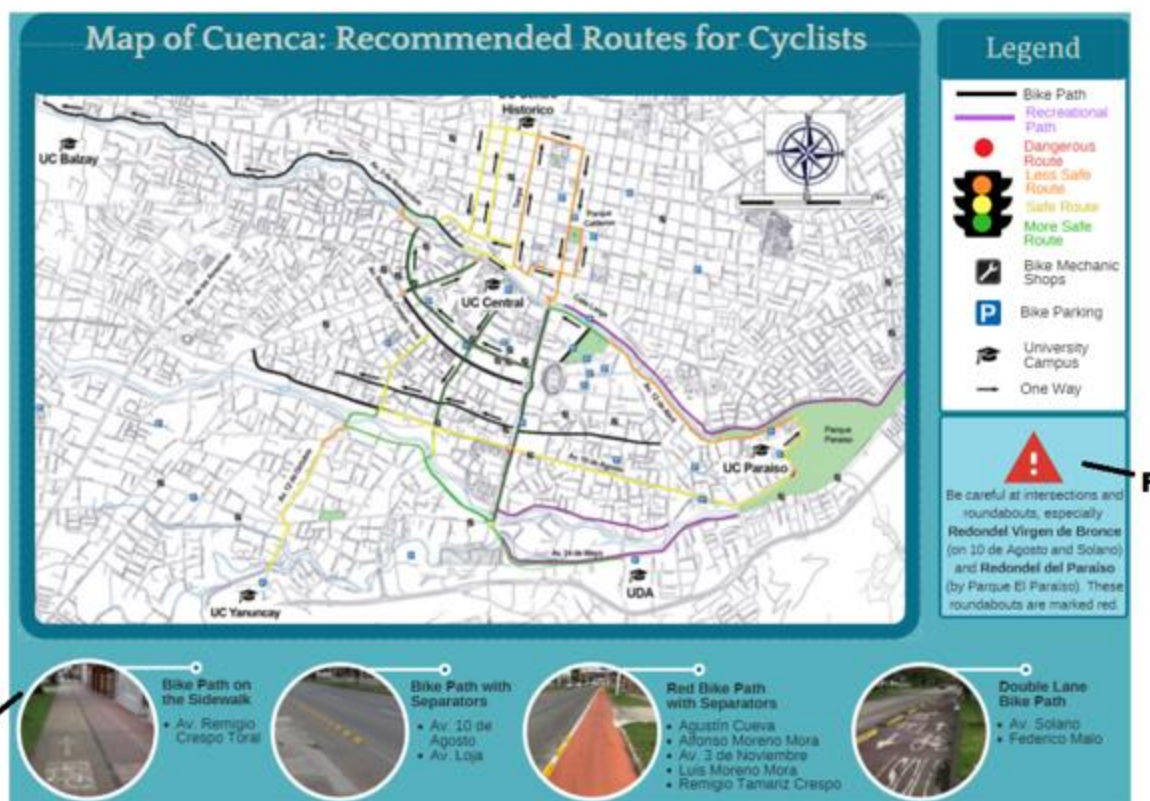


Figure 14: Panels of Our Biking Guide

5 Conclusions and Recommendations

Through our personal experiences as well as our conversations with locals, we have learned that though the presence of cycling has grown with the implementation of new bikeways, the streets of Cuenca are principally dominated by other means of transportation. Our observations of mostly unoccupied campus bike racks, as well as the low percentage of surveyed students who bike to school, show us that students, though contributing more to the city's cycling than many other demographics, have room for increased ridership. To encourage cycling among students we determined that lack of safety is a key barrier to overcome. The lack of road space and respect from drivers, especially in the city's historic center, have contributed to the safety barrier. A lack of bike ownership is one of the most prominent reasons for opting not to bike to school. This, in conjunction with a noticeable absence of bike rental services offered regularly in the city, has led us to determine a lack of accessibility as another significant barrier. Cultural tendency to favor motorized transportation, is prevalent in Cuenca. We found that deterrents related to distance commonly lacked a concrete basis, serving more as issues of perception and mentality because many of the routes taken to school by non-cyclists are also traveled by bikers.

As a way to overcome these barriers, we decided to focus on creating a guided cycling map of recommended bike routes in Cuenca, as shown in Figure 13. Our routes are displayed in the form of a network reaching to various residential areas as well as other points of interest such as parks and college campuses. The network of recommended routes was adjusted based on feedback from students and representatives of EMOV EP that rode along some of the routes. To address the barrier of safety concern, we included calm, less trafficked roads in the established network and color-coded the streets to highlight various levels of safety and the presence of bike lanes. To promote accessibility to cycling resources, we included the locations for local bike maintenance shops and parking facilities. To overcome the issue of mentality regarding the misinformed perception of travel times, we included average times for riding to various points of interest by bike.

Considering the enthusiasm of many students to aid in the development of the cycling map by riding along some of the recommended routes, there is an evident interest in the project outcome, showing potential for the successful delivery of our guided map. The map can be used as a promoting resource displayed in EMOV EP's bike manual. Additionally, EMOV EP personnel can hand out the guided map in person during bike programs, especially providing it as a persuading resource at current and future bike share stations. In addition to the distribution of the guided map and encouraging the use of the included routes, we recommend the following short-term and long-term approaches to further popularize biking, based on our findings:

- **EMOV EP should add a bike share station close to the University of Cuenca's central campus.** We have found that one of the biggest reasons that university students do not bike is due to a lack of accessibility to bikes. By having a bike share station at this centralized campus with a large student body, students could take bikes to and from their homes, university campuses, and other popular places in the city. Using our guided map, as explained above, students will be able to safely navigate to many of these places.

In addition, we recommend that EMOV EP operate the station during the hours of lunch on weekdays. From our research, we found that many students either go home or into the city for lunch. Having the program open during these hours will allow students to use a bike to leave for lunch before returning it as they arrive back to class. If EMOV EP finds

a bike share program at the school to be effective, they should consider expanding to new locations and campuses.

- ***In the future, EMOV EP should limit car traffic in the city's center.*** The city's center is a dangerous environment for cyclists due to the quantity of cars and the speed at which they travel. In addition, there is little room to construct bike paths because the streets are narrow. If EMOV EP wants to encourage biking in the center, they should consider some strategies to reduce automobile traffic, some of which we learned through our interview with Ms. Velasco. Potential strategies include closing off some streets to only non-motorized transportation, taxing private vehicles entering El Centro, or selecting cars based on license plate number that are allowed to enter the city center on certain days. By giving cyclists the chance to ride in the city center without the congestion caused by traffic, they can become more comfortable to take up biking as a regular form of transportation over time.
- ***In the future, EMOV EP should connect all the bike paths in the city.*** In order to provide the safest and most comfortable experience for bikers, biking should be thought of as its own form of travel and should be allotted lanes separate from those designated to pedestrians and motorized vehicles. Crossing streets to get from one bike path to another can be dangerous especially in areas of high traffic. To counter this, all the bike paths in the city should connect to create a safe cycling network.

Through the distribution of our guided cyclist map and adherence to these future recommendations, we believe that Cuenca will experience an increase in cycling among university students because our deliverables and suggestions were tailored to address the three major biking barriers among students: concern for safety, lack of accessibility, and mentality. An increase in student ridership would pave the way for future generations, serving as a model for overcoming a cultural barrier that exists in Cuenca. As the people of Cuenca grow to further accept cycling as a regular form of transportation, the city can begin to see a decrease in traffic congestion and automotive emissions, while encouraging healthy, active transport in the city. With this, EMOV EP will come closer to achieving its goal of popularizing cycling such as to completely integrate it into an intermodal transportation network for the city.

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Appendix A1: Outline of Bike Shop Interviews

Interview for Bike Shops

These questions were translated to English from Spanish, as most of the bike shop interviews were conducted in Spanish

1. What services does this store offer?

If the store offers bike rentals ...

- i. Where do clients typically go with the bikes?
 - ii. Do you offer suggested routes for the bikers who rent from you?
2. What is your opinion on bike culture and perception of cycling in the city?
3. Do students frequent the store?
4. According to the store worker, what are the biggest problems with cycling in the city?

Appendix A2: Table of Responses from Bike Shop Interviews

| Recorded Responses from Interviews with Bike Shop Workers | | | | | |
|--|--|---|--|--|--|
| Bike Shop Name | BASE Extreme | Bici Tienda | Bike Monkey | Bike Tour | Ciclorutas |
| What services does the store offer? | Sells bikes Fixes bikes | Sells bikes Fixes bikes Bike school | Sells bikes Fixes bikes | Sells bikes Fixes bikes | Sells bikes Fixes bikes Rents bikes |
| If the shop offers rentals, where do clients go with the bikes? and do they offer suggested routes for the bikers? | Not Applicable | Not Applicable | Not Applicable | Not Applicable | Users mostly go to mountains with the rented bikes; suggests mountain routes to his users. |
| What is the store worker's opinion on bike culture and perception of cycling in the city? | Enjoys biking a lot and would like to see it grow and expand in the city; feels that currently people use it mostly for sport and that only around 30% of the city's bicycle use is for transportation | Feels as though cycling is not very popular or widely practiced; estimates that only 2% of the people in Cuenca ride a bike | Feels biking in the city is still in the process and is growing | Feels it is a good mode of transportation and sport; feels the city's perception is negative as there is not much respect for it | Feels there is not much of a good bike culture and that generally, people are rude to cyclists; feels there is a lack of respect from cars |
| Do students frequent the store? | The store gets all types of customers and cannot affirm for sure that they receive many students | Estimates that only about 4% of his client base is students | The store receives some students as clients | Does not receive many students as clients | Does not receive many students as clients |
| Is the store worker a cyclist? What does he/she bike for? | Bikes for sport, though not competitively; hopes to bike for transportation in the future. | Bikes for recreation on the weekends; doesn't bike for transportation because only has enough time on the weekends to bike | Bikes for transportation a bit but mostly rides a bike for competition and sport | Bikes for recreation and transportation | Participates in all forms of cycling including competition |
| According to the store worker, what are the biggest problems with cycling in the city? | There is a lack of space and respect for cyclists in the city. Some streets are too narrow and do not provide enough space | The relationship with and treatment from the city's drivers | The traffic in the city can make cycling dangerous | Bike routes are only adequate on major roads; bike paths are not being constructed on smaller streets | Bikeways should be better connected and people should be better educated about cycling |
| Other Notes | No additional notes | No additional notes | No additional notes | No additional notes | No additional notes |

Appendix A2 (cont.): Table of Responses from Bike Shop Interviews

| Recorded Responses from Interviews with Bike Shop Workers | | | | | |
|--|---|--|---|---|--|
| Bike Shop Name | Cikla | CUBE | Life Bike | Los Angeles | MTB |
| What services does the store offer? | Sells bikes Fixes bikes | Sells bikes Fixes bikes Rents bikes | Sells bikes, Fixes bikes | Sells bikes Fixes bikes | Sells bikes Fixes bikes |
| If the shop offers rentals, where do clients go with the bikes? and do they offer suggested routes for the bikers? | Not Applicable | Users mostly go to Turi with the rented bikes. | Not Applicable | Not Applicable | Not Applicable |
| What is the store worker's opinion on bike culture and perception of cycling in the city? | Feels cycling is growing in the city a bit due to the construction of new bike ways | Estimates a 35% increase in cycling in recent years | Feels there is a lack of respect and still an insufficient amount of bikeways | Feels there is a general lack of respect for cyclists in the city | Feels there is a general lack of respect for cyclists |
| Do students frequent the store? | The store receives some students as clients | Does not receive many students as clients | The store receives many students as clients | The store receives many students as clients | The store receives few students as clients |
| Is the store worker a cyclist? What does he/she bike for? | Bikes competitively | Participates in all forms of biking; uses it as a main mode of transportation for all traveling within the city except to take children to school | Rides a bike for transportation and recreation; bikes throughout the city | bikes for recreation in the mountains; cannot bike for transportation because needs to bring children to school | Biking is the only way he gets around, serving as his only form of transportation; also competes as a cyclist and rides his bike |
| According to the store worker, what are the biggest problems with cycling in the city? | Traffic and a lack of respect are the biggest problems | There should be better education of biking and a better overall culture; generally, people are close-minded and do not deviate from transportation | There is a feeling that bikers need to compete with cars | Theft and a general lack of respect for bikers | A general lack of respect for cyclists |
| Other Notes | No additional notes | The company is in the process of adding a location in Turi in the hopes that people who would like to rent bicycles, can ride between the two | No additional notes | No additional notes | Holds competitions |

Appendix A2 (cont.): Table of Responses from Bike Shop Interviews

| Recorded Responses from Interviews with Bike Shop Workers | | | |
|--|---|---|--|
| Bike Shop Name | Podium | Speed Bike | Tecnocycle |
| What services does the store offer? | Sells bikes Fixes bikes | Sells bikes Fixes bikes | Sells bikes Fixes bikes |
| If the shop offers rentals, where do clients go with the bikes? and do they offer suggested routes for the bikers? | Not Applicable | Not Applicable | Not Applicable |
| What is the store worker's opinion on bike culture and perception of cycling in the city? | Feels biking is growing more everyday | Feels biking is a great because it has a lot of benefits | Feels the city's bike routes are not well organized nor well planned; believes there is not much of positive bike culture in Cuenca; feels bikers are not respected on |
| Do students frequent the store? | The store receives a few students as clients | The store receives many students as clients | The store does not receive many students as clients |
| Is the store worker a cyclist? What does he/she bike for? | Bikes for transportation, recreation and sport | Rides a bike for transportation and recreation; bikes from his house to other parts of the city including El Centro | Rides a bike only for sport purposes |
| According to the store worker, what are the biggest problems with cycling in the city? | The interactions with traffic due to cars is not safe | Cyclist's relationship with drivers is not safe | There is too much car traffic on the roads for cyclists to feel safe |
| Other Notes | No additional notes | Believes if EMOV EP is considering adding a new bike share station, it should be located by the University | No additional notes |

Appendix B1: Observations from En Bici Por el Centro



The above pictures depict the registration process (left) and the bike check-up process (right)

The bike share at the plaza at Simon Bolivar y Huayna-Capac consisted of a tent, registration table, and 5-6 bikes. The bike share as of now, has a handwritten registration form that users are required to fill out asking for name, telephone number, passport number, and more. This process can be seen in the picture above on the left. This manual system hinders the security of the current system as users can lie about their personal information. If instead, information was filled out on some sort of electronic database, information could be stored and then accessed later. This would be very helpful for individuals who used the program more than once because they would not have to fill out the registration form multiple times.

The plaza that the bike share is at often holds events for the public. These events are a great way to provide a large pool of potential users for the bike share program. Unfortunately, on the day we observed the bike share, the plaza was hosting a school showcase for young children. EMOV does not loan bikes to younger children due to the possibility of them getting hurt, they recommend riders be over the age of 8 years, but if there are events that draw an older crowd, we expect there to be much more interest in the bike share program.

Of the people that did use the program, we noticed that they mainly were using the bikes for tourism purposes. People would take the bikes and travel around the center to explore and/or grab lunch. Nobody was using the bikes for transportation, which was mostly due to the two hour time limit constraint and there being only one bike share station to drop the bikes off. For the program to be more successful we believe they should increase the time limit and put up more stations around frequent places of interest.

Appendix B2: Registration Form for En Bici Por el Centro

Ficha de Registro de Préstamo de Bicicleta

Nombre: _____ No. Cédula: _____

Dirección: _____ Teléfono: _____

Email: _____ Celular: _____

Bicicleta No. _____ Asiento: Si ☐ No ☐ Coche: Si ☐ No ☐ Casco No. _____

Observación: _____

Me comprometo al uso adecuado y responsable de los bienes antes indicados, dentro de este espacio de recreación y deporte.

Firma del Usuario

El uso inadecuado que genere destrucción o pérdida de los bienes, generará en el usuario la obligación de la devolución del bien o bienes de las mismas características, o el inicio de los procesos legales pertinentes.

Appendix B3: Survey for Bike Share Users

Survey for En Bici por el Centro

1. What aspects of the program do you like?

2. What aspects do you not like? Is there anything that can be improved?

3. If you could add another station for the program, where do you want a new station?

4. What is your main mode of transportation in el Centro?

5. Would you consider biking as a mode of transportation in el Centro? Why?

Thank you for your time and answers to this survey. Your identity will remain anonymous.

Appendix B4: EMOV EP Program Logistics

En Bici Por el Centro

EMOV EP runs this bike share program on Fridays from 8 a.m. to 4 p.m. and on Saturday from 8 a.m. to 12 p.m. Typically, there are two stations running: one at Av. Simon Bolivar y Av. Huayna-Capac, and the other at varying locations (often at the intersection of Presidente Borrero y Calle Larga). In order to rent a bike, users are required to fill out a handwritten registration form and present some form of identification. Users are allowed to use the bike for a duration of 2 hours and must return the bike to the same station.

BiciEscuela

BiciEscuela is a program designed to expose young kids to biking. It is held on weekday mornings in the local park, La Parque de la Madre. During this program, groups of young students are educated on the different parts of a bicycle and general safety practices when using a bike. The program also allows the students to participate in different activities, including coloring on an activity page equipped with various brain teasers and having a chance to ride on a bike. BiciEscuela enables young children to learn how to properly and safely ride a bike in a stress-free environment and encourages the future use of cycling.

Ruta Recreativa

La Ruta Recreativa is a recreational cycling event that is held on Sundays from the hours of 8 a.m. to 1 p.m. During this event, people are encouraged to bike along a six-kilometer recreational bike path that runs alongside the Tomebamba River. The route consists of various types of bike paths and streets which are closed off for the event or stationed by traffic cops to ensure the safety and comfort of all participants. In addition to the main route, there are also five recreational stations along its length that provide various activities for bikers to stop and enjoy. The themes of these stations revolve around recreation and leisure, culture, sports, and learning.

Like in, En Bici Por El Centro, people who would like to participate in Ruta Recreativa, but do not own a bike are able to rent a bike from the first station along the route. These users are required to fill out a similar handwritten registration form to check out a bike. Again, they are allowed to use the bike for only two hours.

Bici Mujer

Bici Mujer is a program intended to expose women to cycling in order to break cultural barriers. This is a two-month training that teaches women, older than 15 years of age, various biking skills before culminating in a graduation. (“ĖMOV EP Ejecuta...”, 2017) The curriculum covers topics such as bike adjustment, safe street maneuvering techniques, and bike signs and signals.

Appendix C1: Interview with Sponsor, Representative of EMOV EP

Interview with Maria Veronica Hormazabal Andrade

Day and Time: Thursday, January 18, 2018; 3:00 PM

Location: EMOV EP

Attendees: Mrs. Hormazabal Andrade (interviewee), Mateo Frare (head spokesperson), Alexander Cruz, Lauren Souza, Jeffrey St. Hilaire

The following responses are summarized as they were acquired by taking notes while interviewing Maria Veronica Hormazabal Andrade. These questions and responses were translated to English from Spanish as the interview was originally conducted in Spanish

Is there a particular demographic or group of people, you would like us to focus on with our project? For example, students, tourists, women, etc.

Response: *We would like you to focus on students we believe many use or could, in the future, use cycling to travel to and from school. Also, many students do not have the money to pay for a car*

What is the main reason you are interested in promoting cycling in Cuenca?

Response: *The city has a lot of potential for biking as commute distances are not too long due to the cities relatively small size and compact setup. There is not much room, however, for bikers in El Centro due to the congested vehicular traffic and narrow streets. The more people that bike, the safer it will begin to feel as a form of transportation.*

What are you most interested in seeing from our project?

Response: *We would like to see statistics and a new, outside perspective on the problem to come up with fresh ideas that can be used for potential programs in the future.*

Can you explain to us the logistics of the bike share program that runs in el Centro on Fridays and Saturdays?

Response: *Though the program runs on Saturdays, it does not run every Saturday. People who would like to use a bike must provide a passport of cedula number for identification and a photo is taken of the user. The user has two hours before the bike should be returned. If the bike has not been returned for more than thirty minutes beyond this two-hour span, the user will be called to assess the situation.*

Appendix C2: Interview with Representative of Llacta Lab

Interview with Dr. Daniel Orellana

Day and Time: Monday, January 29, 2018; 10:00 AM

Location: Llacta Lab, University of Cuenca Central Campus

Attendees: Dr. Orellana (interviewee), Mateo Frare (head spokesperson),
Alexander Cruz, Lauren Souza, Jeffrey St. Hilaire

The following responses are summarized as they were acquired by taking notes while interviewing Daniel Orellana of the Llacta Lab at the University of Cuenca.

We understand you have a large knowledge base on transportation and the culture of Cuenca. What is your overall opinion of the current perception of cycling in Cuenca?

Response: *Overall, there is a good attitude towards cycling though not too many people do it. Students and corporate workers are the two biggest contributors to Cuenca's bicycle-commuting population. Students make up about 35% of this commuting population. The two biggest motivators for biking are health/sport and comfort/time.*

Have you done any research or studies specifically geared toward college students?

Response: *Though my studies have not been specific to students, my investigation encompassed the general public and I asked about the demographics of the respondents. The students followed the same general trends for attitude toward cycling as did the public in general. Interestingly, about 70% of students who bike also have a relative or friend who bikes.*

What do you think are the best ways to incentivize cycling as an alternate form of transportation.

Response: *Safety and emphasis of bike paths are good incentives.*

Appendix C2 (cont.): Interview with Representative of Llacta Lab

Do you have any other suggestions for our project?

Response: *Focus on overcoming the obstacles your audience is currently facing. It could be helpful to highlight benefits such as efficiency, environmental effects, and cost. Stick with the students who currently bike or who are interested in taking it up; it is important not to lose the cycling base currently present and to focus on their desires. To determine which roads are safest, get the opinions of the city cyclists themselves.*

Additional information from conversation:

Many students take 4 trips to and from school as many leave campuses for lunch. Students inclined to use bikes would probably be interested in cycling home so it may be a good idea to emphasize safe ways to get to the city's major neighborhoods, which mostly sit on the city's outskirts. A focus on bus stations/stops, such as the one at Presidente Cordova, may be a good idea too, as many students ride the bus to and from school. Additionally, public bus fares are rising from \$0.25 to over \$0.30 a ride, which could be another motivator for using a bike. Overall, a lack of safety seems to be the biggest concern for cyclists where dangerous intersections and lack of respect from drivers specifically are the two greatest barriers. Robbery and lack of bikeways and parking facilities are other examples of common barriers. Many students own a bike. The city should consider implementing a bike path along the Tomebamba river to connect many of the university campuses. Construction of bike lanes is very important and should not be confused with recreational bike paths.

Appendix C3: Interview with Representative of GIZ

Interview with Alexandra Velasco

Day and Time: Monday, February 5, 2018; 10:00 AM

Location: Gaviota Apartments via Skype

Attendees: Mrs. Velasco (interviewee), Mateo Frare (head spokesperson),
Alexander Cruz, Lauren Souza, Jeffrey St. Hilaire

The following responses are summarized as they were acquired by taking notes while interviewing Alexandra Velasco of Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ).

Can you tell us a bit about your work?

Response: *Currently assists the mobility secretary and is in charge of sustainable mobility of the world program at GIZ. Worked in the past on a feasibility study in various cities including one in Cuenca.*

What do you think of the bike culture in Cuenca? What are some of the biggest challenges that the city faces in terms of the popularization of cycling?

Response: *Cuenca has the right conditions to be a cycling city. It is not too steep, and the distances are quite short to get places compared to sprawled out cities like Quito. I think that there is a big lack of cultural acceptance to switch to another form of transportation. It is not so much a problem of infrastructure anymore.*

Do you have any recommendations for Cuenca's bike share as it attempts to expand?

Response: *In terms of popularizing the bike share in the city center, they need to reduce the traffic of cars. Maybe EMOV EP should consider taking cars off of some of the streets. It is possible to make people enter the city center only by taxi or require the people that want to drive into the city pay a fee. The city could also implement travel bans that vary day to day in Cuenca based on license plate number as done in parts of Quito. Ultimately, the best strategy is to make it as difficult as possible for people to drive in el Centro.*

Appendix C3 (cont.): Interview with Representative of GIZ

Why is it so hard to prevent people from driving in Ecuador?

Response: *Gasoline is so cheap; the municipality cannot really control the amount of people that choose to drive instead of use alternate forms of transportation. The only real solution to this problem is making people pay the true price for gasoline*

Our sponsors want us to focus on university students with our project. Do you know of any types of programs or strategies to increase student cycling?

Response: *Start with a good road safety campaign beginning with students, establishing them as the spokespeople for the city regarding safe city streets and driving practices.*

What are some of the best strategies for promoting biking in cities like Cuenca?

Response: *You can refer to the sustainable mobility plan that I will supply you with. Firstly, it is important that people know exactly what plan phase the city is in; everyone needs to know where the city is at in order to have complete cooperation. It is also important to give incentives to different groups of people to use bikes, such as giving workers incentives for biking to work.*

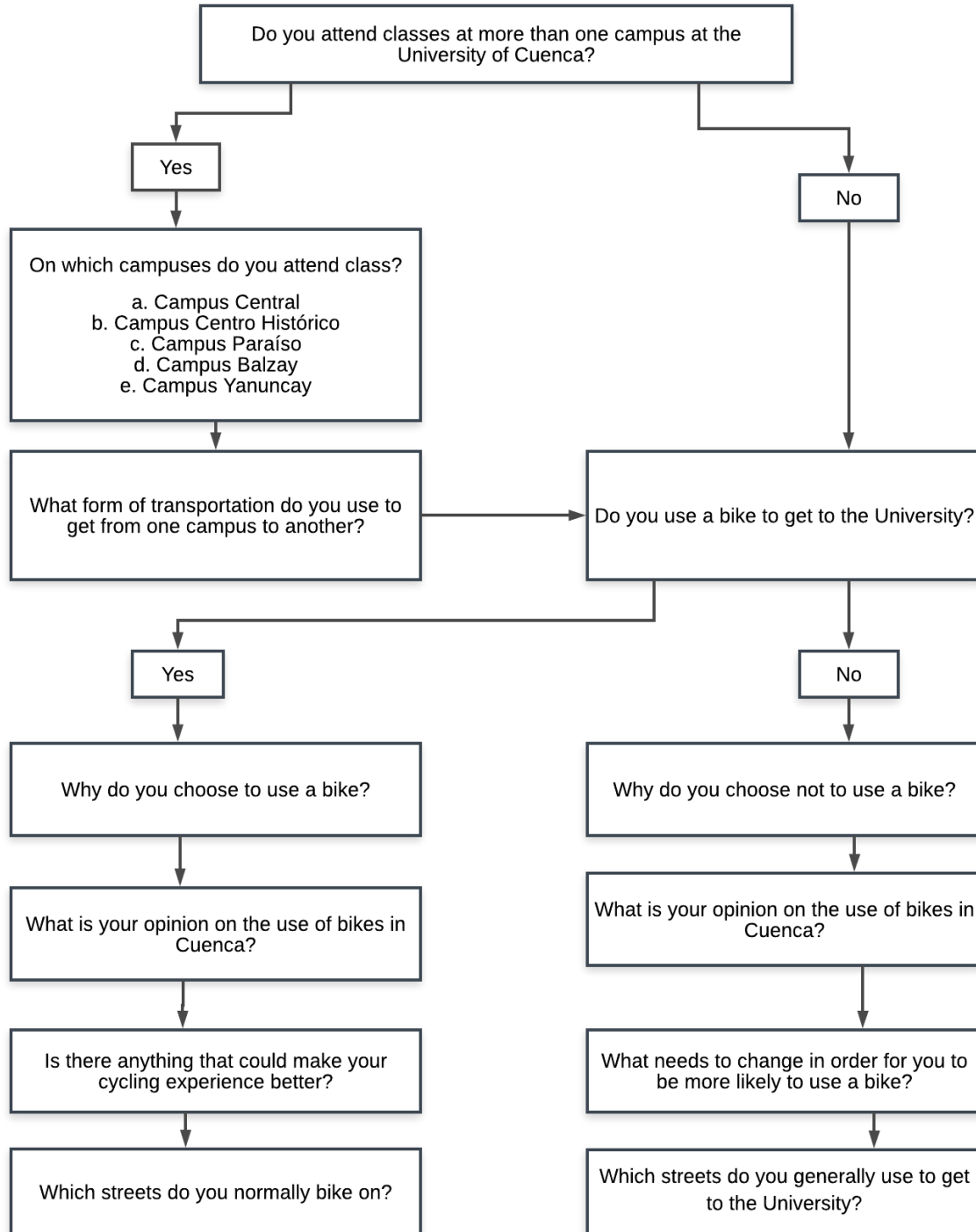
Generally speaking, where did you suggest placing bike share stations in Cuenca in your plan?

Response: *El Ejido, near the universities and Av. Solano is a great place to start. Based on the plan, bike stations were not intended to enter el Centro until phase 3 because there needs to be time to address other problems before going straight for the most difficult portions of the city; people need time to adjust.*

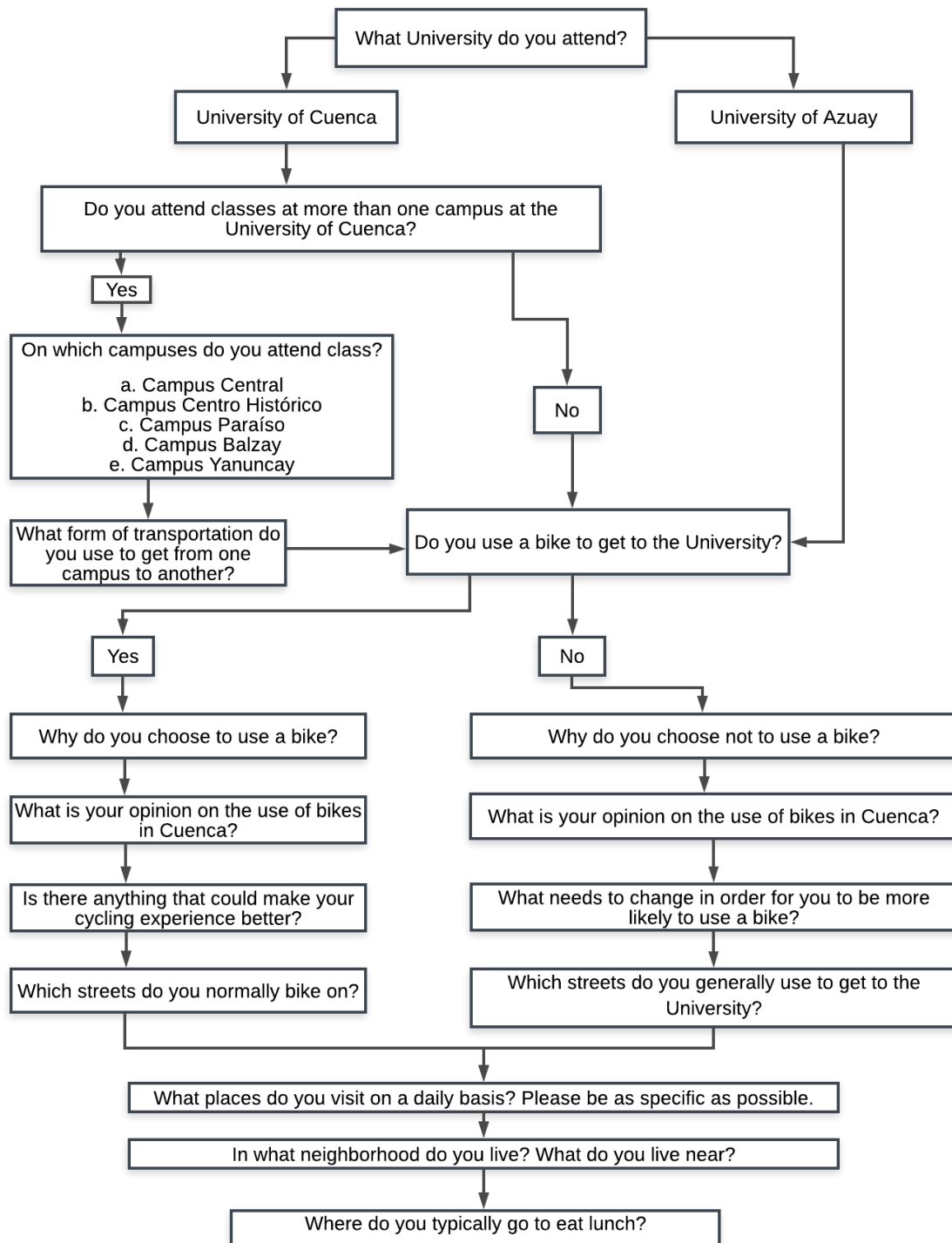
Did you consider putting stations in or near residential areas?

Response: *Whenever one is trying to determine placement of bike stations, it is a matter of trial and error; the stations need to be flexible. It is however, wise to consider population density. To find a good bike share station location, there needs to be desirability. It is a good idea to survey people to understand where the most desirable locations are in the city. It is as if to create "a matrix of origins and destinations in the city."*

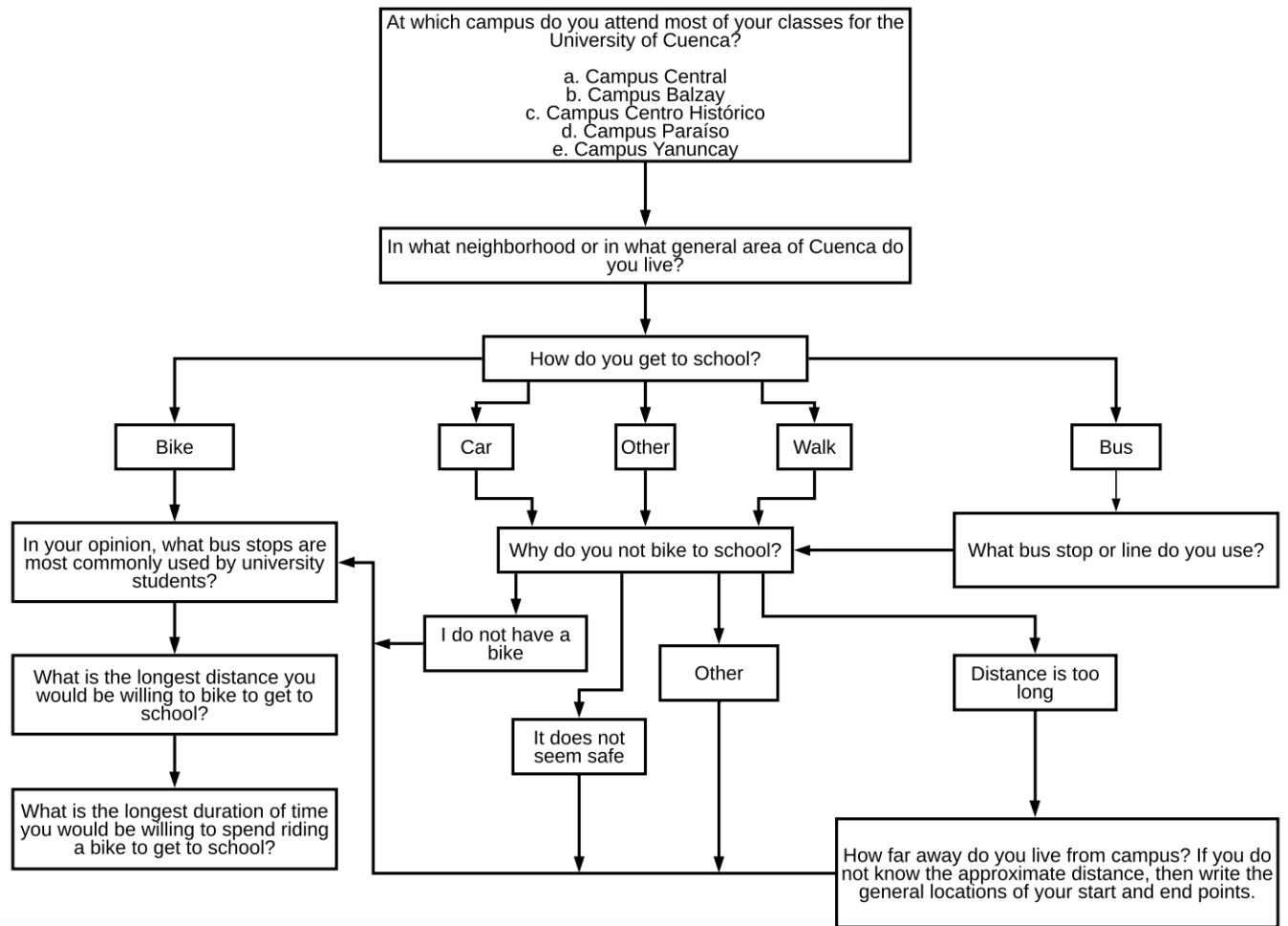
Appendix D1: Flowchart of Original “Mobility of the Universities” Student Survey



Appendix D2: Flowchart of Updated “Mobility of the Universities” Student Survey

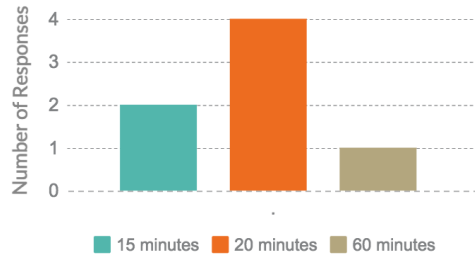


Appendix D3: Flowchart of “Modes of Transport” Student Survey



Appendix D4: Responses to “Modes of Transport” Student Survey

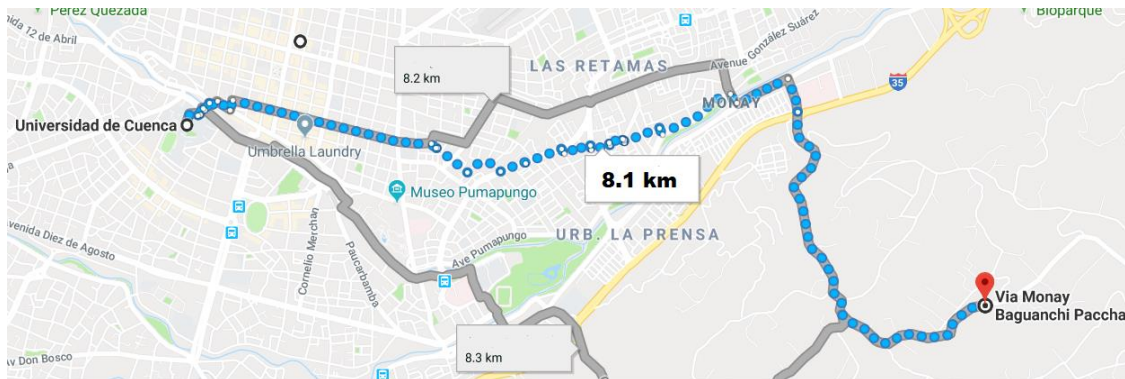
What is the maximum duration of time you would be willing to ride a bike to the university?



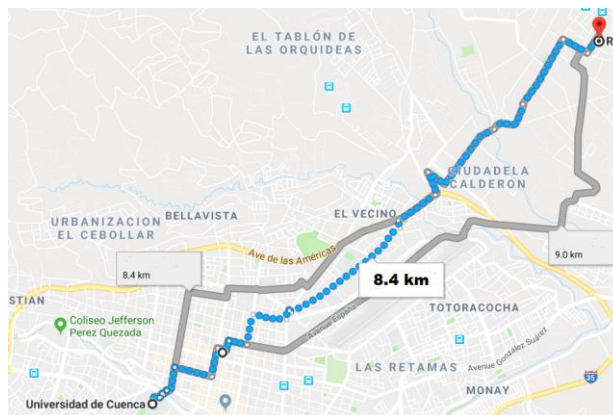
What is the maximum distance you would be willing to ride a bike to the University?



The following three maps represent the estimated routes of transportation and distances between the students given home location and their university. The maximum distance under the map indicates the distance they claim to be willing to ride a bike to get to the university.

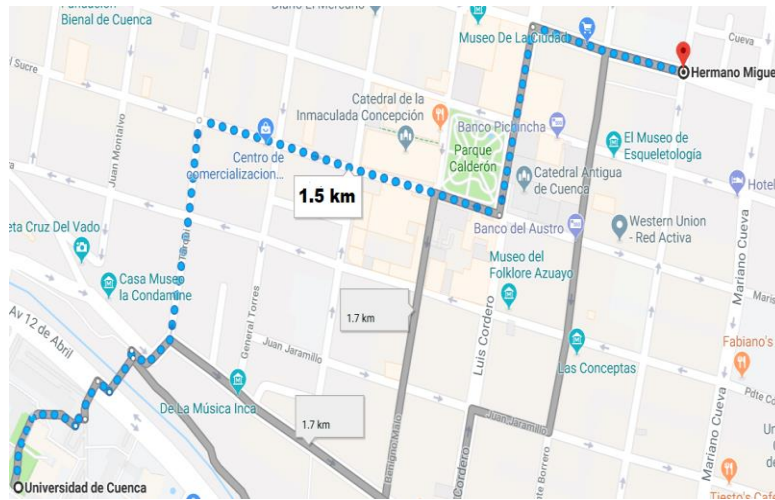


Maximum Distance: 19 km



Maximum Distance: 3 km

Appendix D4 (cont.): Responses to “Modes of Transport” Student Survey



Maximum Distance: 10 km

Appendix E1: Interview Questions for University Students

1. Using the map draw the general route you take to travel to the university.
2. What is your main mode of transportation for this route?
3. What places do you visit on a daily basis?
 - a. Where do you stop on your way to the university?
4. Do you ride a bike to or around the university?
 - a. Why or why not?
 - b. Would you ever consider riding a bike to or around the university?
5. What is preventing you from using a bicycle in the city?
6. In your opinion, what improvements need to be made on or around campus to increase cycling habits?
7. Where do you typically go for your lunch break when you have classes?
8. What are your thoughts on a bike-to-lunch bike share program in which students would be able to rent a bike for free during the hours of lunch?
9. Do you know anyone else that would be interested in participating in this interview?
 - a. Could you provide us with their contact information/give them our information?
Anyone who bikes?

Appendix E2: Tabulated University Student Interview Responses

For question 1 that refers to maps of the general routes of the students, please see the map below that corresponds with the letter found in that row.

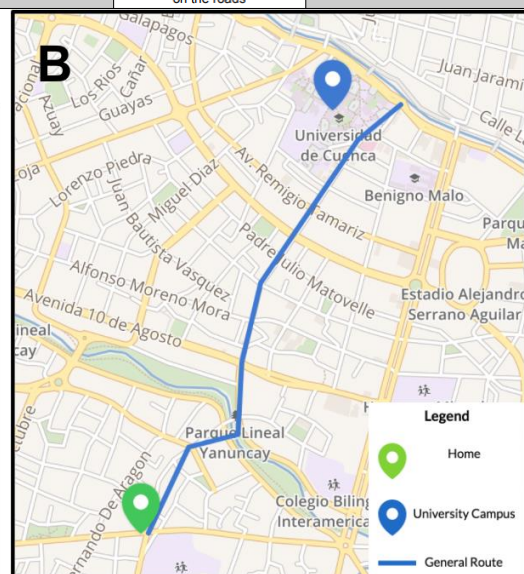
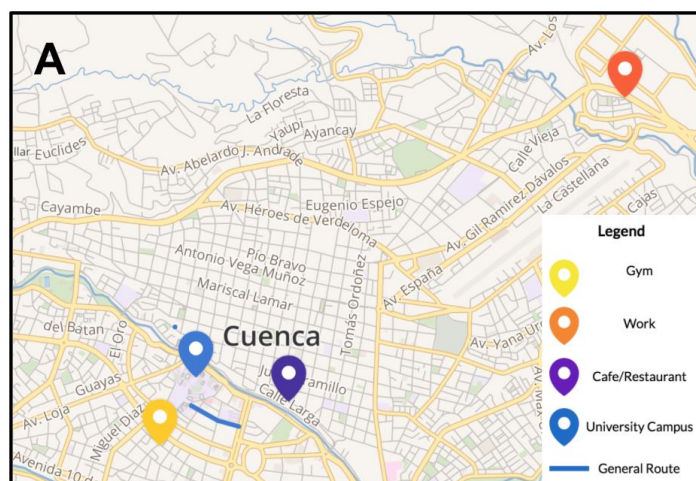
| Recorded Responses from the University Student Surveys | | | | | |
|--|--|---|--|---|---|
| Student | Female 1 | Male 1 | Female 2 | Male 2 | Male 3 |
| 1. Using the map draw the general route you take to travel to the university. | A | B | C | C | D |
| 2. What is your main mode of transportation for this route? | Walk | Bike | Bus | Car | Car |
| 3. What places do you visit on a daily basis? | Gym, work, and Calle Larga | Home and the university | Home, Centro Historico, and the university | Home and the university | Home and the university |
| 3.a. Where do you stop on your way to the university? | | | | | |
| 4. Do you ride a bike to or around the university? | No | Yes | No | No | No |
| 4.a. Why or why not? | She does not have one | It is very comfortable and it is very easy in terms of both time and money | She lives over an hour from the university | He has a car | He has a car |
| 4.b. Would you ever consider riding a bike to or around the university? | Yes because she enjoys riding a bike | N/A | Yes, if she lived closer to the university | No, he thinks he could get hurt if he rides a bike in the city | He does not have enough time with all his classes |
| 5. What is preventing you from using a bicycle in the city? | She does not have the money to buy one | N/A | It is very dangerous to ride a bike | It is a mentality issue. He believes it will always be too dangerous | People are in the habit of using a car |
| 6. In your opinion, what improvements need to be made on or around campus to increase cycling habits? | It is a problem of culture. There is no cycling culture in the city and that is something that needs to change | It is more a problem of time. Before the streets did not have a lot of bike paths, so it is difficult for people to be comfortable with the changes to the streets right away | There need to be more bike paths. Right now they are only on the main streets | There needs to be more educational programs or advertising to suggest how to properly share the road among vehicles and cyclists | There needs to be more promoting of cycling, especially the health and environmental benefits, to get more people to cycle |
| 7. Where do you typically go for your lunch break when you have classes? | Her house | His house | At a restaurant typically or at her house if she has a lot more time | He typically eats lunch at a restaurant 2 blocks away | At the university |
| 8. What are your thoughts on a bike-to-lunch bike share program in which students would be able to rent a bike for free during the hours of lunch? | It would be a good idea. It would be really useful for the students that live farther from the university, but it wouldn't help me because I live so close | It is a good idea because some students could benefit from using a bike if they do not already have one | She thinks its a good idea. In Quito they have a similar program that you can use your ID to check out a bike and then return it when you are done | He does not think it is a good idea because a lot of people eat on campus or very close. Also by the time 1pm rolls around people are very tired and may not want to ride a bike anywhere | Not many students have cars so it would be good for the people who would prefer to go home for lunch, especially at his campus (U of Cuenca; Paraiso) |
| 9. Do you know anyone else that would be interested in participating in this interview? | Yes; she gave us the contact of one of her friends | No | Yes; her boyfriend (Male 2) | No | No |
| Additional Notes: | | | | | |

Appendix E2 (cont.): Tabulated University Student Interview Responses

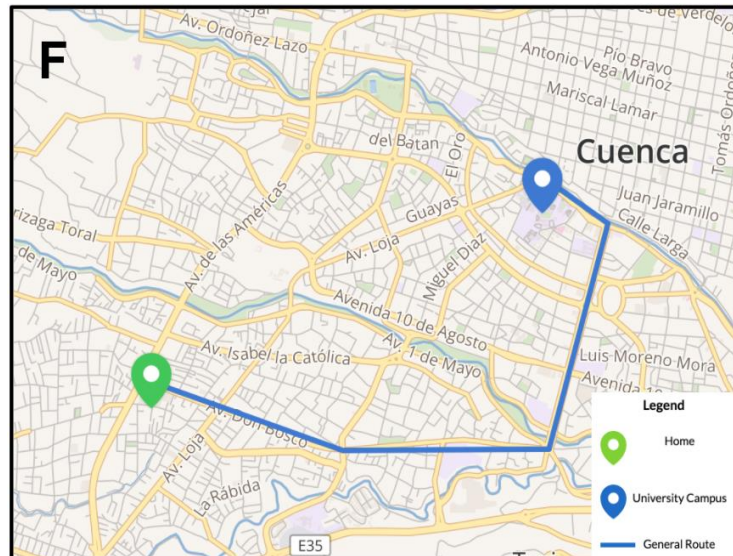
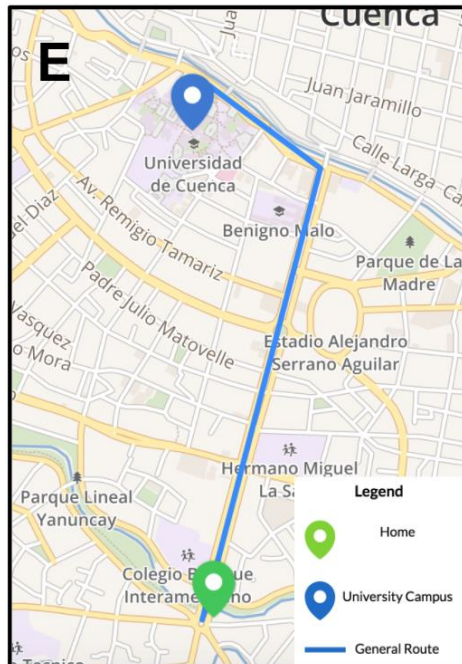
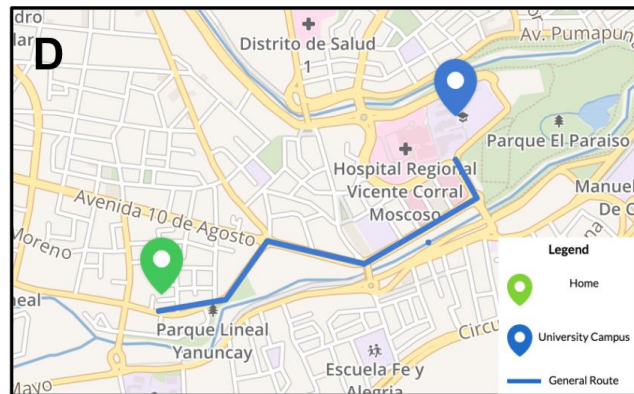
| Recorded Responses from the University Student Surveys | | | | | |
|--|---|--|---|---|--|
| Student | Male 4 | Male 5 | Female 3 | Male 6 | Male 7 |
| 1. Using the map draw the general route you take to travel to the university. | E | F | G | H | I |
| 2. What is your main mode of transportation for this route? | Bike | Bus | Bus | Bike | Bike |
| 3. What places do you visit on a daily basis? 3.a. Where do you stop on your way to the university? | Home and the university | Home and the university | Home and the university | Home and the university | Home, Centro Historic, and the university |
| 4. Do you ride a bike to or around the university? | Yes | Yes, but not to the university | No | Yes | Yes |
| 4.a. Why or why not? | It is easy for him because he lives close to campus and he enjoys riding for sport | He rides a bike, but not to campus because it is not as easy as taking the bus | She believes it is too dangerous to be her main form of transportation | It is very fast for him because he lives close | It is easier for him |
| 4.b. Would you ever consider riding a bike to or around the university? | N/A | N/A | Yes because it would take less time than the bus | N/A | N/A |
| 5. What is preventing you from using a bicycle in the city? | N/A | N/A | The drivers here are very ignorant. The do not have any respect for anyone, not even the people that may be walking a bit too close to the road. The bus drivers think they own the roads | N/A | N/A |
| 6. In your opinion, what improvements need to be made on or around campus to increase cycling habits? | It is a lack of habit for most people. There definitely needs to be more respect for cyclists. Also the price of bikes is a little too pricey for some people | There need to be more bikeways near the campus. People also need to address the issue of safety and respect cyclists | At the medical campus people are more concerned with health issues so maybe advertising the positive aspects of cycling would increase cycling | There need to be more bike paths on the major roads through out the city and the streets that surround the campus in order to increase the safety | He does not think there can be any additional infrastructure because the university already has a lot of bike racks that are always empty. He thinks it is more of a problem of fear |
| 7. Where do you typically go for your lunch break when you have classes? | On campus, but sometimes at a restaurant near campus | His house | Typically at the university because she does not have time to go home, but would prefer to | His house | On campus |
| 8. What are your thoughts on a bike-to-lunch bike share program in which students would be able to rent a bike for free during the hours of lunch? | He thinks it is a good idea and that many students would be interested in using it. He thinks the major incentive is that it would be free. | He would use the bikes because he lives so close to the campus | That would be perfect for her. Even if one street is closed down, it makes it nearly impossible to use the bus lines | He agrees with the program. He doesn't think it would be as useful for him because he already has a bike, but for others it would be good | He thinks that the bikes would get stolen even if people were going to their houses for lunch. He also doesn't think people would bike if they live 5 minutes from campus |
| 9. Do you know anyone else that would be interested in participating in this interview? | Yes; gave me the contact for some of his friends | No | Yes | No | No |
| Additional Notes: | | | The size of the city is perfect for cycling and the government is often willing to pay to advance itself and develop upon the city. The government is conscious of the need to change the attitude toward cycling/public transportation | | |

Appendix E2 (cont.): Tabulated University Student Interview Responses

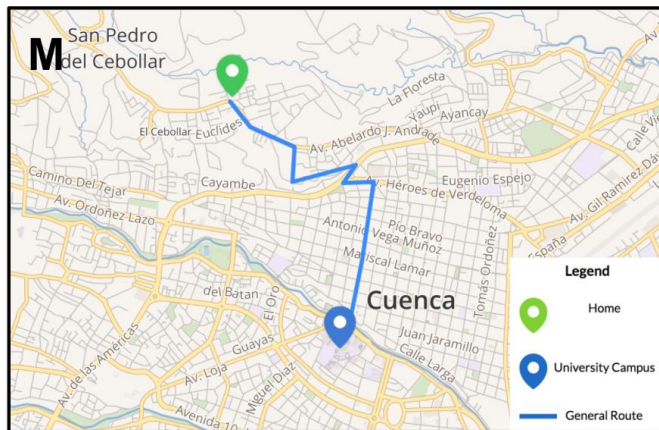
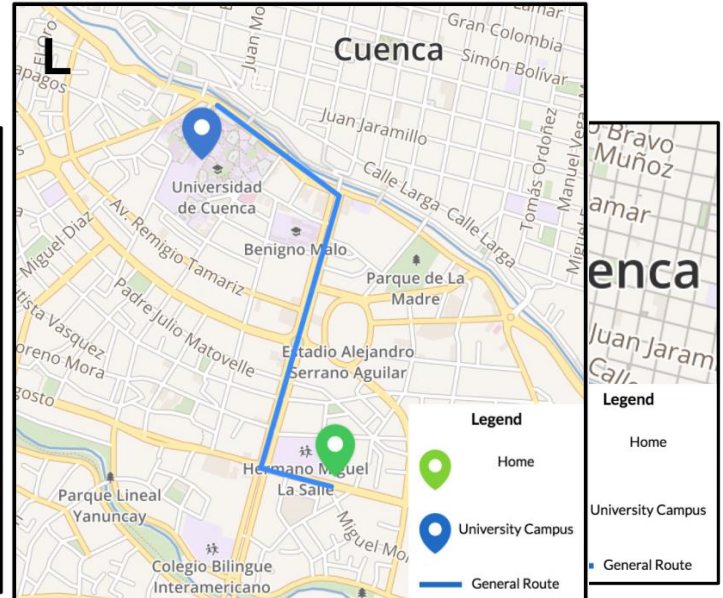
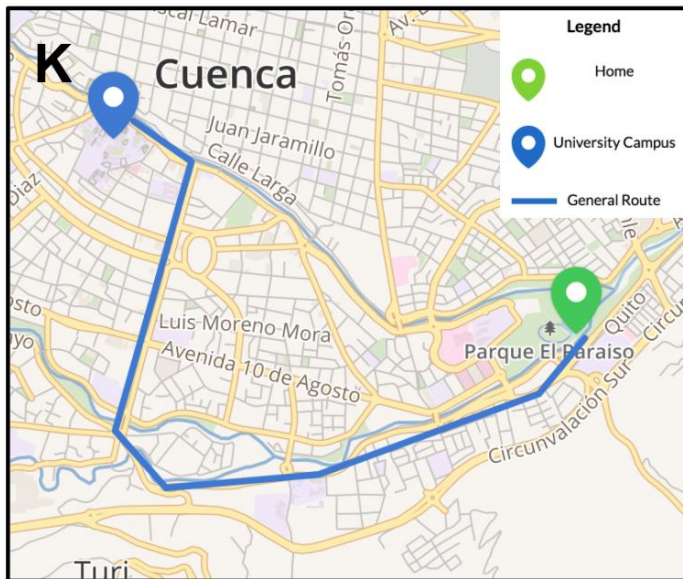
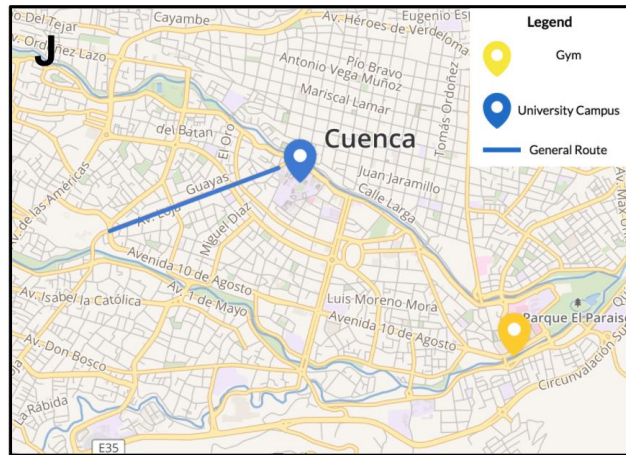
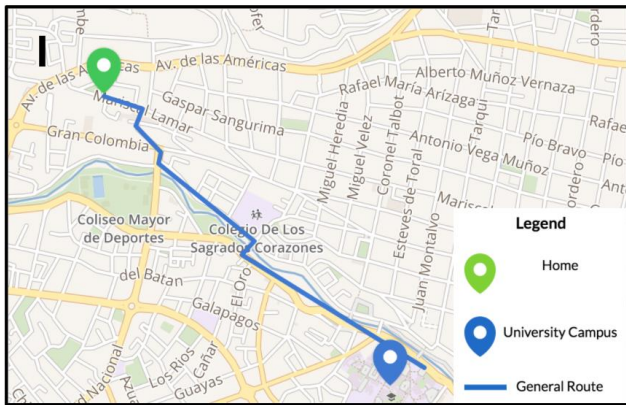
| Recorded Responses from the University Student Surveys | | | | | |
|--|---|---|---|--|--|
| Student | Female 4 | Male 8 | Male 9 | Female 5 | Group Interview 4 Females 1 Male |
| 1. Using the map draw the general route you take to travel to the university. | J | K | L | M | N |
| 2. What is your main mode of transportation for this route? | Walks | Motorcycle | Bike | Bus | 1 Bike; 1 Bus; 3 Cars |
| 3. What places do you visit on a daily basis? 3.a. Where do you stop on your way to the university? | Gym, home, and the university | Home and the university | Home, Centro Historico, and the university | The university | Homes and the university |
| 4. Do you ride a bike to or around the university? | Yes, but not to the university | Yes | Yes | No | *Not able to accurately distinguish responses |
| 4.a. Why or why not? | She bikes around the city, but not to school | He road a bike as a child, but he prefers a motorcycle | He lives closer to campus so it is more convenient for him | She does not know how to ride a bike and does not own one | *Not able to accurately distinguish responses |
| 4.b. Would you ever consider riding a bike to or around the university? | N/A | N/A | N/A | No because she does not know how | *Not able to accurately distinguish responses |
| 5. What is preventing you from using a bicycle in the city? | N/A | N/A | N/A | There is a lack of respect from drivers in the city so it is very dangerous anyways | *Not able to accurately distinguish responses |
| 6. In your opinion, what improvements need to be made on or around campus to increase cycling habits? | There need to be more bike stations and a bike path on the main road, 12 de Abril | Bike are expensive to buy in the city | There needs to be a bike share program that runs during the week and not only on Friday and Saturdays | She thinks the bikepaths have helped, but not many of the streets have enough room for both the paths and cars to coexist | The general consensus of the group was that there need to be more bike paths around the campus and there needs to be an increase in safety |
| 7. Where do you typically go for your lunch break when you have classes? | Her house | His house | Typically goes home, but eats on campus twice a week | On campus | 3 Restaurants; 2 homes |
| 8. What are your thoughts on a bike-to-lunch bike share program in which students would be able to rent a bike for free during the hours of lunch? | It is a good idea because a lot of people take the bus during lunch and there is a lot of traffic | It is a good idea because it gives students a new way to travel to their homes. The problem is that people do not have a bike or know how to bike so this program would give them the resources | He thinks it is a good idea. He has friends that are from surrounding cities and they would be interested in exploring more of the city especially during lunch | Some students have time and others do not. It would definitely be a good resource for students that have time and would prefer to go home for lunch | It is a good idea. They had said that they were aware of a similar program in Quito |
| 9. Do you know anyone else that would be interested in participating in this interview? | No | Yes; gave contact information | No | No | No |
| Additional Notes: | | | | She mentioned that in Quito there is a program to limit the number of cars on the roads. This program takes numbers from license plates and on certain days restricts cars with those number from driving on the roads | |



Appendix E2 (cont.): Tabulated University Student Interview Responses

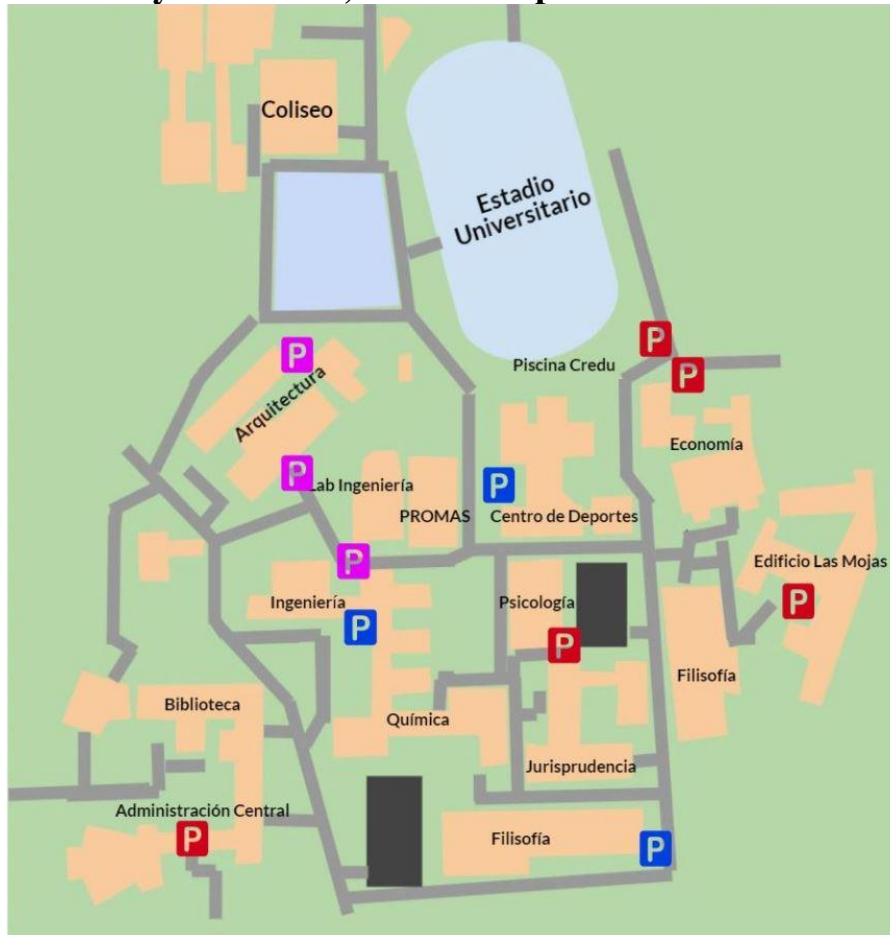


Appendix E2 (cont.): Tabulated University Student Interview Responses



Appendix F: University Bike Infrastructure

University of Cuenca; Main Campus



Appendix F (cont.): University Bike Infrastructure

University of Cuenca; Campus Paraíso

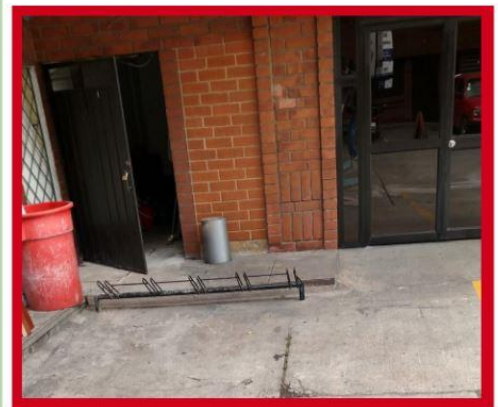
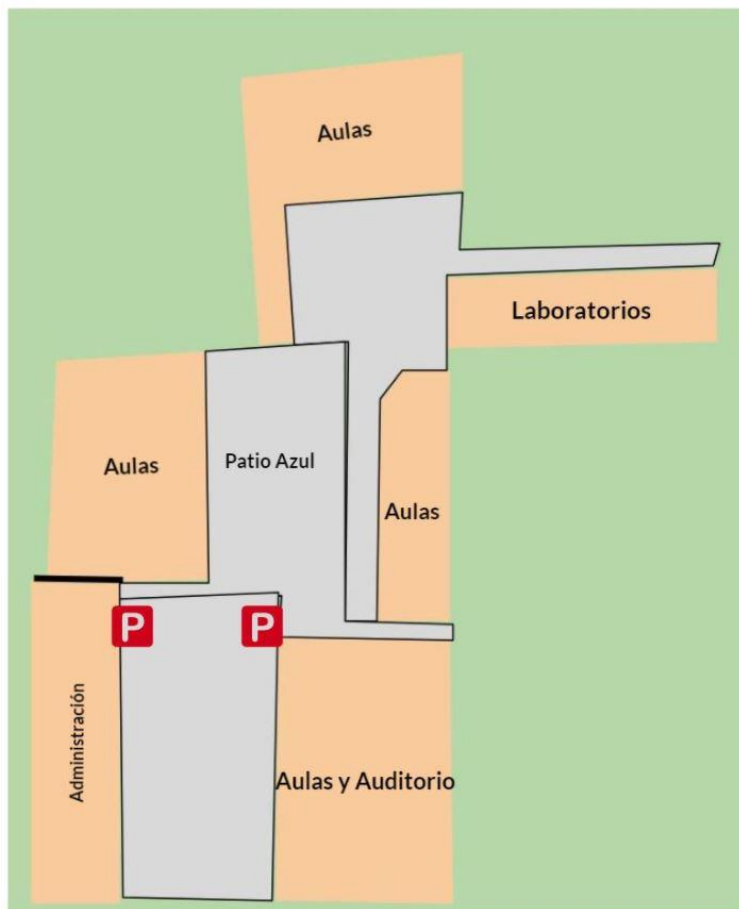


Appendix F (cont.): University Bike Infrastructure

University of Cuenca; Campus Yanuncay



University of Cuenca; Campus Centro Histórico



Appendix F (cont.): University Bike Infrastructure

University of Azuay



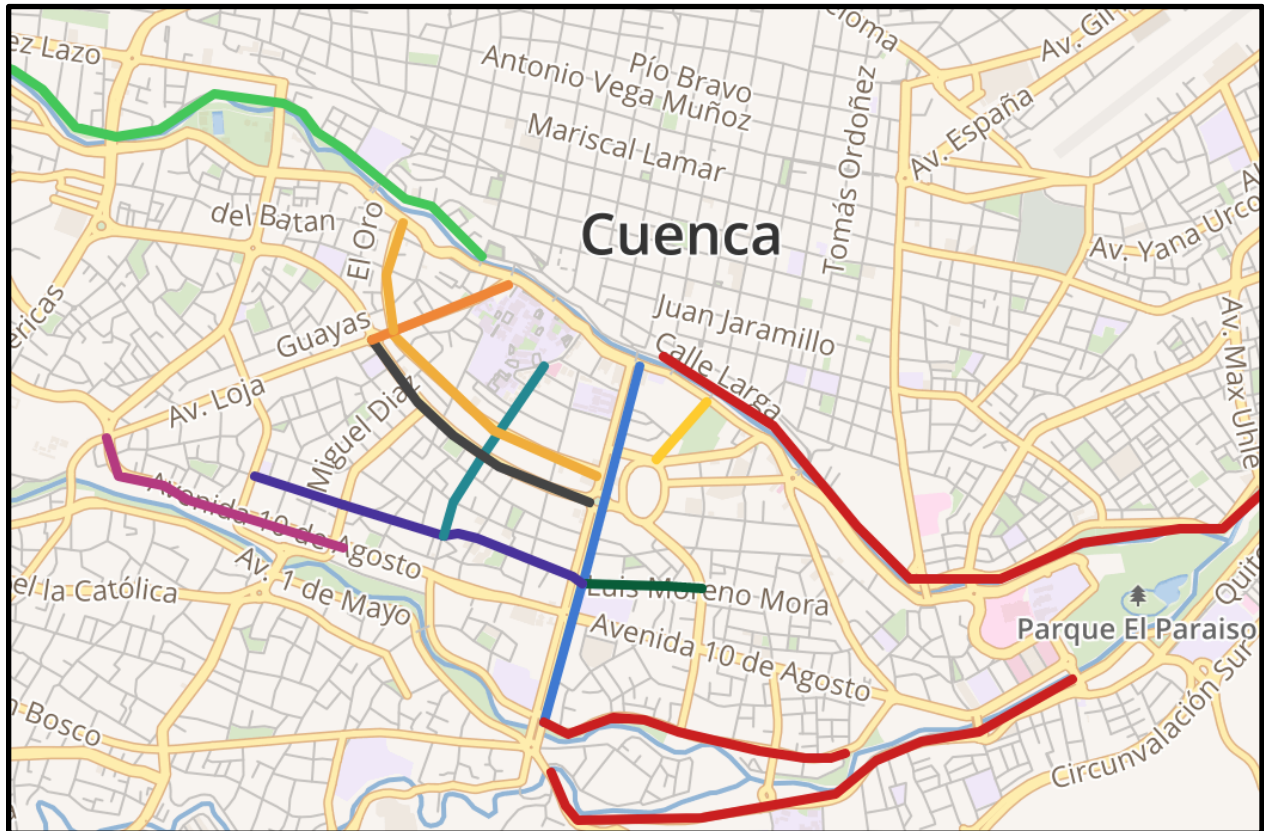
Appendix G: Photos from Observations of Proposed Bike Routes



Appendix G (cont.): Photos from Observations of Proposed Bike Routes



Appendix H: Map of Current Bike Paths



Orange - Avenida Loja

Maroon - Avenida 10 de Agosto

Blue - Avenida Fray Vicente Solano

Purple - Alfonso Moreno Mora

Dark Green - Luis Moreno Mora

Black - Avenida Remigio Crespo Toral

Turquoise - Agustin Cueva Vallejo

Light Orange - Avenida Remigio Tamariz

Green - Avenida 3 de Noviembre

Red - La Ruta Recreativa

Appendix I1: General Outline of Questions for Post Bike Ride Focus Group

1. What is your gender and age?
2. What parts of the route felt the safest? The most dangerous?
3. What do you recommend to improve the most dangerous areas?
4. Are there any routes that you would change?
5. Do you have any suggestions on the parts of the route that we did not bike?
6. Do you have any other suggestions for things that we can include on our map?
7. Do you have any suggestions on how the map should be used or distributed?
8. In your opinion if there was a bike loan station near the university, what would be the best days and hours of operation?

Appendix I2: Transcript of Post Bike Ride Focus Group

Day and Time: Sunday, February 18, 2018; 11:30 AM

The following responses are summarized as they were recorded during the focus group. The responses include general ideas from the three participants whose voices could not be distinguished in the recording. These questions and responses were translated to English from Spanish as the interview was originally conducted in Spanish.

What is your gender and age?

Responses:

- Male, 24
- Female, 20
- Male, 22

What parts of the route felt the safest and most dangerous, in your opinion?

Responses:

- Parque Paraíso is the safest.
- Yes, Parque de La Madre and the route below Parque Paraíso are the safest.
- Don Bosco and 10 de Agosto are the most dangerous. There were a lot of parked cars.
- Instead of using Don Bosco, you should use 1 de Mayo.
- There is a bike path on 1 de Mayo which is linear to Don Bosco.

Are these two routes okay? (Felipe II and ____)

Responses:

- Yes, Felipe II was very safe. There were not many cars.
- I think it would be better to avoid any connection to Don Bosco.

For the route to Parque Paraíso, you guys believe it would be better to use the recreational route on the other side of the river?

Responses:

- Yes, it is better.

Appendix I2 (cont.): Transcript of Post Bike Ride Focus Group

In addition to the safe routes, on the map we are going to include places where you can rent and fix bikes, locations to park bikes and the locations of all the bike paths. Are there any other things that you think would be beneficial to add to this map?

Responses:

- *It would be good to add some points of interest, like the parks that you have added.*
- *Yes, Parque Paraíso is a good place to highlight.*
- *All the university campuses are also shown as well.*
- *Places with water. Streets that run along the water (rivers).*

Do you think it would be important to note places where there are hills?

Responses:

- *No, many cyclists would not be affected by hills.*
- *If you put the map onto an app, you could be able to tell the altitude of the hill. As well as how many hills you would encounter on a certain route.*

Do you have any suggestions for how the map should be used or distributed?

Responses:

- *Apps.*
- *"Move-It"*
- *I think if you give people paper then they will just throw it away. I think a digital one, because I think everyone here already has a smartphone, well at least the youth. Even at public schools there are a lot of good cell phones.*

Do you know about the bike loan program that EMOV currently has?

Responses:

- *Yes.*

It operates on Fridays and Saturdays right now. They want to add another station in the future. Do you have any suggestions on where it should go?

Responses:

- *Where is it operating now?*

Appendix I2 (cont.): Transcript of Post Bike Ride Focus Group

It is mostly in El Centro (center of the city).

Responses:

- *It would be good somewhere near Don Bosco, 1 de Mayo, Avenida Loja.*

EMOV wants students to use the bike loan program. In your opinions, what hours and days would be best for the system to operate during?

Responses:

- *Mondays to Fridays: 7 in the morning to 10 at night*
- *I think it would be better if you could rent the bike for the month. Otherwise you would have to take the bike everyday.*
- *If we can put stations in the University, it would be a lot easier for students because we have the infrastructure to park the bikes.*
- *Yes, and if it is raining you can bring the bikes inside or under the cover of the university.*

Do a lot of student eat lunch at their houses, in restaurants or on campus?

Responses:

- *It is 50/50 because some people can go home and will eat with their family, but other students do not have enough time to go all the way home.*

Do you think the students that go home would be interested in borrowing a bike to take home for lunch and then bringing it back?

Responses:

- *I think it depends a lot because if you can take a bus to your house, you wouldn't take a bike because you would be tired and wouldn't have eaten all day. Then coming back to the university on a full stomach wouldn't be a great idea.*

Appendix I2 (cont.): Transcript of Post Bike Ride Focus Group

Day and Time: Sunday, February 18, 2018; 11:30 AM

The following responses are summarized as they were recorded during the focus group. The responses include general ideas from the three participants whose voices could not be distinguished in the recording. These questions and responses were translated to English from Spanish as the interview was originally conducted in Spanish.

What is your gender and age?

Responses:

- *Female, 21*
- *Male, 21*
- *Male, 23*

What parts of the route felt the safest and most dangerous, in your opinion?

Responses:

- *The safest are the streets with bike paths on them*
- *Other safe roads are the ones in el Centro with the Tranvia*
- *It's also very safe around the University*
- *Most Dangerous were Benigno Malo, Calle Larga y Padre Aguirre, basically anywhere in el Centro*

What other streets in el Centro would you recommend to travel on?

Responses:

- *El gran colombia as well as Mariscal Lamar and Gran Colombia*
- *Padre Aguirre, although dangerous is one of the safer routes in el Centro*
- *I think it would be better to avoid any connection to Don Bosco.*

What other streets, outside the center, would you recommend?

Responses:

- *Primero de Mayo*
- *Av. Solano*
- *24 de Mayo*
- *Ordoñez Lazo*

Appendix I2 (cont.): Transcript of Post Bike Ride Focus Group

For our project we are trying to create a map that connects the different parts of the city and different campuses, that are safe for biking. What would be the best way to distribute the map?

Responses:

- *Distribute the maps at the different University Campuses*

Do you have any suggestions for how the map should be used or distributed?

Responses:

- *Apps.*
- *"Move-It"*
- *I think if you give people paper then they will just throw it away. I think a digital one, because I think everyone here already has a smartphone, well at least the youth. Even at public schools there are a lot of good cell phones.*

Do you know about the bike loan program that EMOV currently has?

Responses:

- *They knew it existed and they knew about Ciclo-Sundays, but they were not aware of the other days that they could use it*
-

It operates on Fridays and Saturdays right now. They want to add another station in the future. Do you have any suggestions on where it should go.

Responses:

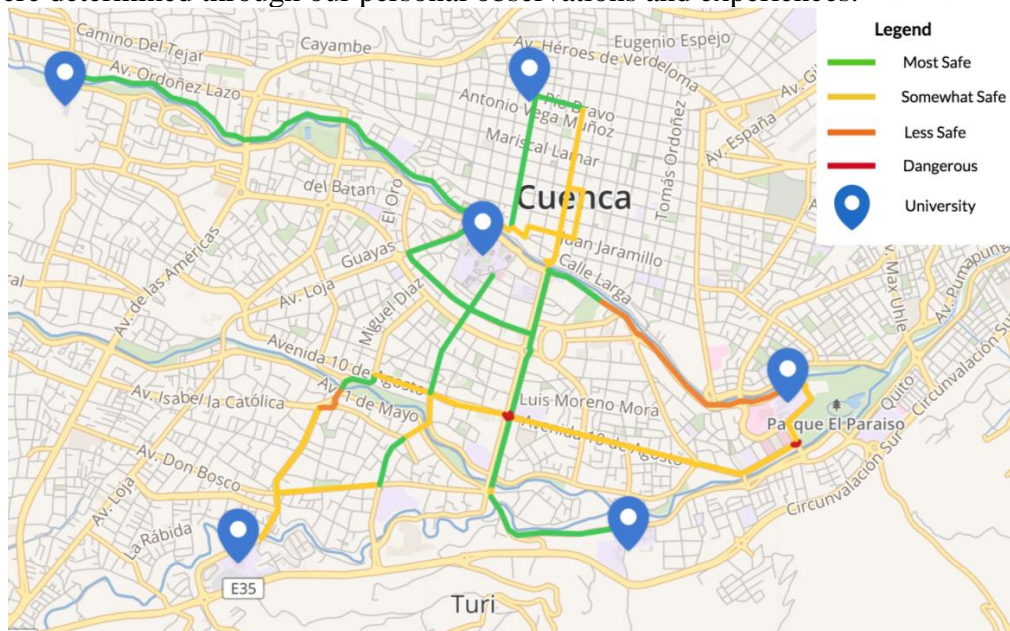
- *They say somewhere between the University of Cuenca's main campus and Parque Paraiso*
- *Also suggest a bike station at the main campus and the medical campus.*

Appendix J: Progression of Cycling Map

Map 1. This map depicts the initial stage of our map of suggested routes. This map takes into consideration all the bike paths and routes that were commonly taken by both cyclists and non-cyclists.



Map 2. This map is the second iteration. This map depicts the routes we believed would be the safest after we had done our first bike ride along the routes. The colors (safety levels) of the routes were determined through our personal observations and experiences.



Appendix J (cont.): Progression of Cycling Map

Map 3. This map is the third iteration of the map. This map depicts the suggested routes after all bike rides with students. These colors and routes were determined from suggestions made by the university students and their personal experience during the focus groups. Any additional changes made from these routes were determined from the advice of representatives of EMOV EP.

