Design of an Express Carpooling System for the Border Region

by

Gabriel A. Valdez, Lorenzo Cornejo, David Galicia, Arturo Bujanda, David Salgado, Marianna Borrego, Karen Jurado

Project performed by
Center for International Intelligent Transportation Research

Report No.
CIITR Project: Design of an Express Carpooling System for the Border Region

August 2014

Report prepared by
Center for International Intelligent Transportation Research
Texas A&M Transportation Institute
4050 Rio Bravo, Suite 151
El Paso, Texas 79902

TEXAS A&M TRANSPORTATION INSTITUTE
The Texas A&M University System
College Station, Texas 77843-3135
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>List of Figures</td>
<td>iii</td>
</tr>
<tr>
<td>List of Tables</td>
<td>v</td>
</tr>
<tr>
<td>Disclaimer and Acknowledgments</td>
<td>vi</td>
</tr>
<tr>
<td>Executive Summary</td>
<td>1</td>
</tr>
<tr>
<td>The Problem</td>
<td>1</td>
</tr>
<tr>
<td>Research Approach and Methodology</td>
<td>1</td>
</tr>
<tr>
<td>Conclusions and Recommendations</td>
<td>1</td>
</tr>
<tr>
<td>Chapter 1: Introduction</td>
<td>3</td>
</tr>
<tr>
<td>1.1 Background</td>
<td>3</td>
</tr>
<tr>
<td>1.2 Research Need</td>
<td>3</td>
</tr>
<tr>
<td>1.3 Research Objective</td>
<td>3</td>
</tr>
<tr>
<td>1.4 Structure of the Report</td>
<td>4</td>
</tr>
<tr>
<td>Chapter 2: Literature Review</td>
<td>5</td>
</tr>
<tr>
<td>2.1 United States Experience</td>
<td>5</td>
</tr>
<tr>
<td>2.1.1 Washington, D.C. – Slug Lines</td>
<td>5</td>
</tr>
<tr>
<td>2.1.2 San Francisco, California – Casual Carpool</td>
<td>10</td>
</tr>
<tr>
<td>2.1.3 Houston, Texas</td>
<td>14</td>
</tr>
<tr>
<td>2.1.4 Seattle, Washington – Real-Time Ridesharing</td>
<td>17</td>
</tr>
<tr>
<td>2.1.5 Zimride</td>
<td>18</td>
</tr>
<tr>
<td>2.1.6 Sidecar</td>
<td>20</td>
</tr>
<tr>
<td>2.1.7 iCarpool</td>
<td>22</td>
</tr>
<tr>
<td>2.2 International Experience</td>
<td>23</td>
</tr>
<tr>
<td>2.2.1 Auckland, New Zealand – Raspberry Express</td>
<td>23</td>
</tr>
<tr>
<td>Chapter 3: Express Carpool Operations Model</td>
<td>25</td>
</tr>
<tr>
<td>3.1 Objective</td>
<td>25</td>
</tr>
<tr>
<td>3.2 Stop and Go System</td>
<td>25</td>
</tr>
<tr>
<td>3.3 Credit System</td>
<td>26</td>
</tr>
<tr>
<td>3.3.1 Stop and Go – Credit Based</td>
<td>27</td>
</tr>
<tr>
<td>3.3.2 Dynamic Rideshare – Credit Based</td>
<td>28</td>
</tr>
<tr>
<td>3.3.3 Credits Marketplace</td>
<td>28</td>
</tr>
<tr>
<td>3.4 Dynamic Rideshare</td>
<td>29</td>
</tr>
<tr>
<td>Chapter 4: Local Transportation Systems</td>
<td>31</td>
</tr>
<tr>
<td>4.1 VáMONOS Vanpool System</td>
<td>31</td>
</tr>
<tr>
<td>4.2 iCarpool</td>
<td>32</td>
</tr>
<tr>
<td>4.3 Sun Metro</td>
<td>32</td>
</tr>
<tr>
<td>4.4 El Paso Bus Rapid Transit System</td>
<td>39</td>
</tr>
<tr>
<td>Figure</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>Slug Signs Typically Used in Washington, D.C., Express Carpooling System</td>
</tr>
<tr>
<td>2</td>
<td>Map of Pick-up/Drop-off Locations for the Slug Lines System</td>
</tr>
<tr>
<td>3</td>
<td>Main Reasons People Carpool in San Francisco</td>
</tr>
<tr>
<td>4</td>
<td>How People Commuted before Participating in Casual Carpooling</td>
</tr>
<tr>
<td>5</td>
<td>Number of Commuters Who Use Express Carpool System in San Francisco</td>
</tr>
<tr>
<td>6</td>
<td>San Francisco Bay Express Carpool System</td>
</tr>
<tr>
<td>7</td>
<td>Reasons That Would Cause People Not to Casual Carpool</td>
</tr>
<tr>
<td>8</td>
<td>Reasons for Casual Carpoolers Using the System</td>
</tr>
<tr>
<td>9</td>
<td>Houston Express Carpool System</td>
</tr>
<tr>
<td>10</td>
<td>Seattle’s go520 Website to Promote the Pilot Project</td>
</tr>
<tr>
<td>11</td>
<td>Zimride Homepage</td>
</tr>
<tr>
<td>12</td>
<td>Lyft Platform Developed by Zimride for iPhone and Android Devices</td>
</tr>
<tr>
<td>13</td>
<td>Sidecar Main Web Page</td>
</tr>
<tr>
<td>14</td>
<td>Sidecar Smartphone Application User Interface</td>
</tr>
<tr>
<td>15</td>
<td>Features Included in iCarpool System</td>
</tr>
<tr>
<td>16</td>
<td>Raspberry Express Characteristics and Benefits</td>
</tr>
<tr>
<td>17</td>
<td>Casual Carpool System in San Francisco, CA</td>
</tr>
<tr>
<td>18</td>
<td>Stop and Go System Summary</td>
</tr>
<tr>
<td>19</td>
<td>Credit System Summary</td>
</tr>
<tr>
<td>20</td>
<td>Dynamic Ridesharing System Summary</td>
</tr>
<tr>
<td>21</td>
<td>Vámonos Vanpool Ride Search Map</td>
</tr>
<tr>
<td>22</td>
<td>Sun Metro Routes Commuting to UTEP</td>
</tr>
<tr>
<td>23</td>
<td>Sun Metro Routes Commuting to EPCC Northwest</td>
</tr>
<tr>
<td>24</td>
<td>Sun Metro Routes Commuting to EPCC Rio Grande</td>
</tr>
<tr>
<td>25</td>
<td>Sun Metro Routes Commuting to EPCC Transmountain</td>
</tr>
<tr>
<td>26</td>
<td>Sun Metro Routes Commuting to EPCC Valle Verde</td>
</tr>
<tr>
<td>27</td>
<td>Sun Metro Routes Commuting to EPCC Mission</td>
</tr>
<tr>
<td>28</td>
<td>El Paso Bus Rapid Transit Corridors</td>
</tr>
<tr>
<td>29</td>
<td>Survey Participants College Campus Attendance Rate</td>
</tr>
<tr>
<td>30</td>
<td>Commuting Mode to College</td>
</tr>
<tr>
<td>31</td>
<td>Students Weekly Attendance Rate</td>
</tr>
<tr>
<td>32</td>
<td>Campus Arrival Time</td>
</tr>
<tr>
<td>33</td>
<td>Campus Departure Time</td>
</tr>
<tr>
<td>34</td>
<td>Students Current Enrollment Status</td>
</tr>
<tr>
<td>35</td>
<td>Gender Specification</td>
</tr>
<tr>
<td>36</td>
<td>Students Age Category</td>
</tr>
<tr>
<td>37</td>
<td>Smartphone Ownership</td>
</tr>
<tr>
<td>38</td>
<td>Vehicle Ownership</td>
</tr>
<tr>
<td>39</td>
<td>Vehicle’s Model Year Greater or Lower than Year 2000</td>
</tr>
<tr>
<td>40</td>
<td>Trip Start Region to Commute to College</td>
</tr>
<tr>
<td>41</td>
<td>Port of Entry Used by Students Commuting from Juárez</td>
</tr>
<tr>
<td>42</td>
<td>Willingness to Try Flexible Carpooling</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table 1. Slug Lines Boarding and Alighting Locations. ................................................................. 8
Table 2. Dynamic Rideshare SWOT Analysis. ............................................................................ 65
DISCLAIMER AND ACKNOWLEDGMENTS

This research was performed by the Center for International Intelligent Transportation Research, a part of the Texas A&M Transportation Institute. The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein.

The research team would like to thank Dr. Kelvin Cheu from The University of Texas at El Paso for facilitating on obtaining the feedback from the campus students.
EXECUTIVE SUMMARY

THE PROBLEM

The increasing amount of single occupancy vehicles (SOVs) in the U.S. metropolitan area transportation infrastructure have led to mobility and environmental concerns by local transportation authorities. Transportation agencies and professionals remain constantly challenged on how to improve traffic mobility and/or promote carpooling. Efforts to do this include the implementation of high occupancy vehicles (HOVs) (which can incur high costs) or carpooling programs where a pre-determined schedule is required to match carpoolers. However, the need for pre-arrangement between both parties (i.e., driver and passenger) is one of the main problems due to unpredictable school/work schedules or commitments. A flexible carpooling program could help address such problem.

RESEARCH APPROACH AND METHODOLOGY

A flexible carpooling program is being proposed as an approach to alleviate traffic congestion in the city of El Paso to improve vehicle mobility and air quality in the border region. In order to determine the feasibility of a flexible carpooling program the following methodology was developed:

1) A literature review was conducted to document the strengths and weaknesses that define a flexible carpooling system. The leading programs were found in Washington, D.C.; San Francisco, California; Houston, Texas; and Seattle, Washington. Emerging carpooling systems that use smartphone applications (e.g., Lyft and Sidecar) were also included in the literature.

2) Common operational models were explored to identify the advantages and disadvantages of each one. The various types included stop and go, credit based, and real-time dynamic ridesharing.

3) An analysis was conducted on the current transportation modes that are available in the city of El Paso as well as future plans (i.e., BRT system).

4) A survey was developed and distributed among students from the University of Texas at El Paso (UTEP) and El Paso Community College (EPCC) to determine the feasibility of a dynamic carpooling program. The survey consisted of 13 questions with an average completion time of two to three minutes.

5) A Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis was evaluated and showed the positive and negative aspects of the implementation of a dynamic ridesharing system in the city of El Paso.

CONCLUSIONS AND RECOMMENDATIONS

The feedback obtained from the local college students showed that a significant amount had some interest in a dynamic carpooling system in the El Paso region. Results indicated that approximately 40 percent of the students showed interest in trying a dynamic ridesharing program similar to those currently operating in the U.S. with smartphones as their main platform.
Around 80 percent of those interviewed owned a smartphone with GPS capabilities. The main concern of those that were unsure or did not want to get involved in the program was due to security concerns (i.e., background check, documents verification, vehicle inspections). Of those students whose main concern was security, 38 percent of them were females and 31 percent males. Students who did not own a vehicle revealed greater interest in dynamic carpooling with a 46 percent response rate as opposed to 38 percent of those that do own one. Students who were currently taking the bus had the highest interest rate in carpooling (of 51 percent) followed by those that already carpool with more than one person (46 percent).

The high smartphone ownership among the local students would facilitate the implementation and distribution of a carpool system through a free to download application. This provides the ridesharing program a strong platform where students can access it at any time or place. Most importantly, the application needs to be user-friendly, efficient, and with an attractive design to provide a prompt service.

Students that were skeptical on trying a dynamic rideshare system was mostly due to security issues. Local students expressed their concern on who would they be sharing their ride with to/from campus. In order to address this issue, the dynamic rideshare program would have to implement various measures to ensure the safety of both drivers and passengers such as: background checks, cashless transactions, document verification, and a minimum vehicle quality level.

A dynamic ridesharing system can be an attractive option for students in the city of El Paso. The no need for pre-arrangement might interest students into trying carpooling, as opposed to having a fixed schedule that might conflict with other commitments. However, in order for the system to work a strong communication channel would have to be established with students from both UTEP and EPCC. This would help clear any questions and/or concerns that they might have as well as promoting the service in-campus. Furthermore, stored profiles or optional social network integration could improve the ride share match rate. Proper advertisement of a new carpooling system would be critical to the success of it. This could be done through focus groups, in-campus publicity (e.g., posters, flyers), dedicated website, and email. If the dynamic ride share program is not properly advertised in-person it could severely affect the participation rate (as of the writing of this report, no similar system operates in the city of El Paso).

Implementing a dynamic rideshare service however, could face institutional challenges that could impact its attractiveness in the region. This includes defining the appropriate roles from both the public and private sectors to encourage ride share as a safe and viable commuting mode. For example, the rideshare system could be designed in a way that would complement the local transit transportation system and thus giving more options to the users.

If properly implemented with both cooperation from the private and public sector, a dynamic rideshare program could provide local students with another environmentally friendly commuting option in the border region.
CHAPTER 1: INTRODUCTION

1.1 BACKGROUND

Congestion is getting worse in the nation’s metropolitan areas as a result of increasing population, but also due to the limited resources available for transportation infrastructure. This has led transportation agencies and professionals to remain constantly challenged in how to improve traffic mobility. Typically, HOV lanes are implemented on congested freeways to allow drivers to bypass the delay experienced on the general-purpose lanes. This encourages and promotes carpooling around the region by providing vehicles lower travel times. However, to avoid the high costs associated with building a new HOV facility, other alternatives have been identified to encourage carpooling, keeping fewer SOVs off the road (1).

Carpooling has been seen as one of the lowest cost alternatives to reduce the amount of SOVs; however, most of the carpooling programs implemented across the U.S. have failed to live up to its expectations. One of the main reasons lies behind the various issues when trying to find a partner with similar transport schedules. People with unpredictable work schedules cannot be tied to other people’s daily schedule. An alternative to the conventional carpooling programs is an express carpooling system (also known as flexible carpooling), which is designed for people with varying or similar transport schedules. The key difference between express carpooling and the other carpooling programs is that there is no need for pre-arrangement. Express carpooling systems have been operating successfully in cities such as Washington, D.C., Houston, and San Francisco. For example, the San Francisco express carpool program has 9,000 daily participants, which represent around 3,000 carpools. The travel time savings, emissions, and energy saved by residents and businesses in the Bay Area are estimated to be around $30 million dollars per annum (2). Other methods for flexible carpooling have been gaining popularity in the U.S. due to their simple and intuitive way of arranging interested carpoolers. This is possible with the use of smartphone applications that handle the arrangement between the drivers and passengers. Some of these applications include Sidecar and Lyft (that originated in San Francisco, CA), but have been expanding to other states to promote carpooling in an easy and rewarding manner.

1.2 RESEARCH NEED

Currently, the El Paso region experiences severe congestion on both directions of Interstate 10 (I-10) during the morning and afternoon peak hours. I-10 serves as the main transportation highway between the west and east areas of the city. The frontage road and commercial areas around I-10 leave little to no room for expansion. Consequently (as of early 2014), the city of El Paso has no high-occupancy toll (HOT) or HOV lanes implemented on I-10. With these facing issues, the El Paso region needs innovative and cost-effective ideas to help reduce the amount of vehicles and help maintain a cleaner environment.

1.3 RESEARCH OBJECTIVE

The objective of this research is to develop a strategy to both operate and finance a flexible carpooling system in the El Paso region. Based on the current flexible carpooling practices in the U.S., different strategies were studied and documented to help identify their individual strengths and weaknesses. The research team distributed surveys among the target community in the
region (i.e., students from UTEP and EPCC) to gather their feedback and help improve the overall carpooling strategy.

1.4 STRUCTURE OF THE REPORT

This report is organized in six chapters, including this introduction. Chapter 2 covers the literature review conducted on the current flexible carpooling practices in the U.S. and abroad. The most notable practices found were Sidecar (3) and Lyft (4), which are smartphone applications, since their user base is expanding successfully throughout the country. Chapter 3 documents the current transportation systems available in the city of El Paso such as iCarpool (online ride sharing program), Vanpool, and Sun Metro (public transportation). Chapter 4 explores the different ways to operate a flexible carpooling system via credits, a stop and go method for cities with HOV lanes, and a dynamic ridesharing system. Chapter 5 presents the survey findings and observations from both UTEP and EPCC. Chapter 6 documents the strengths, weaknesses, opportunities, and threats that were found on the proposed carpooling strategy for the border region.
CHAPTER 2: LITERATURE REVIEW

2.1 UNITED STATES EXPERIENCE

Currently, there are three U.S. metropolitan areas that have implemented an organized express carpooling system. The “slug lines” in Washington, D.C., and the casual carpooling in San Francisco, California, have been around since the early 1970s. During the 1990s the express carpooling system concept spread to Houston, Texas. To this date, all continue to operate successfully in all the three cities (5). Other carpool programs, such as Sidecar and Zimride, currently under operation in the U.S. were reviewed.

2.1.1 Washington, D.C. – Slug Lines

The Washington, D.C.’s transportation system provides various modes of travel throughout the region including a transportation hub for auto, air, rail, and bus. It also offers the second-busiest rapid transit system in the U.S. in number of passenger trips, DC Metro, just after the New York City Subway (6).

Among all the different modes that Washington, D.C., offers to its citizens and visitors, there is a unique form of commuting known as Slug Lines (7). This “Instance Carpooling” has the singularity of letting inbound commuters stop at pre-determined locations to pick up other passengers. Slugging is a very organized system with its own set of rules, proper etiquette, and specific pick-up and drop-off locations. Probably the best feature of this service is that it is free for the passengers. The system has been proven to be reliable, simple, convenient, and faster than the regular bus service, train, or even DC Metro for daily commuters into the District. Car drivers get the benefit of meeting the 3+ people HOV requirement to get access into the designated HOV lanes.

Slugging has operated in Northern Virginia/Washington, D.C., area for about 35 years. This service started around 1975, shortly after the HOV lanes were opened to carpools and vanpools. Although the exact date is uncertain, this type of express HOV lane gained popularity in 1982 due to different factors, gas price being one of the most influential.

The way the slugging process starts is by letting the car drivers position their cars so that the slugs are on the passenger side. The driver either displays a sign with the destination or simply lowers the passenger window, to call out the destination, such as Pentagon, L’Enfant Plaza, or 14th and New York. The system mimics a fixed route bus system where the passengers need to visually look for their most convenient destination routes. The slugs first in line for that particular destination board the car, normally confirming the destination, and take the ride. Figure 1 shows an example of the slug signs used in the Washington slug lines.
One of the advantages over transit systems is that in the slugging process no money is exchanged because of the mutual benefit mentioned before in this section: “the car driver needs riders just as much as the slugs need a ride” (7). The beauty of this transportation system is that each party needs the other in order to survive. Normally, there is no conversation unless initiated by the driver; usually the only words exchanged are “Thank you” as the driver drops off the slugs at the destination. Additionally, there is no need to spend time on stop requesting (as in transit services) or giving directions (taxi service) because the drop-off points are generally clear and understood by both parties. However, there are a few places where the destination drop-off point is not understood; in these cases, the slug (passenger) must state where he or she wishes to be dropped off.

The system has its own set of etiquette and rules that are detailed in the Slug Lines website for new users to familiarize with the system (7). The set of rules are basic courtesies; however, others are truly unique to slugging. The rules and etiquettes for this type of service are described below.

- **First Come - First Served.** The slug first in line gets the next ride to their destination and also gets to choose the front or back seat. Slugs should never take a ride out of turn.

- **Slugs do not talk.** This is not completely true, because there are times when conversation is acceptable, but normally slugs must wait for drivers to initiate it; otherwise, there is no talking. One note about this rule. Even though it may sound impolite not to initiate conversation, there are some good reasons why this rule exists. The driver (and sometimes the slug) isn’t interested in getting to know the other person. On the contrary, all that is wanted is a quiet ride home. For many riders, it’s a chance to think, sleep, or read the paper. For the driver, it may be the only chance to listen to the news or relax to his or her own music. The last thing both riders and drivers want is to feel obligated to carry on a 30-minute conversation. It’s a good rule. Now, with that being said, sometimes conversations do take place, but you’ll just have to use your own judgment as to when it’s appropriate.

- **No conversations of religion, politics, or sex.** Enough said...

- **No money, gifts, or tokens of appreciation are ever offered or requested.** A driver doesn’t expect the riders to help out with gas money. The relationship between the driver and rider is mutually supporting. The driver needs the slugs just as much as the slugs need the driver. If a
driver wants help with the gas, he should organize his own carpool. He shouldn’t ask a slug to pitch in for helping him access the HOV!

- **Cell Phones.** Slugs should not have a conversation on their cell phone while commuting. The very short, “Hey, I’m on my way home,” is okay, but do not have a long conversation about what you did last weekend! For drivers, it is acceptable.

- **The line does not leave a woman standing alone.** Call it chivalry or simply thoughtfulness toward the safety of others, but this rule has certainly helped many women feel safer. Notice that I said “the line,” because the rule applies to both men and women. It works like this: If the line has three people left in it and the driver needs only two in order to meet the HOV-3 requirement, the “line” should ensure that a woman is not left standing. Either a man forfeits his place in line so that he is left standing, or the ride is declined until another slug arrives. Or, it is acceptable to ask the driver if he will take more slugs in order to clear the line. Whatever the situation, the intent is not to leave a woman standing alone on the street, especially at night.

- **There is no smoking or eating by the driver or slug.**

- **A slug does not ask to change the radio station or adjust the heat or air conditioning.**

- **Normally, the slug does not open or close the window.**

- **Both slugs and drivers usually exchange a “Thank you” before and after the ride.**

- **No “curbside” service.** There are certain understood destinations. Horner Road means the parking area at Horner Road, not the gas station just down Prince William Parkway or around the block to where you live. If you have a special request, be sure to ask the driver before accepting the ride. Normally, as long as the stop is on the way, drivers will not object.

- **Slugs have the right to pass or forfeit a ride if they do not like a particular car.** Let’s say a couple of rough-looking characters pull up and your gut feeling tells you this ride isn’t safe. PASS. There are plenty of other rides that will pass your own personal gut check.

- **No “Body Snatching.”** If the line of cars picking up slugs is too long, many times drivers will cruise the commuter parking lots, attempting to pick up slugs walking to the line. This practice is unfair to both slugs and drivers. I have seen this rule both enforced and violated, by both drivers and slugs. Hopefully, this rule will stand the test of time; otherwise, it will be a free-for-all.

- **Drivers should not “stop short.”** Stopping short happens when the driver decides not to take the slug all the way to the agreed-upon destination. For example, the driver decides to stop at his parking garage, just a few blocks short of the understood drop-off point, forcing the slug to walk the remainder of the distance. In this case the driver should tell the slug that he is only going part way to the destination and let the slug decide whether or not to accept the ride.
• **Will Call.** The driver’s option to pick a particular slug not at the front of the line. This situation usually happens when a driver sees a friend in line and simply calls for that individual.

• **Seat Belts.** It is understood that both drivers and passengers should buckle-up. Drivers please allow the slugs time before leaving the parking lot.

• **Consideration.** Both drivers and slugs should use common consideration during the commute. For example, drivers should try to use a relatively clean car, avoid heavy use of perfumes or colognes, and keep the radio at a moderate level.

• **Avoid Personal Hygiene Care.** Both drivers and slugs should avoid things like: putting on make-up, combing hair, etc.

A list of available slug lines are shown in Table 1, while the map (Figure 2) shows the available pick-up and drop-off locations within the system.

<table>
<thead>
<tr>
<th>Table 1. Slug Lines Boarding and Alighting Locations.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Washington, D.C.</strong></td>
</tr>
<tr>
<td>----------------------</td>
</tr>
<tr>
<td>14th &amp; NY</td>
</tr>
<tr>
<td>14th &amp; D Street</td>
</tr>
<tr>
<td>14th &amp; Constitution</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>14th &amp; Independence</td>
</tr>
<tr>
<td>L’Enfant Plaza</td>
</tr>
<tr>
<td>19th &amp; F St.</td>
</tr>
<tr>
<td>Pentagon</td>
</tr>
<tr>
<td>Rosslyn</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
Figure 2. Map of Pick-up/Drop-off Locations for the Slug Lines System.
2.1.2 San Francisco, California – Casual Carpool

The San Francisco Bay Area has a population of more than 7.15 million people (8). The main cities of this region are San Francisco, San Jose, Oakland, Richmond, and Berkeley. Thousands of the Bay Area residents commute on a daily basis to downtown San Francisco (one of the major trip generators/attractors of the region). Commuters can choose to either take transit, drive their personal vehicle alone, or pick-up passengers at the designated pick-up/drop-off locations throughout the city. The express carpool system connects the East Bay area with downtown San Francisco. There are a total of 24 carpool locations in the East Bay and two pick-up/drop-off locations on downtown San Francisco (see Figure 6).

Express carpooling has gained popularity in the last few years because of HOT lanes. To travel along the San Francisco-Oakland Bay Bridge, vehicles must be occupied by at least three passengers to meet the occupancy requirement. During weekday peak hours, autos pay $6.00; carpool drivers pay $2.50 while non-peak autos pay $4.00. On average, drivers that take the HOT lanes save 20 minutes per trip approximately. The toll and travel time savings serve as a good incentive for daily commuters to casual carpool with interested passengers. The casual carpooling system in the San Francisco Bay Area operates in the following manner (9):

- In the morning from 6:00 a.m. to 9:30 a.m. approximately, riders and drivers meet at any of the pick-up locations in the East Bay. Casual carpoolers receive parking benefits that are closer to the morning pick-up areas.
- To access to the HOT lanes, driver’s vehicles must have a specific transponder (i.e., FasTrack).
- In the evening from 3:30 p.m. to 7:00 p.m., drivers pick riders up from the same location in which they drop riders off in the morning. Riders wait for drivers next to the sign that indicates their destination. Generally, the farther is the final destination, the larger is the queue to get a ride.
- The casual carpool system takes the peoples feedback (via email) into consideration when defining new pick-up locations.

In addition, the casual carpool program in San Francisco has developed a set of rules or etiquette that all participants should follow (9). These are fairly similar to the ones previously mentioned for the Washington, D.C., slug line system.

2.1.2.1 Etiquette

1. In line, as a rider and a driver, respect the first come, first serve policy.
2. Riders should respect the driver’s vehicle (food, odors, phone conversations, makeup, hair dryers, electric shavers, etc. should be finished before getting into the car).
3. Drivers should refrain from having loud music/radio, dirty car, etc.
4. Drivers and passengers are all responsible for safe driving or riding.
5. Drivers have the prerogative to start a conversation, otherwise passengers should remain quiet.
6. If conflicts happen throughout the ride, riders or drivers should stay calm and inform the community about particular people who caused the incident.

Currently, if a person does not get a ride, casual carpool locations are close to several public transportation methods. In case any of the public transportation options are not in service, people are encouraged to use services such as Lyft and Sidecar to look for someone available to give a
ride. The San Francisco casual carpool has not developed its own mobile application to provide ridesharing services.

It is estimated that around 5,000 persons make use of the express carpooling provided in the San Francisco Bay Area (9). Thanks to this system, carpoolers may save hundreds of dollars in toll fees, gas, transit fares, etc.

To further understand the casual carpooling behavior of drivers and passengers a survey was conducted through a period of two weeks from April 27–May 5, 2010. The survey was developed, distributed, and performed by 511 Rideshare\(^1\) staff at 13 out of the 25 carpool locations in the East Bay and San Francisco. The methodology consisted on two steps: (i) the surveyor distributed and explained the survey to passengers and drivers; (ii) the surveyor performed the survey or offered the possibility of taking the survey online (i.e., web-based or via email). The overall response rate was 39 percent from a total of 6,000 surveys distributed. The surveys were classified between those who were riders, drivers, or a combination of both. About two-thirds of the respondents were usually riders (10).

### 2.1.2.2 511 Rideshare Survey Results – Highlights (10)

Highlights of the survey are:

- Approximately 82.6 percent of express carpoolers commute between 4–5 days a week.
- Around 53.1 percent of the people surveyed have been using the express carpool program for more than 3 years.
- Before people switched to express carpool people commuted to work/school on their own private vehicle (19 percent) or through the Bay Area Rapid Transit (35.6 percent).
- The main reasons people use the service is to save money and time by 33.8 percent and 25.7 percent, respectively (see Figure 3).
- During the afternoon peak hours, 55 percent of the respondents use transit and 14.5 percent use express carpool. This is illustrated in Figure 5.
- People often walk (34.6 percent) or use the park-and-ride facility (40 percent) to get to the express carpool pick-up spot.

![Figure 3. Main Reasons People Carpool in San Francisco.](image)

\(^1\) The 511 Regional Rideshare Program is operated by the Metropolitan Transportation Commission.
Figure 4. How People Commuted before Participating in Casual Carpooling.

Figure 5. Number of Commuters Who Use Express Carpool System in San Francisco.
Figure 6. San Francisco Bay Express Carpool System.
2.1.3 Houston, Texas

The people in Houston, TX, meet at three locations west of the central business district (CBD) to partake in the casual carpooling system. These locations are: Kingsland Park-and-Ride lot, Addicks Park-and-Ride lot, and the Northwest Station Park-and-Ride lot situated along I-10 (Katy Freeway) and US-290 (Northwest Freeway). Riders wait in-line for drivers willing to pick up a couple of passengers. Drivers, on the other hand, get the benefit of driving through the HOV lanes and decrease their commuting travel time. In the case that there are not enough drivers for all waiting carpool riders, people can still take transit. As expected, most of the carpools occur during the morning peak hours (i.e., 6:00 a.m. to 9:00 a.m.) when people are heading to work toward the CBD (11). However, after 9:00 a.m. almost no casual carpools are recorded at the park-and-ride locations.

The HOV requirements on Katy Freeway and US 290 Northwest Freeway vary throughout the day as follows:

- Katy Freeway (12):
  - HOV (2+) free during HOV hours.
  - Monday through Friday, 5:00 a.m.–11:00 a.m. and 2:00 p.m.–8:00 p.m.
  - Tolls apply at all other times.

- US 290 Northwest Freeway (12):
  - HOV (2+) enter free for most of the day except during rush hours from 6:45 a.m. to 8 a.m. where the minimum requirement is 3+ occupants.
  - HOV (2+) can still enter during rush hours by paying a toll of $2.00.

Casual carpools occur mostly during the morning peak hours when the HOV requirements on US 290 are 3+ occupants. Such requirements give passengers a higher chance of getting a ride. During the afternoon the majority of the casual riders use transit when heading out of the CBD (see Figure 9).

The Texas A&M Transportation Institute (TTI) conducted a study on casual carpool passenger behavior as part of a larger traveler survey in November 2003 (11). The surveys were distributed via mail to carpool users and at the three park-and-ride facilities in Houston. A total of 539 surveys were distributed with a total response rate of 40 percent. The final dataset analysis focused on the morning peak hours and those who use the service at least three times per week. Some of the most relevant observations included (11):

- 47.8 percent of the casual carpool participants would not carpool if more than 10 persons were waiting for carpool (see Figure 7).  
- Most casual carpool passengers used transit for evening return trips.
- Around 63 percent used casual carpool to save money (see Figure 8).
- Approximately 53 percent carpooled due to a slow bus service.
- 76 percent of casual carpoolers used this mode three times or more on a weekly basis.
- Monetary transactions between drivers and rider were not practiced.

---

2 Percentages of reason to carpool sum more than 100 percent since surveyed people could choose more than one answer.
The results of this study showed some of the characteristics of casual carpoolers in the Houston region. The research expressed the concerns with potential liability issues that most likely will prevent public agencies from promoting casual carpooling (e.g., impact on transits revenue, safety of riders).
Figure 9. Houston Express Carpool System.
2.1.4 Seattle, Washington – Real-Time Ridesharing

In 2009, the Washington State Department of Transportation (WSDOT) provided a $400,000 grant to develop a pilot carpool project in the Seattle region. The pilot program incorporated the latest smartphone technology to arrange carpools at any time (i.e., real-time ridesharing). As opposed to casual carpooling, real-time ridesharing allowed riders and drivers to arrange convenient pick-up locations anywhere along the driver’s route. In 2010, Avego® (a global provider of software, hardware, and professional services for the efficiency of passenger transportation) was selected by WSDOT to conduct the pilot project (13). The pilot project consisted on testing the feasibility of real-time ridesharing using GPS-enable smartphones throughout SR 520. The busy corridor runs from Redmond, WA, to downtown Seattle. The pilot was formally launched on January 2011 with an outreach campaign to attract and register 1,000 participants (i.e., 250 drivers and 750 riders). The project was promoted as go520 across local television, radio, dedicated website, and others (e.g., The New York Times). Furthermore, to increase the number of participants, Avego offered incentives such as gas cards or rider credits.

As part of this campaign, the pilot was backed up by local employers including the University of Washington, Seattle Children’s, and the Microsoft Campus. The 1000 participants goal was reached by April 2011 (13).

After the outreach campaign, Avego documented some of the key findings and observations when promoting and recruiting for the go520 pilot as follows:

- Channels and media were effective in maximizing awareness of the pilot.
- Outreach conducted through the major employers and campuses was by far the most successful (i.e., Microsoft and the University of Washington).
- It is ideal to incorporate an element of joint marketing by using trusted channels to attract more people.
- Conduct meet-up events to personally introduce the program to participants.

A problem encountered when enrolling participants to the pilot program was the strict qualification criteria. Riders and drivers were required to provide their social security number and date of birth to perform a background check. Drivers needed to provide proof of auto insurance, driving record, and certify to the best of their knowledge that proper maintenance was provided to the vehicle (14). As a result of the steep registration requirements, participants lost interest on the pilot program. Of 962 individuals that signed up to participate, only 279 provided their social security. However, out of those 279 only 89 riders and 9 drivers passed through the strict screening process. During March, April, and May 2011, a survey was emailed to people who initially expressed interest but never completed the registration process. The survey was answered by 33 people out of a total of 127 surveys distributed. The most notable observations were (14):

- Forty-nine percent of respondents decided not to complete the registration process because of the social security number requirement.
- Fifty-eight percent of respondents found out about go520 by an email from their employer and 9 percent from newspaper, radio, or television.
- The most influential factors to participate were to save time and money at 58 percent and 42 percent, respectively.

As seen on Figure 10 bottom right corner, the go520 pilot utilized the Avego Driver smartphone application. Currently, the free app is available for windows and iOS phones (15).
Drivers earned $1.00 for each pick-up plus $0.20 per mile (minus a 15 percent transaction fee). All of the transactions were handled by the Avego system that automatically credits the driver’s account (16).

2.1.5 Zimride

In 2007, Zimride was founded to create a social, cost-reducing, and sustainable form of travel in the U.S. and now has more than 300,000 registered users. The program offers private rideshare communities to more than 50 of the nation’s leading companies and universities including Texas A&M University, Stanford University, University of California-Los Angeles, among others. For example, to implement Zimride to a college campus the ridesharing company provides a software license for an annual fee to provide students and staff an easy way to carpool. Some of the Zimride’s rideshare system features include (17):

- Built specifically for your institution with email verified sign-up.
- Engages users with social profiles and optional Facebook functionality.
- Provides hands-on marketing and promotional support to build a critical mass of users.

In order to register via the website Zimride users can choose the network to which they are part of to start requesting or offering rides in their area. When posting a request or offer users are required to input the following information:

1. Starting and destination points.
2. Specify if the trip is one time only or a regular commute (software gives flexibility to each day of the week) and departure time.
3. Specify the vehicle (previously registered by the driver into Zimride).
4. Price willing to pay or be paid for that particular trip (Ride payouts are made via PayPal one day after the ride is complete. If a round-trip, driver will get compensated after the returning trip).

5. Requested trip can be shared with all Zimride users or just a private rideshare network (see Figure 11).

6. Best matches are shown in a list with Google Maps to help support the user with a decision.

7. Information about potential carpoolers includes Facebook profile (if allowed public), current feedback, other riders (if any), email, phone number, and to which private network they belong. (When booking a ride and submitting payment the driver has 24 hours to accept, if they do not the rider does not get charged. If a driver fails to give a ride once accepted, riders can contact Zimride for a full refund).

8. The user can either request or offer a ride to the best match selected and if further coordination is needed they can make contact by phone, email, or Facebook.

![Zimride Homepage](image)

**Figure 11. Zimride Homepage.**

In order to expand their ridesharing community in San Francisco, CA, Zimride launched the Lyft app on August 30, 2012, for iOS and Android users (see Figure 12). The system incorporated a suggested donation option to facilitate the user experience. People interested in becoming Lyft drivers have to be at least 23 years old with a valid U.S. driver’s license. Each driver must have auto insurance, clean DMV, and go through a background check. Drivers are required to have a vehicle no older than the year 2000 plus able to pass a safety inspection.

On September 6, 2012, the Lyft team announced that the platform now provided drivers with a first of its kind $1M excess liability insurance policy as an additional safety measure (4). The insurance is 100 percent free for Lyft drivers while offering passengers peace of mind. The policy offers excess liability protection over a driver’s existing insurance while they are transporting Lyft passengers on a trip arranged through the Lyft platform (4).
2.1.6 Sidecar

The introduction of Sidecar to the Bay Area was a result of the increasing popularity of ridesharing. Zimride’s Lyft service could not keep up with the increasing demand, which lead to the implementation of a waiting list and cancellation fees. The availability of drivers was not enough to meet the passengers requesting rides. Furthermore, riders who cancelled a ride five minutes after the request was made would have a $5 cancellation fee (18).
Similar to Zimride, Sidecar provides a digital platform for instant peer-to-peer carpooling in the San Francisco Bay Area (see Figure 13). The ridesharing smartphone app first launched on June 26, 2012, for iOS and Android with a donation-based system (see Figure 14). Interested users must download the application, set up an account (including providing credit card information), and start offering or requesting rides. Riders can request specific drivers via a map within the app or they can choose to send the pick-up notice to all nearby drivers. Furthermore, users can block riders/passengers based on their carpooling experience for future trips.

In order to become a driver applicants must make a request to Sidecar (through webpage or within the app) and go through several steps. To address and ensure the safety of all the program users, Sidecar takes the following steps (3):

1. All drivers undergo a criminal background check.
2. Sidecar meets every driver in person before they hit the road.
3. Verify and keep on file every driver’s insurance, registration, and driver’s license.
4. Verify every rider’s identity via credit card and billing address.
5. Every ride is GPS tracked.
6. Drivers and riders rate one another. Users with low ratings are removed from the Sidecar community.
7. Maintain a standard vehicle quality level and only allow vehicles in tip-top shape.
8. The entire experience is cashless. All donations are made through the app.
9. “Share my ETA” feature allows sharing a current location with friends, family, and social networks.
10. Provide online support through the app.
Furthermore, to build up the trust between the passenger and the driver, both know the exact destination. This prevents that drivers are asked to ride somewhere they are not comfortable, but also gives riders the option to share their destination through live updates.

Figure 14. Sidecar Smartphone Application User Interface (3).

Sidecar has recently expanded to the city of Seattle as a result of $10 million raised by Lightspeed Venture Partners and Google Ventures (19). In December 2012, city community managers were appointed in San Francisco and Seattle (3). The Sidecar program has recently expanded to Los Angeles, Chicago, Boston, Brooklyn, Philadelphia, and Austin (19).

2.1.7 iCarpool

The service iCarpool was developed as a solution to reduce emissions and traffic congestion. iCarpool created partnerships with different entities including the state, county, local agency, city, or employer. It is currently serving 500 employers, state DOTs, transit agencies, and major metropolitan areas such as San Diego, California, Denver, Colorado, Washington State, Oregon, and Idaho. iCarpool was mainly innovated with the purpose of protecting the environment from vehicle emissions and to lower oil consumption by providing a rewards system (20).

iCarpool comes with software that provides web-based incentives and subsidies to the users directly from the system by tracking saved CO2 emissions, reduced VMT (miles not driven), saved fuel, and increased program participation. iCarpool features include offering user interface, branding option, tip logging, and administrative capabilities adapted to the agency needs, requests, and goals. The system includes API integration, which gives access to third parties to invest their own funds and to develop applications for the platform.

As a result, users may have access to the newest technologies from such investments. Furthermore, iCarpool also has approval to be used by companies such as Apple, Google, Microsoft, Facebook, Twitter, and many others (20).
The program offers access with an application available for iOS (not yet released for Android) and from the main webpage. Users can take advantage of registering in the program to find matches depending on location and schedule, or simply by deciding to be casual users of the system in a non-determined environment. The program combines fixed and dynamic ridesharing to have privately owned vehicles and vanpools available for users requesting a ride match on the go. However, the passengers using the ridesharing service are allowed to plan one time trip for each day only, if wanting to book more trips, it would become just a carpool. Vanpool and carpool can operate as self-service, as agency administrated carpool management, or both; new members decide if they want to be drivers, riders, or both.

Combining recurring (or fixed) and flexible carpooling helps maintain maximum seat usage among vehicles and support a real-time ridesharing system. Moreover, iCarpool provides carpools and vanpools with fixed routes to travel, time agreements, pick-up and drop-off locations, and an emergency ride home program. Figure 15 depicts the iCarpool system foundation.

![Figure 15. Features Included in iCarpool System.](image)

### 2.2 INTERNATIONAL EXPERIENCE

#### 2.2.1 Auckland, New Zealand – Raspberry Express

Similar to the San Francisco casual carpooling system, a flexible carpooling system pilot project was designed for Auckland, New Zealand, called the Raspberry Express. The Raspberry Express consisted on defining new routes based on the demand (or interest). The idea was to have people either vote or simply suggest a new one. On May 2, 2011, the first route of the flexible carpooling service started from Link Crescent to the Albany Bus Station (14 miles approximately). Other two routes were being considered (but not yet operational) for the Raspberry Express depending on their local support. One of them had the same pick-up point but goes to the CDB with an estimated trip distance of 25 miles. The third and last one proposed route went from Silverdale to the Albany Bus Station.
There were three types of costs associated with the flexible carpool program of Auckland, which included:

- The membership application processing.
- Ride-credits.
- Service fees.

Interested people would be charged a $20 application fee to review all the personal information, vehicle plates, insurance, etc. Next, the ride credits cost given to drivers by passengers were determined by a formula that Trip Convergence Ltd.³ had developed, but at the same time keeping the fare similar to a bus ticket for the same route (21). Each time someone used the system they would be charged a service fee of $1.00. At the time of this review the Raspberry Express did not gather enough funding to launch another pilot project or have the system operational.

---

³ Trip Convergence Ltd from Auckland, New Zealand, helps local, regional, and state agencies to achieve greater sustainability of their transportation systems by making it easier for people to share rides in private vehicles.
CHAPTER 3: EXPRESS CARPOOL OPERATIONS MODEL

3.1 OBJECTIVE

This chapter presents the most relevant flexible carpooling operational models. The research team analyzed the diverse challenges and opportunities for different flexible carpooling systems. The systems described include: stop and go, credit based, and real-time dynamic ridesharing.

3.2 STOP AND GO SYSTEM

The mechanics of the system consists of riders and passengers that meet at pre-determined locations to offer or catch a ride in a first come, first serve basis. However, passengers and drivers have the option to wait for another driver if the person does not feel comfortable sharing the ride (9). The pick-up locations are often near major intersections, shopping centers, park-and-ride facilities, or close to a HOV lane (11). The driver then travels to the agreed drop-off location (e.g., transportation facilities, executive centers, CBD). The evening pick-up locations are placed near the morning drop-off locations in case users need a ride home. Furthermore, these locations are usually near transit stations to offer another option to the passenger. Since Stop and Go system matches carpoolers without the need for pre-arrangement, the demand for passengers, and drivers might vary on a daily basis. Figure 17 shows a flexible carpool pick-up location in San Francisco, CA. Figure 18 represents a conceptual explanation on how the stop and go system operates.

Figure 17. Casual Carpool System in San Francisco, CA (9).
3.3 CREDIT SYSTEM

Technology plays an important role to track carpool rides. It also allows transferring credits between users through the implementation of a Credit System (14). The credit system tracks payments between carpoolers in the currency of ride credits. In the same manner as the Stop and Go system, there is no need for pre-arrangement as demand fluctuates on a daily basis (21).

The credit system has more of a business operational model character; it differs from the Stop and Go System as the credits are proposed to serve as an optional method for payment, implementing other features to enable tracking technology and credits transfers. However, the Credit System can apply also to a Dynamic Ridesharing System, varying in tracking the participation from a smartphone rather than other technology features.
The most common applied models for a Credit System require pre-screening membership, emergency ride home, and (depending on the combination with another system) tracking devices, or a smartphone ridesharing application with riders and drivers interfaces. There are two main types of Credit System Models, the combination with a Stop and Go System, and the combination with a Dynamic Rideshare System. Both combinations have the main target of using ride credits as a marketplace to benefit drivers and riders.

3.3.1 Stop and Go – Credit Based

A Stop and Go credit based system would work in the same manner as explained on section 4.2. The only difference lies on the ride credits marketplace for all carpoolers. The University of California, Davis did an exploratory study on how such system would work. The study showed the following recommendations and conclusions for implementation (1):

1. Visit the website and complete an application – driving record, criminal background check, auto insurance coverage, existing commune modes, flexible carpooling route, address, driver’s license number, email address, and terms of membership agreement. Decide if always a driver, always a rider, or always both; provide a photo to laser on membership card, pay application fee, and wait for identity confirmation email.

2. Upon acceptance (through email), pick up infrared membership card at the flexible carpooling office; if being a driver, also pick up infrared vehicle transceiver, achieved upon showing driver’s license and providing signed hard copy of membership agreement.

3. Activate Infrared Membership card at the facility by using a thumb print into the biometric figure on card. If being a driver, install infrared vehicle transceiver in the car at center of windshield.

4. Load money on online account to be able to buy credits and pay service fees. (A possible service fee of $1.00 can be charged per each ride, either given or taken. The credit price is to be more or equal to a bus fare ticket along the same route, or based on distance traveled such as a cost per mile).

5. Training on how the system works and on what the membership agreement form comprehends.

6. System use: Online account gets issued 10 free credits upon membership approval: 5 for the morning route and 5 for the evening route. The system presents two arrangements as for being a rider or a driver.

a) Rider: Every time a ride is taken, one credit will lower from the user account, depending on the number of rides per route. So if taking two rides in a day, one in the morning and one in the evening, the credits account will lose two credits for that day.

- **Morning Route.** The user drives to park-and-ride facility, parks and waits for a ride in the riders line, gets in the driver’s car and activates membership card by pressing the thumb on the biometric figure to confirm identity to the driver and the other passengers. The vehicle transceiver shall light up and display riders’ nicknames inside car along with the driver’s nickname to ensure safety. The user gets off at drop-off point.

- **Evening Route.** The user walks to a pick-up point and waits for driver to approach. The pick-up point is usually on the other side of the street where the drop-off point is located. Same process about activating membership card is repeated by pressing the thumb on the biometric figure. Drops off at drop-off point, transfer point, or park-and-ride facility.
b) Driver: Every time a ride is given, ride credits will increase in the user account, depending on the number of users who took the ride per route with each driver. So if giving two rides in a day, one in the morning to three users and one in the evening to two users, the credits account will gain five credits for that day.

- **Morning Route.** The user approaches the park-and-ride facility, activates membership card as getting into the car, gets into the facility’s drivers lane to load vehicle with riders, waits for them to activate their membership card and for the vehicle transceiver to display nicknames of passengers, and drives along the selected route to drop-off points.

- **Evening Route.** The user drives to a pick-up point access lane to wait for loading the vehicle with riders. Same process about activating membership card by pressing the thumb into biometric figure is repeated. Drops off riders at drop-off point, transfer point, or park-and-ride facility.

### 3.3.2 Dynamic Rideshare – Credit Based

This system represents flexible carpooling operated in real time. There are no pre-determined pick-up and drop-off locations. Instead, passengers can send a ride request through their smartphone to nearby riders participating in the program. Drivers are rewarded with credits that can be later exchanged for a ride or money in the marketplace as further explained on the section below. Furthermore, when a rider enters the driver’s car a one-time generated personal identification number (PIN) appears in the rider’s smartphone flexible carpooling application. The driver must enter that PIN in his application in order to verify the rider’s identity to ensure the safety of both participants (14).

### 3.3.3 Credits Marketplace

The credits marketplace is a “bid and ask” environment for riders and drivers to buy and sell ride credits. Both benefit because every time a rider enters a vehicle, a ride credit is deducted from the rider’s account and transferred to the driver’s account. For example, if a driver picks up three passengers then the driver gains three ride credits (1). Accumulated ride credits can be sold to interested riders through the marketplace or used to take a ride if desired. Credits can be transferred through a membership ID or a one-time generated PIN into the smartphones.

However, to recognize the IDs of all passengers the private vehicles would need a special device to read and identify each passenger. This could get costly and cumbersome to implement. On the other hand, a smartphone application could be a more viable way to monitor and support the carpool program. Furthermore, to maintain the smart system operational, a small fee would need to be charged for each trip to keep releasing updates and improvements for the smartphone application, webpage, support personnel, emergency ride home, etc. Figure 19 shows the basic design of a carpool credit-based system.
3.4 DYNAMIC RIDESHARE

The barriers of having a predetermined pick-up and drop-off locations are overcome with dynamic rideshare, a system that uses GPS-based technologies operated by smartphones. Dynamic ridesharing programs started 15 years ago, but none of these were using GPS-based applications due to technology limitations. At the time, ridesharing was provided via telephone operators, email, and web technology. However, with the increasing popularity of smartphones real time rideshare is now more viable and accessible to the people. Developers have released various applications to provide a digital based dynamic carpool infrastructure. Using smartphone’s specialized applications they can track shared rides travel routes (for safety reasons), send ride requests on the go, compensate drivers via donations/payments, provide support to the users, estimate pick-up time with current traffic conditions, incorporate a rating system, and match drivers with riders in real time. Figure 20 shows the dynamic ridesharing system concept.
Figure 20. Dynamic Ridesharing System Summary.
CHAPTER 4: LOCAL TRANSPORTATION SYSTEMS

This section describes current transportation modes available in the city, which are the Vámonos Vanpool Program, a ridesharing website called iCarpool, and the local transit system Sun Metro. A small description of the upcoming Bus Rapid Transit system is also included.

4.1 VÁMONOS VANPOOL SYSTEM

El Paso County - Vámonos Vanpool Program, operated by VPSI Inc., offers a commuting service monthly contract for anyone riding to and from work. The contract is renewed month to month to avoid long term commitment. Vámonos Vanpool Program receives funds from Congestion Mitigation Air Quality (CMAQ) to pay the monthly vehicle expenses such as insurance, maintenance, and washes, while the users pay the gas and parking costs at the beginning of each month. The money collected from the users goes into a gas card called VPSI ConnectCard. This allows the primary driver to pay for gas when needed during the month. The program also offers an emergency ride home service in which each rider has the right to have up to 4 emergency ride homes.

The vanpool program requires the completion of an application form, an agreement, and a monthly fee. There must be from 5 to 15 people for a van request, a primary driver, two alternate drivers for each van, a central meeting location, and an agreeable work schedule. The primary driver can be anyone enrolled in the program who voluntarily agrees on being responsible for the van in a monthly basis (e.g., maintenance, maintenance, collecting the monthly fees). The primary driver is allowed to use the van for personal purposes during the weekends or after work hours for no more than 200 miles per month. The alternate driver takes care of the van in case the primary driver is not able to. The step to step procedure as described by Vámonos Vanpool is the following (22):

1. Determine your basic route.
2. Estimate monthly expenses.
3. Advertise your route and recruit riders.
4. Identify candidates for volunteer driver/ coordinators and alternate drivers.
5. Qualify driver candidates.
6. Follow up steps.
7. Hold a group formation meeting with potential riders.
8. Determine start date and collect first month’s payment.
9. Establish van rules and, if possible, register all participants in any Guaranteed Ride Home or local subsidy programs that may exist in your area.
10. VPSI will deliver the van to you.

Interested commuters can visit the vanpool ride website to look at all the available vans/routes in the region (see Figure 21). This will tell users if there are seats available for a particular vanpool, the schedule, and the origin and destination of the trip. Popular destinations in the region are the William Beaumont Army Medical Center, Fort Bliss, and White Sands.
The current contract from January 2013 to January 2014 consists of 52 vans with an average capacity of 8 users per van to provide a total of 416 available spaces. El Paso commuters have the option to Vanpool, however, with the understanding that it is a pre-arranged monthly program (23).

4.2 ICARPOOL

As mentioned in Chapter 2, iCarpool is a free online ridesharing program that provides a dynamic ride matching based on the user’s travel time, route, and preferences. On February 27, 2013, the city of El Paso’s Economic Development and Sustainability Division announced the implementation of the iCarpool as El Paso’s first ridesharing program (24). Users can sign up to the program through a dedicated website and create a profile, enter the trip information, and their preferences (e.g., non-smoking, gender). The user must enter the origin and destination of their trip. In addition, it is required to specify the desired departure and return time with the option to set a flexibility time frame (e.g., 15 minutes).

The last step consists on choosing the travel mode, which can be either carpool, bike, or walk. Once the profile has been created, the iCarpool program will matched the user with someone with a similar commute. After the match has been provided, the user will receive instructions of how to contact this person. The iCarpool’s real-time ridesharing program is available on smartphones, as well as social networking sites such as Facebook and Twitter.

4.3 SUN METRO

The public transportation system in El Paso, Sun Metro, has been one of the main transportation modes for students at UTEP and EPCC. Sun Metro has a standard fee of $1.50, and a student reduced fare of $1.00 with a valid student identification; if the passenger needs more than one route to reach his/her destination, a free transfer is provided. Sun Metro also provides monthly, weekly, and day passes. The student monthly pass cost is $30.00, the student weekly pass is $7.00, and the standard daily pass is $3.50. Students get one free transfer when they pay their student fare. The number of transfers needed for each student to get to the college.
or university location depends on how far does the student lives from the university. The headway of the busses at each location can vary from 15 minutes to one hour depending on the route (25).

There are six routes that have UTEP as a final destination. The bus routes are the following: 10, 11, 14, 15, 70, and 204. Routes 70 (Eastside terminal) and 204 (Downtown Transfer Center) are considered express routes due to their fewer bust stops. EPCC has specific routes for each campus. The Northwest campus, located at the far west side of the city has only one route available, route 17. The Rio Grande campus, located at the city’s downtown area, has greater coverage due to its vicinity with UTEP. The routes available for this campus are 10, 11, 14, 15, 34, 70, and 204. The Transmountain campus (North East of the city) has three routes available which are: 7, 46, and 45. The Valle Verde campus is the largest community college in the district as it handles most of the student services. This campus counts with bus routes 7, 65, and 66. The Mission El Paso campus (located at the Far East region of the city) has only one bus route, 84. Figure 22 shows the six bus routes available to UTEP students. All of the routes depart from the Downtown Santa Fe Transfer Center, except route 70, which departs from the Eastside Terminal.
The community college campus on the northwest region of the city has only one bus route available, route 17. As shown in Figure 23, it runs from Mesa Street to Loop 375. This route does not depart or arrive to the Downtown Santa Fe Transfer Center. Route 17 departs from the Westside Transfer Center.
Figure 23. Sun Metro Routes Commuting to EPCC Northwest.

The Rio Grande Community College campus counts with seven routes that pass by the institution (see Figure 24). This is due to its proximity to the Downtown Santa Fe Transfer Center and UTEP. Routes 204 and 70, shown in Figure 24, were created specifically to UTEP and EPCC students, decreasing the frequent stops toward both institutions.
Figure 24. Sun Metro Routes Commuting to EPCC Rio Grande.

The Transmountain Community College Campus has three routes available: routes 45, 46, and 7. Routes 45 and 46 depart from the Northgate Terminal located on the northeast region of the city. These two routes are EPCC circulators, having minimal designated bus stops and running only a certain perimeter around the northeast campus. Route 7 departs from the Mission Valley Transfer Center located on the far eastside area of the city. As it can be seen in Figure 25, route 7 passes by Hunter Drive and North Loop Drive, where Valle Verde Community College is located.
Figure 25. Sun Metro Routes Commuting to EPCC Transmountain.

Figure 26 shows the three bus routes that pass by the Valle Verde Community College. Two of these routes, 65 and 66, depart from the Downtown Santa Fe Transfer Center and travel toward the far southeast region of the city. Route 7 departs from the Mission Valley Transfer Center and travels toward the Transmountain Community College. The bus headway for these three routes is usually between 45 minutes to one hour.
The Mission del Paso Community College has only one bus route (i.e., 84) available for students. This is due to the location of the institution and the low amount of students that attend this campus.
4.4 EL PASO BUS RAPID TRANSIT SYSTEM

The city of El Paso is in the process of implementing a Bus Rapid Transit (BRT) system in the region known as Sun Metro Brio. The new public transit service is expected to deliver a higher quality ride, improved speed, and reliability for El Pasoans. The BRT system will deploy 60-foot articulated buses in mixed traffic with frequencies of 10 and 15 minutes during peak and off-peak hours, respectively. This will be accomplished with fewer stops and signal prioritization
along the specific corridors. Furthermore, each bus will have a seating capacity for 58 passengers plus space for 25 standing passengers (26).

Four BRT corridors will be implemented in the region starting with N. Mesa St., Alameda Ave., Dyer St., and Montana Ave. The N. Mesa St. corridor is expected to start operating in summer 2014. The second BRT corridor to be implemented will be at Alameda Ave., and it is scheduled to begin in spring 2015. The third and fourth corridors (i.e., Dyer St. and Montana Ave.) are projected to be operational in 2017 and 2019, respectively.

The Mesa corridor will be 8.6 miles in length with 22 stop stations. The BRT will depart from the Downtown Transfer Center with the Westside Transfer Center as its destination. The Montana corridor will be 16.8 miles long with 26 stops. The route will start at the Five Points Terminal (located at central El Paso) and end at the Far East Side Transfer Center. The Alameda Ave. BRT corridor will be the second longest covering 14.5 miles with 29 stop stations. The route will depart from the Downtown Transfer Center and toward the Mission Valley Transfer Center. The 10.2 miles Dyer corridor will depart from the Downtown Transfer Center and end its trajectory at the Northeast Transfer Center with a total of 22 stop stations. All corridors are shown in Figure 28.

The upcoming BRT system promises to give El Paso residents a reliable commuting choice with lower travel time than the current transit structure. The first BRT corridor (i.e., Mesa) will positively impact students who are currently attending UTEP. Future corridors might be also beneficial for those attending the EPCC campuses around the region. However, at the time of this report the research team is not able to gather any feedback from BRT users since it is still months away from implementation.
Figure 28. El Paso Bus Rapid Transit Corridors.
CHAPTER 5: PUBLIC PERCEPTION

The literature review conducted showed that there are different methods/models to encourage people to carpool. Various platforms have been tested in the U.S. and abroad with the most popular being dedicated websites to match potential carpoolers, dynamic ridesharing using smartphones, and casual carpooling (or slug lines). Such methods, however, might or might not work depending on the transportation infrastructure of the region.

For the city of El Paso, casual carpooling would be less than ideal since that there are no HOV lanes. Meeting the occupancy requirements for an HOV lane is a strong incentive for casual carpooling drivers currently participating in cities such as San Francisco and Washington, D.C. However, one of the current project studies in the El Paso district is looking at doing operational improvements on I-10. This would add one lane in each direction (on the east side of the city) by reducing the current lane and shoulder widths to accommodate for that fourth lane (27). The possibility of this additional lane being an HOV only lane is still to be determined, but could serve as a significant carpooling incentive in the region.

Another method explored was organizing carpoolers through a dedicated website. As mentioned on section 3.2, the city of El Paso’s Economic Development and Sustainability Division implemented an online ridesharing program called iCarpool. Locals can sign-up through a dedicated website to make use of this service that will match carpoolers with a similar commute. iCarpool’s service also offers a smartphone application called TripLogger. However, this application lacks some of the dynamic carpool matching features that other services have implemented. This application is mainly used to log trips from the smartphone to the user’s personal trip log calendar from the main website (20). This could pose problematic for the future of this program given the popularity of smartphones with GPS integration that can facilitate the carpool matching process on-the-go. For example, Zimride has been focusing on their application Lyft as the peer-to-peer service has being growing successfully across the U.S. The easier the matching process is for the user, the more likelihood that local residents will share a ride.

The research team explored the current practices on dynamic ridesharing. Over the past two years, successful dynamic ridesharing systems such as Sidecar and Lyft have been expanding at a significant rate across the U.S. It is for this reason that the researchers decided gather feedback from the UTEP and EPCC students by focusing on hypothetical questions regarding dynamic ridesharing.

The survey consisted of 13 questions with an average response time of two to three minutes (see Appendix A). The carpooling survey was distributed in-person to students of EPCC and UTEP. The surveyors used tablets and specialized software (i.e., QuickTapSurvey) to perform the data collection efforts. This improved the way the survey was distributed by making it quicker and easier to understand for the participants. Furthermore, all responses were safely stored in a cloud server once a wireless connection was established with the tablets.

5.1 EL PASO COMMUNITY COLLEGE CAMPUSES

The research team gathered a total of 754 surveys from all EPCC campuses in the El Paso area. The community colleges included in the study were Valle Verde, Northwest, Rio Grande, Transmountain, and Mission Del Paso. The majority of the responses (i.e., 51 percent) were obtained from the Valle Verde campus as it is the largest one in El Paso (see Figure 29). However, the surveyors had difficulty finding a large amount of participants at smaller campuses.
such as Mission Del Paso. The UTEP response rate of 6 percent corresponds to the students that were attending both campuses in the current semester.

Figure 29. Survey Participants College Campus Attendance Rate.

As expected, the majority of the students interviewed commute as an SOV with a rate of 58 percent. The results show that around 18 percent carpool with another person. The same rate was found for people using the local transit service. Last, 5 percent of the students choose to walk or ride a bike to the campus.

Figure 30. Commuting Mode to College.
The third question of the survey asked students to specify the days that they commute to college. Results show that attendance was pretty much even for all weekdays with a very small percent that attend on Saturdays.

**Figure 31. Students Weekly Attendance Rate.**

Figure 32 shows the most common time that students arrive to their campus. Almost 50 percent of the surveyed students arrive between 7 a.m. and 9 a.m. After 9 a.m., approximately 41 percent of the students arrive to the campus. Only a small percentage (i.e., 12 percent) needs to attend class before 7 a.m.

**Figure 32. Campus Arrival Time.**
Similarly to the previous results, students were asked to specify their departure time from the campus. Around 53 percent leaves the campus between 1 p.m. and 5 p.m. In addition, surveyors often observed that the demand for transit was higher during this time period.

**Figure 33. Campus Departure Time.**

Figure 34 and Figure 35 show the current enrollment status and gender of students participating in the study. Most of the students were attending college as full-time students. Results also showed that 84 percent of those surveyed were in between the age of 18 to 24 (see Figure 36). With smartphones popularity, it was no surprise that 80 percent owned some type of smartphone with GPS integration.

**Figure 34. Students Current Enrollment Status.**
Figure 35. Gender Specification.

Figure 36. Students Age Category.
Participating students were asked to specify vehicle ownership status and vehicle year. Approximately 40 percent of the students that attend EPCC do not own a vehicle, therefore, relying on transit or carpooling to reach the campus.

Figure 37. Smartphone Ownership.

Figure 38. Vehicle Ownership.
Figure 39. Vehicle’s Model Year Greater or Lower than Year 2000.

Of those attending EPCC, only 13 percent commute from Juarez. Students crossing the border on a regular basis do it through either Bridge of the Americas (BOTA) or Paso del Norte. Only a small percentage (14 percent) crosses through Ysleta. This was expected as lot of students walk across Paso del Norte to get to the Sun Metro Santa Fe Transfer Center. Students crossing through BOTA save the toll costs incurred at other ports of entry.

Figure 40. Trip Start Region to Commute to College.
Survey participants were asked their willingness to try a flexible carpool program in the border region. Of the 754 participants, 45 percent responded they would be interested in trying such program. Those who answered “no” or “unsure” were prompted to a last question to provide their main reasons. Students were most reluctant due to security concerns, as seen in Figure 43.
Figure 43. Main Reasons Preventing People to Consider Flexible Carpooling.

Students that were interested in the carpool program stated their preference as far as being a driver, passenger, or both. Figure 44 shows the results. More than 90 percent of the students preferred to have access to a short profile for those participating in the program.

Figure 44. Students Role of Interest in Carpooling.
5.2 THE UNIVERSITY OF TEXAS AT EL PASO

A total of 489 surveys were collected from UTEP. The results show that the majority of the students commute as an SOV to college. Furthermore, 19 percent of the participants share their ride while only 7 percent uses the local transit system.

Surprisingly, the attendance rate yielded the same at 21 percent from Monday through Thursday. A smaller percent of the students at 14 percent and 3 percent attend college on Fridays and weekends, respectively (see Figure 47).
Figure 47. Students Weekly Attendance Rate.

Figure 47 show student’s usual arrival time to the campus. As expected, most of the students arrive between 7 a.m. and 9 a.m. After 9 a.m., 23 percent of the students arrive to the campus.

Figure 48. Campus Arrival Time.

Similar to the previous graph, Figure 49 shows the usual departure times from the university. About 64 percent of the students depart from campus between 1 p.m. and 5 p.m. After 5 p.m,
approximately 22 percent of the students depart from campus. Only 14 percent depart before 1 p.m.

![Figure 49. Campus Departure Time.](image)

The fifth question on the survey asked the students about their current enrollment status. Of those surveyed, 94 percent are enrolled as full time students and only 6 percent are part time students.

![Figure 50. Students Current Enrollment Status.](image)

Figure 51 and Figure 52 depicts the students' gender and age categories, respectively. The majority of the students that participated in the survey were of age between 18 and 24.
Nowadays most of the students own a smartphone and a car. Figure 53 and Figure 54 show the smartphone and vehicle ownership, respectively. Figure 55 shows the vehicle’s model year to classify them between greater or lower than the year 2000. Not surprisingly, almost 90 percent of the students interviewed owned a smartphone. In addition, 80 percent of them owned a vehicle.
Figure 53. Smartphone Ownership.

Figure 54. Vehicle Ownership.
Fifty percent of the students commuting from Ciudad Juarez use the Santa Fe Bridge as their main port of entry, 32 percent cross the border through BOTA, and 19 percent of the students cross through the Zaragoza Bridge (Ysleta). These results were expected since the Santa Fe Bridge is the closest port of entry to UTEP.

Figure 56. Trip Start Region to Commute to College.
Figure 57. Port of Entry Used by Students Commuting from Juarez.

In the survey, students were asked about their willingness to try a flexible carpooling program in the city of El Paso. According to the results shown in Figure 58, 34 percent of the students who participated in the survey would be interested in trying the program. Students who were not willing to participate in the program and those who were not sure about trying the carpooling system were prompted to answer one last question regarding their main concern. As shown in Figure 59, almost 40 percent of the students were unwilling to participate in the program due to security concerns.
Students interested on carpooling were asked to specify what role they would be willing to take in the program. Figure 60 shows the results in which 40 percent were inclined to be both a passenger and a driver. Furthermore, 72 percent of the surveyed students would prefer to have access to a short personal profile of the people participating in the carpooling program.
5.3 UTEP AND EPCC SURVEY CORRELATIONS

The research team developed several correlations using the survey data collected from both institutions. Such relationships showed the influence in the student’s decision to participate in the carpooling program by taking into consideration the student’s gender, vehicle ownership, and commuting mode.

The first correlation shows the willingness of the students to participate in the carpooling program, and it also defines the preference of each student according to their gender. As shown in Figure 62, the student’s gender did not show a great impact on deciding whether or not to participate in the program. The answers’ rate between the females and males are very similar in every answer provided by the students.

Figure 62. Relationship between Males and Females Willing to Try Carpooling System.
For the second correlation, the students who were not willing to be part of the carpooling program were asked for their main concerns. According to the results showed in Figure 63, there was not a visible difference in the ratio between the females’ and males’ main concerns responses except for one, security concern. The main issue students have regarding their participation in this program is safety. As shown in Figure 63, 38 percent of the females and 31 percent males stated their unwillingness to try an express carpooling system due to a safety concern. The second main concern students had was the reliability of the carpooling program.

![Figure 63. Main Concern Why Students Would Not Be Willing to Carpool.](image)

The third correlation was made to identify if the vehicle ownership status of the student would have any impact on the student’s willingness to participate in the carpooling program. Figure 64 shows that approximately 46 percent of the students who do not own a vehicle are more willing to try the program. About 38 percent of the students who own a vehicle were enthusiastic to try carpooling with other students. As it can be seen in the charts below, around 30 percent of the students who own a vehicle, and those who do not, are not willing to participate in the carpooling program. This might be due to the student’s concerns mentioned in the previous graph.
Among the students who own a vehicle and were not willing to carpool with other people, 34 percent of the students were concerned about their security, and 28 percent about their commitments before or after school (see Figure 65). As shown in the graph, students who own a vehicle have more concerns about trying to carpool with other students, compared to those who do not own a vehicle.

Figure 65. Main Concern among Students Who Own or Not a Vehicle about Trying Carpooling.

---

**Figure 64. Students’ Willingness to Try Carpooling Depending on Car Ownership.**

Among the students who own a vehicle and were not willing to carpool with other people, 34 percent of the students were concerned about their security, and 28 percent about their commitments before or after school (see Figure 65). As shown in the graph, students who own a vehicle have more concerns about trying to carpool with other students, compared to those who do not own a vehicle.
It was of interest to know if the commuting method of each student would persuade them to try an express carpooling program to get to their destination in a faster and reliable way. According to Figure 66, among the students willing to try the program, approximately 51 percent of them use the public transportation to go to college, and 46 percent of the students willing to participate are already carpooling with more than one person. Among the students who most hesitate about trying carpooling are those who drive as an SOV and those who walk or ride a bicycle to college.

Figure 66. Willingness to Carpool Depending on Current Commuting Mode.

5.4 ZIP CODE – TRIP GENERATORS

During the survey process, students were asked to specify their zip code and the closest major intersection to their home. This allowed the researchers to identify the areas in El Paso where most of the students originate their trip. Figure 67 and Figure 68 show the results for EPCC and UTEP, respectively. Students commuting from the Far East side of El Paso such as N. Zaragoza Rd. (near Montana Ave.), Horizon, and Socorro have limited options on how to arrive to their corresponding campus. Transit routes in this region are somewhat limited and most of them require at least one transfer. Surprisingly, as seen in Figure 68, there is a significant concentration of students commuting to this campus from the east side near Loop 375 and I-10.
Figure 67. EPCC Zip Code Area Classification.
Figure 68. UTEP Zip Code Area Classification.
CHAPTER 6: DYNAMIC RIDE SHARE SWOT ANALYSIS

A Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis was conducted to further evaluate all aspects of implementing a dynamic ridesharing system in El Paso. The SWOT analysis is presented in a 2×2 matrix as shown in Table 2. One of the major challenges that current dynamic rideshare companies have faced are policy regulations that can prevent them from delivering such service. For example, on April 21, 2014, the DC Taxicab Commission wanted to shut down Sidecar by citing standards for public safety and access (28). This is just one example, but donation-based dynamic ridesharing programs have encountered various regulation and policy challenges along the implementation phase. Typically, support from the local community is required to keep such innovative transportation solutions operating and provide the users with an alternative commuting choice.

Table 2. Dynamic Rideshare SWOT Analysis.

<table>
<thead>
<tr>
<th><strong>Strengths</strong></th>
<th><strong>Weaknesses</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>- No pre-determined pick-up/drop-off locations</td>
<td>- New method of carpooling might take time to fully develop in the region</td>
</tr>
<tr>
<td>- No need for pre-arrangement</td>
<td>- Need significant resources to protect the safety of drivers and riders (i.e., background check for drivers, insurance, support personnel)</td>
</tr>
<tr>
<td>- Promote carpooling using innovative technology</td>
<td>- Need to establish a strong communication channel with the target community</td>
</tr>
<tr>
<td>- Complement the public transportation system</td>
<td></td>
</tr>
<tr>
<td>- Provide college students with an environmentally friendly commuting mode</td>
<td></td>
</tr>
<tr>
<td>- Reduce SOVs from the local transportation infrastructure</td>
<td></td>
</tr>
<tr>
<td>- Improve mobility</td>
<td></td>
</tr>
<tr>
<td>- Improve air quality</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Opportunities</strong></th>
<th><strong>Threats</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>- Recent dynamic rideshare companies have been expanding across the U.S. successfully</td>
<td>- Local policy and regulations might delay the implementation of a cashless-based dynamic ridesharing system</td>
</tr>
<tr>
<td>- Smartphone applications keep improving and offering additional options for users</td>
<td>- Demand can be low if the system is not marketed and advertised properly</td>
</tr>
<tr>
<td>- Promote a green/environmentally friendly lifestyle for the city of El Paso</td>
<td></td>
</tr>
<tr>
<td>- Work with local transportation agencies to promote the new commuting system</td>
<td></td>
</tr>
<tr>
<td>- Can target the whole El Pasoans, not just college students</td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER 7: CONCLUSIONS AND RECOMMENDATIONS

The increasing population in the border region of El Paso, TX, and its neighboring city Juarez, Chihuahua, has led to significant traffic congestion levels during peak hours. Limited resources and right of way constraints are some of the major reasons that make it difficult to expand or improve the existing transportation infrastructure. Implementing HOV lanes might encourage additional carpooling in the city, but there can be high costs associated with building a new facility. However, an innovative alternative could be a dynamic ridesharing program using smartphones technology in an effort to improve vehicle mobility and air quality in the region as well as providing an additional commuting mode.

The literature showed that dynamic ridesharing programs in the U.S. have been gaining popularity with an increasing user base. Systems such as Sidecar and Lyft have both developed hassle-free and user friendly interfaces (i.e., applications) that can be accessed through any smartphone with GPS capabilities. As a result, the service is open to almost anyone that owns a smartphone. Cities where such service is being offered but it is not limited to include: Austin, Dallas, Houston, San Diego, San Francisco, Los Angeles, Boston, and Seattle. These dynamic ridesharing programs also offer customer support, cashless transactions, and safety procedures to protect both their drivers and riders.

In order to study the feasibility of a similar dynamic ridesharing program in El Paso the research team gathered the feedback from more than 1,200 students (i.e., target audience) attending UTEP or one of the EPCC campuses in the city. The surveys showed that approximately 80 percent of those interviewed owned a smartphone with GPS capabilities. Furthermore, approximately 40 percent of the students showed some interest in trying a similar dynamic ridesharing program as those currently operating in the U.S. The main concern of those that were unsure or did not want to get involved in the program was due to security concerns (i.e., background check, documents verification, vehicle inspections). Of those students whose main concern was security 38 percent of them were females and 31 percent males. Furthermore, the results showed that students who did not own a vehicle were more willing to give the dynamic ridesharing program a try with a 46 percent response rate as opposed to 38 percent of those that do own one. Based on current commuting mode, students who were currently taking the bus had the highest response rate (of 51 percent) to give the dynamic rideshare program a chance followed by those that already carpool with more than one person (46 percent).

A dynamic ridesharing system can be an attractive option for students in the city of El Paso. The no need for pre-arrangement might attract more students into trying carpooling, as opposed to having a fixed schedule that might conflict with other commitments. However, in order for the system to work a strong communication channel would have to be established with students from both UTEP and EPCC. This would help clear any questions and/or concerns that they might have as well as promoting the service in-campus. Proper advertisement of a new carpooling system would be critical to the success of it. A dynamic rideshare program could provide students with another environmentally friendly commuting option where they could meet other students and help mitigate the current traffic congestion conditions during peak hours in the region.
REFERENCES


APPENDIX A: SURVEY

Flexible Carpooling Survey

Disclosure
The Texas A&M Transportation Institute is currently developing a project to develop a strategy to implement a flexible carpooling system in the University of Texas at El Paso and El Paso Community College.

Your name or identification will never be asked on this survey. The survey is completely anonymous and voluntary. Survey will take approximately between 5 and 7 minutes to answer.

Project Background
Carpooling has been seen as one of the lowest cost alternatives to reduce the amount of vehicles on the road; however, most of the carpooling programs implemented across the U.S. have failed to live up to expectations. One of the main reasons behind it is that carpoolers face various issues when trying to find a partner with similar school/work schedules. Flexible carpooling helps address this problem because there is no need for pre-arrangement. This way people are not tied to someone else’s school/work hours while still being able to share rides with the community.

Flexible carpooling gives drivers and passengers the opportunity to share rides and costs with no need for pre-arrangement. In other words, drivers are given the option to share a ride using their own vehicle when a request is made by a passenger. This would be facilitated with a carpooling application on your smartphone since it would provide users with a friendly user interface, short profiles of drivers/passengers, and real-time data to know who, where, and when to find a safe ride to your destination (e.g. UTEP, EPCC, home).

1. What college campus are you currently attending?
   - The University of Texas at El Paso
   - El Paso Community College – Valle Verde
   - El Paso Community College – Rio Grande
   - El Paso Community College – Transmountain
   - El Paso Community College – Northwest
   - El Paso Community College – Mission del Paso

2. How do you usually commute to your college campus?
   - Drive alone
   - Carpool with another person
   - Carpool with more than one person (2+)
   - Take the Bus
   - Walking/Bicycle

3. Which days of the week do you make this trip?
   - Monday
   - Tuesday
   - Wednesday
   - Thursday
   - Friday
   - Saturday
   - Sunday
4. What are your usual arrival and departure times to/from the campus?

<table>
<thead>
<tr>
<th>Arrival</th>
<th>Departure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before 7 am</td>
<td>Between 9 and 11 am</td>
</tr>
<tr>
<td>Between 7 and 9 am</td>
<td>Between 11 and 1 pm</td>
</tr>
<tr>
<td>Between 9 and 11 am</td>
<td>Between 1 and 3 pm</td>
</tr>
<tr>
<td>Between 11 am and 1 pm</td>
<td>Between 3 and 5 pm</td>
</tr>
<tr>
<td>Between 1 and 3 pm</td>
<td>Between 5 and 7 pm</td>
</tr>
<tr>
<td>Between 3 and 5 pm</td>
<td>Between 7 and 9 pm</td>
</tr>
<tr>
<td>Between 5 and 7 pm</td>
<td>After 9 pm</td>
</tr>
</tbody>
</table>

5. What is your current enrollment status?
- Full-Time Student
- Part-Time Student

6. Please specify your gender
- Male
- Female

7. Which category represents your age?
- 18 - 24
- 25 - 34
- 35 - 44
- 45 - 54
- 55 – or older

8. Do you own a smartphone?
- Yes
- No

9. Do you own a vehicle?
- Yes (if yes proceed to 9b)
- No (if no proceed to 10)
  9b Please specify vehicle’s year:

10. From which area do you commute to the campus?
- U.S. (proceed to 10b)
- Ciudad Juarez (proceed to 10c)

10b. Please specify nearby major intersection and zip code

10c. Which Port of Entry you utilize to cross the border?
- Zaragoza
- Bridge of the Americas (Puente Libre)
- Santa Fe
- Santa Teresa

11. Would you be willing to try carpooling via a FREE cell phone application where drivers get compensated by the passengers (completely voluntary) for the amount of miles traveled (no cash would be exchanged between the driver and the passenger(s))?
- Yes (if yes proceed to 12)
- No (if no proceed to 11b)
- Unsure (if unsure proceed to 11b)

11b. State why (Check all that apply).
- Security concerns (e.g., driving with a stranger)
- Reliability concerns (e.g., missing a ride, tardiness)
- Commitments before/after university
- I don’t have a strong enough incentive
12. Which carpool role would you be interested in taking?
- Driver
- Passenger
- Both

13. Would you be more likely to contact other students to carpool through the FREE cell phone application if they had a photo and a short personal profile?
- Yes
- No