5 PARKING TECHNOLOGY AND EFFICIENCY

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5.1 INTRODUCTION

Transportation is the second largest source of greenhouse gas emissions in the United States following the electric power sector. According to the Center for Climate and Energy Solutions and US Environmental Protection Agency, 28% of total U.S. greenhouse gas emissions come from the transportation sector (2014). The U.S. Department of Energy states that light vehicles consume the most energy, about 59% of the energy used for transportation (2014). In order to reduce CO_2 emissions and make a conscience effort for a greener campus, Chapman University must address sustainable transportation technology and increase parking efficiency.

Transportation, specifically parking, plays a significant role in the student satisfaction at a university. Though parking is paramount, it is rarely up to students' standards. As Chapman University's population continues to grow, parking will be more impacted, the time needed to find a parking spot will increase, and more of fossil fuels will be used. Recently, parking technology has improved and allowed colleges and universities to upgrade their parking systems and infrastructure. This parking technology will not only save students' time in finding a parking spot, but will also reduce a university's scope three carbon emissions.

5.2 HISTORY OF TRANSPORTATION AT CHAPMAN

5.2.1 Student Population Growth

Since 2002, Chapman's student population has increased, especially its undergraduate population. As seen in **Figure 5.1** and **5.2**, the undergraduate student population increases steadily and the graduate student population skyrockets in recent years.

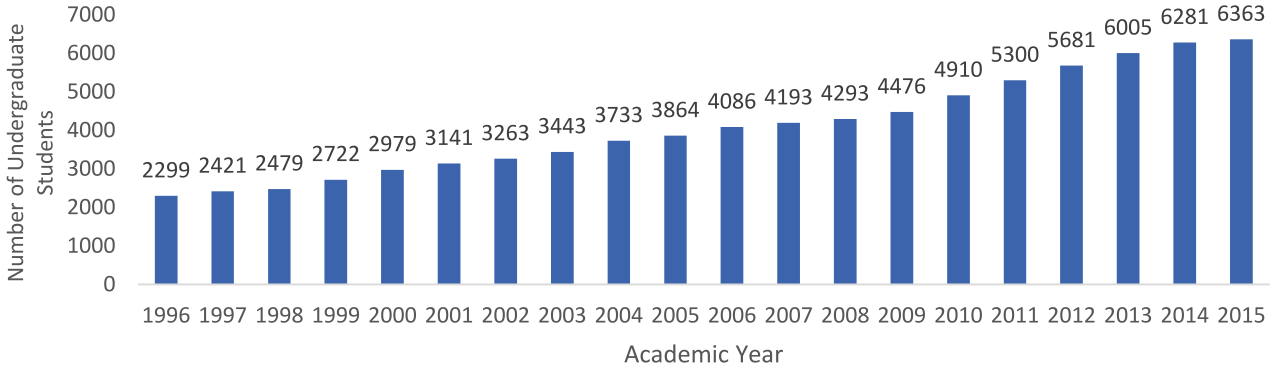

Figure 5.1 - *Undergraduate student population growth from 1995-2015.*

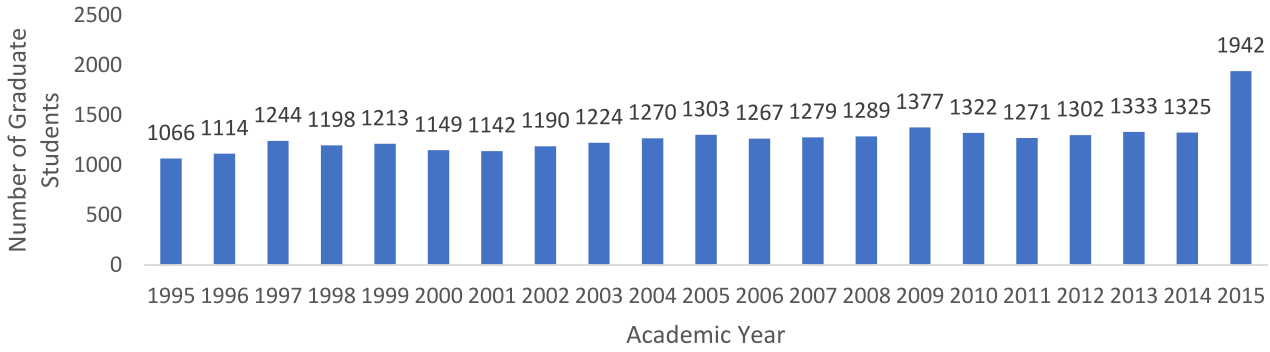

Figure 5.2 - *Graduate student population growth from 1995-2015.*

With this growing student population, more parking permits have been issued each year (**Figure 5.3**). In 2006, the Lastinger parking structure was built adding 893 parking spots. However, the constructions of the Musco Center for the Arts and the new Center for Science and Technology lead to the destruction of two small parking lots. These parking spots were reserved for campus visitors such as prospective students and their families. Currently, these guests are parking in Lastinger parking structure, adding more congestion for current students. On-campus housing has also not grown leading more students are moving off-campus and drive instead of walk to school.

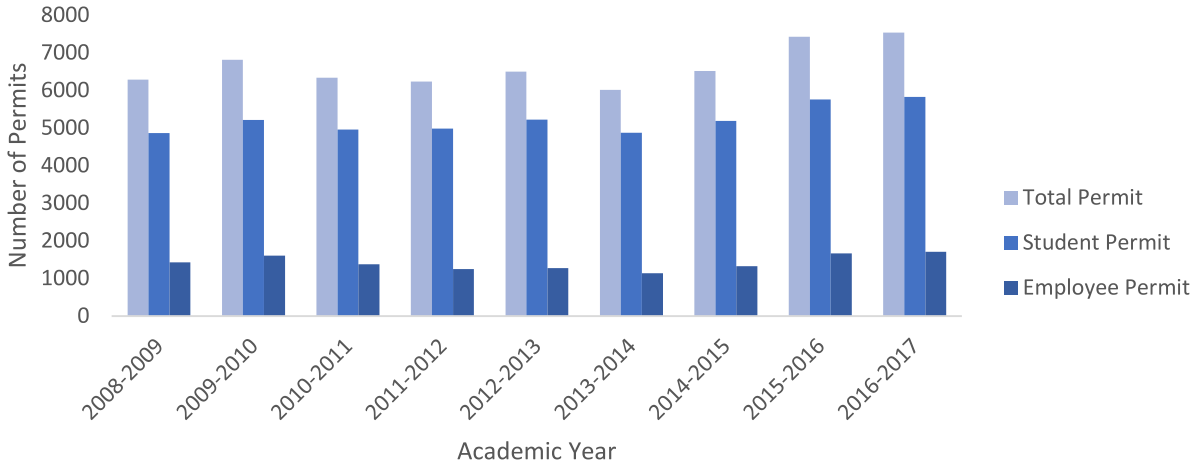

Figure 5.3 - *Number of parking permits issued from 2008-2013 and 2016-2017.*

5.2.2 Student Satisfaction

Student satisfaction plays a key role in determining what needs to be focused on at Chapman University. Every other year, the University conducts the Noel-Levitz Student Satisfaction Inventory (SSI), a nationally recognized survey developed to assess student satisfaction and the importance of campus issues to students. Every time the survey is conducted, parking is one of the least satisfied areas with the largest performance gap. Satisfaction is rated on a scale of 1 ("not satisfied at all") to 7 ("very satisfied"). **Figure 5.4** illustrates student

satisfaction when asked to rate if "the amount of student parking space on campus is adequate." As seen in **Figure 5.4**, satisfaction skyrocketed after the completion of the Lastinger parking structure in 2006. However, since then, parking satisfaction levels have dropped with the increase in student population. The performance gap score is the mean score difference between student satisfaction and level of importance. A large performance gap score for an item indicates that the institution is not meeting the students' expectations, as seen in **Figure 5.5**. As expected, this graph goes in hand with the satisfaction survey. Students were satisfied with parking availability from 2007-2010, but it is more of a concern in recent years.

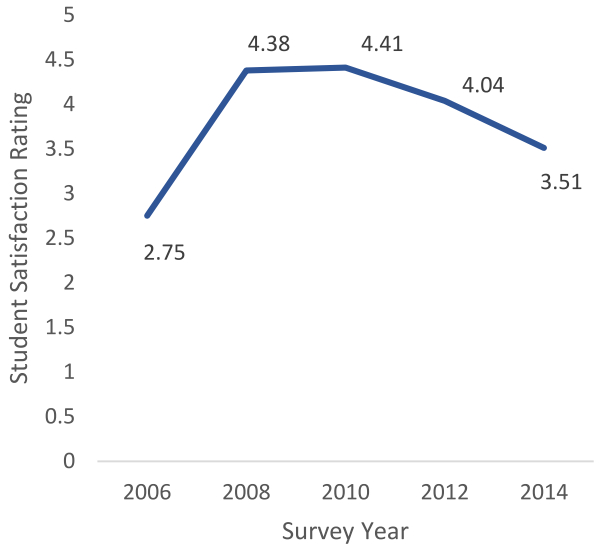

Figure 5.4 - *Student satisfaction ratings from 2006-2014.*

**Most data consisted of undergraduate ratings due to the lack of graduate survey results. In 2008, the data combined both graduate and undergraduate results.*

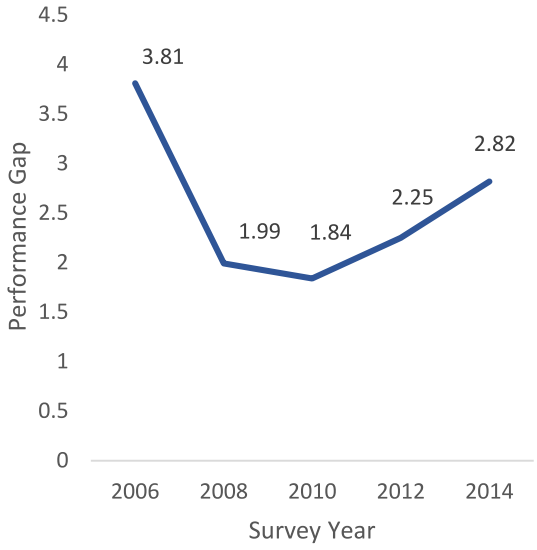

Figure 5.5 - *Performance gap analysis from 2006-2014.*

**Most data consisted of undergraduate ratings due to the lack of graduate survey results. In 2008, the data combined both graduate and undergraduate results.*

5.3 Current Status of Transportation at Chapman

5.3.1 CU Parking App

Chapman University currently has a parking app that tells you how many spaces are unoccupied in the Lastinger, Barrera, and West Campus parking structures. However this app includes the number of EV stations, handicap spots, and reserved areas, which is misleading especially in times of high demand. From the Chapman University 2017 Environmental Audit, respondents commented on the inaccuracy of the app and lack of information it provides. **Figure 5.6** shows how the parking structure fills up in just minutes. This app can also lead to students

using their phones to see where to park as they are driving. On two survey responses, students indicated that they have forgone the usage of the app because they are driving.

The app may be better used for students that live near campus. Before they decide to drive to campus, they could look at the app to see if spots are still open. If the parking structure looks like it is getting crowded, they should be encouraged to bike instead. For example, if location services or GPS says that the student is within a mile of campus, a message could pop saying, "Parking will be full in 10 minutes. Click for alternatives options!" Under this message (**Figure 5.7**), students can click for information about the panther shuttle, rideshare programs, and how long it will take to skateboard/bike or walk. This would incentivize students to use more sustainable transportation methods.

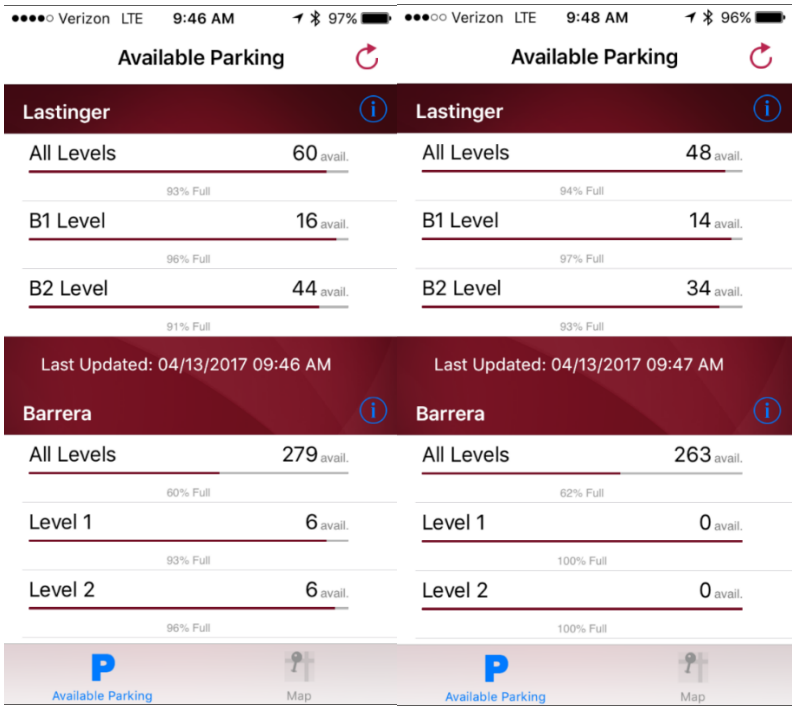

Figure 5.6 - *Taken two minutes apart, these screenshots show how quick the parking structures get filled at Chapman University.*

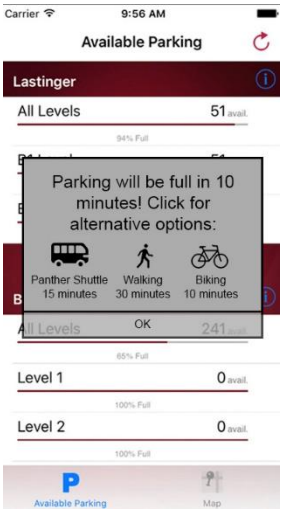

Figure 5.7 - *Pop up message on the parking app if parking is about to fill up and students are located within a mile of campus.*

5.3.1.a Student-Made Panther Park App

A Chapman student has already created another app because they were unhappy with the official CU Parking App. Not only does this app tell how many spaces are available, it also illustrates trends of parking availability and one can turn on geofencing. Geofencing is the use of GPS or RFID technology to create a virtual geographic boundary, enabling software to trigger a response when a mobile device enters or leaves a particular area. When the app realizes that you are near Chapman University, it pushes a notification to your phone to let you know what spaces are available, leading less hands-on usage while driving. **Figure 5.8** are screenshots from the iTunes App Store.

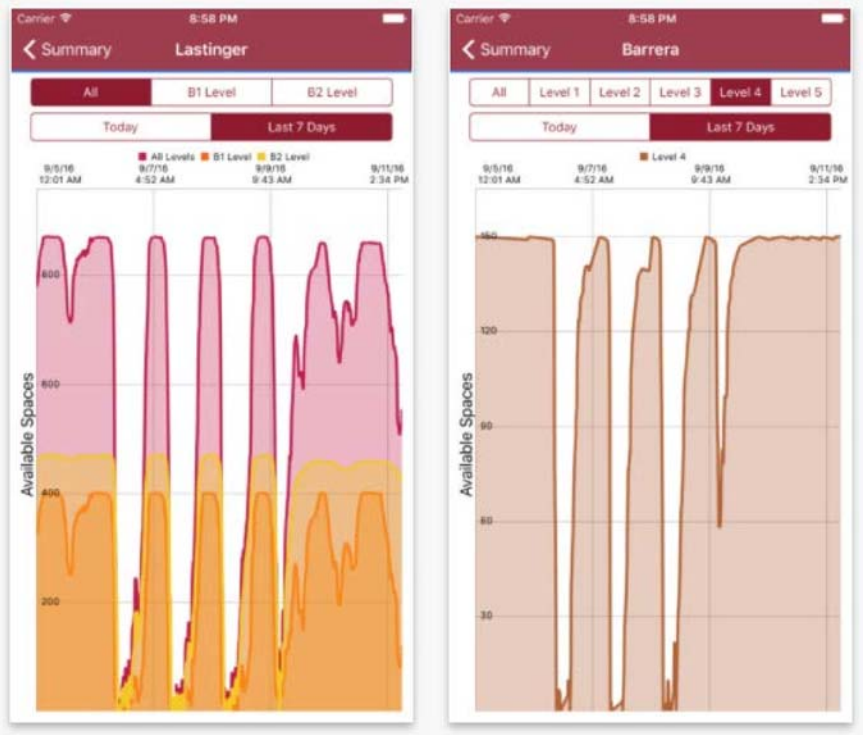

Figure 5.8 - *Screenshots from the PantherPark app developed by a Chapman student. In addition to what the CUParking app already has (real-time parking availability numbers), this app also has graphs to show trends of parking availability using historical data.*

5.3.2 Parking Signage and Efficiency

Currently, Chapman has one sign at the entrance of Lastinger parking structure that signifies how many spots are in that area. By the time one makes a turn onto Walnut and see how many spots are open, it is too late to turn around to go to Barrera. In addition to the signage location, students spend a long time looking for a spot, which increases CO_2 emissions. If the university installed a single-space guidance parking system that clearly signals if spots are open and where, demonstrated in **Figure 5.9**, the amount of time driving around looking for a spot will be reduced. In the 2017 Audit, students were asked if these lights would reduce the amount of time they spent looking for a parking spot (**Figure 5.10**). These signal lights can also differentiate EV charging stations, handicap spots, and reserved areas to lessen the confusion for students. With the addition of the parking area under the Center for Science and Technology, students will be more tempted to drive around and around hoping to get lucky and find a spot.

Figure 5.9 - *Single-space guidance parking system installed at Colorado State University.*

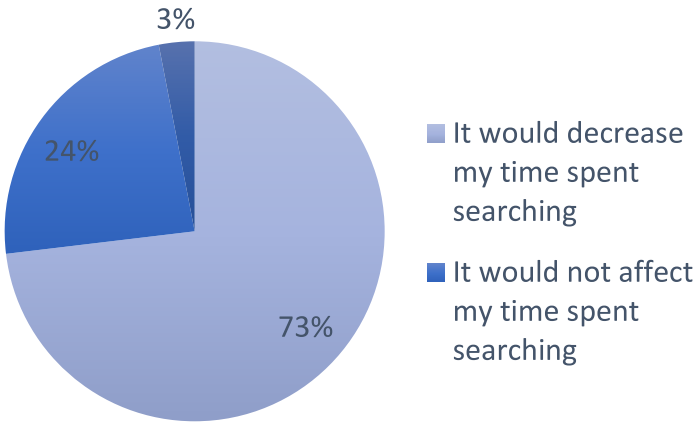

Figure 5.10 - *Student responses from the 2017 Audit.*

According to a parking technology company, parking guidance systems are 99% accurate, eliminate 250,000 lbs. of CO_2 per year for every thousand spaces monitored, and cut search times by 50% or more. Several companies have estimated that the installation of lights for Lastinger would cost $400,000 ($450 per space). To save energy, the lights can be turned off when occupied, since many students park for hours. The parking system can also put a time limit on the EV stations. After the allotted 3 hours in the EV charging station, the light will start to blink. Then, after a designated amount of time (i.e. 15 minutes), a signal is sent to parking enforcement and a ticket is issued.

5.4 Concluding Assessments about Transportation Technology

5.4.1 Parking App Improvements

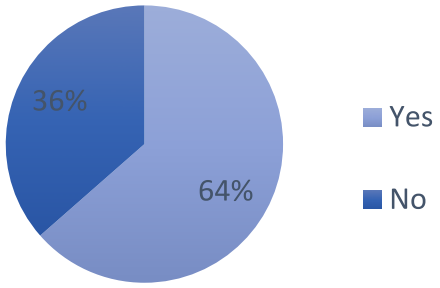

Figure 5.11 *-2017 Audit responses when asked, "Are you aware that Chapman has a parking app?"*

According to **Figure 5.11**, most people do not know that the CU Parking app exists. Therefore, advertising the app to new students in the beginning of the year via social media and at orientation should be implemented. In addition, combining various transportation apps into one: shuttle, ridesharing, and parking into one would be helpful in regards to organization of campus apps.

5.4.2 Future Areas of Research

Conduct and compare surveys after the addition of the parking structure under the new Center for Science and Technology. The new addition of these parking spots may have similar results as Lastinger in 2006. With more parking spots and a growing population, people may or may not drive around even more looking for closer spots. An evaluation and assessment a few years from now will help understand this concept more.

5.5 Recommendations

5.5.1 Low Cost and/or Effort

Adopt a new format and software for a new-and-improved parking app using what a student has already made or by hosting a student contest. The app would show trends of parking availability each hour of each day, and include how many ADA accessible, EV charging, and reserved admissions spaces are currently available. If the student is within a mile of campus, the app should suggest alternative transportation modes when parking structures are crowded. In addition, it should track shuttle locations and how long they are away from destinations. In addition, the parking app can be used to renew parking passes for visitors (i.e. pay by credit card to add an extra hour) and pay parking tickets.

5.5.2 Medium Cost and/or Effort

Figure 5.12 - *Lastinger parking signage cannot be seen before turning onto Walnut.*

Currently, the placement of signage (**Figure 5.12**) in front of Lastinger cannot be seen until driver turns onto Walnut. Adding a new parking signage for Lastinger parking structure would cost approximately $10,000. The parking signage should be places somewhere near Schmid gate so students can decide whether to turn for the Barrera or Lastinger parking structure.

5.5.3 High Cost and/or Effort

Installation of single-space guidance system starting in Lastinger, since it is the most popular spot to park on campus. License plate recognition, an online payment system, and arrows to signal which rows to go down for more parking will help students find parking while reducing carbon emissions. Although this would cost approximately $400,000 for Lastinger ($450/space), these guidance systems save 250,000 lbs. of CO_2 for every 1,000 spots.

To save energy, the lights could be turned off when spaces are occupied. Below are suggested colors for various parking spots:

- Green: EV charging stations
  - We currently have a three hour time limit for these spots. The parking system is able to track how long a car has been parked in the charging stations. After 3 hours and 15 minutes, a signal can be sent to parking enforcement and a ticket can then be issued.
- Blue: ADA accessible parking
- Red: Admissions and Visitors
- Purple: Reserved
- Yellow: Students, Staff, and Faculty

5.6 CONTACTS

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- Stephen Ciauri, Chapman University Student, PantherPark app creator (ciaur100@mail.chapman.edu)

- Will Cai, Western North America Regional Account Manager, Park Assist (will.cai@parkassist.com, 415-816-1552)
- David Leingang, Sales and Development, McCain Inc. Transportation Solutions (dleingang@mccain-inc.com, 760-444-4987)

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6 COST ANALYSIS OF PARKING INFRASTRUCTURE AT CHAPMAN

Cymbre D. Hoffman

6.1 INTRODUCTION

Many people in the world today have a great attachment to a personal vehicle, and along with this attachment, comes an inherent belief that parking is an individual right as an automobile driver. Many drivers are not aware of the costs associated with the infrastructure that they park in every day, largely due to the fact that these are sunk costs, and have no real impact on the drivers. These costs vary widely depending on the size, location, and amenities the structure provides. Typically, parking structures are located in prime locations to make them convenient, and in turn, the value of the land that is covered in the structure drops to considerably lower levels. Shoup cites Cutter and Franco (2012, p. 919) to conclude, “minimum parking requirements lower site density, increase land consumption, oversupply parking and reduce profits per unit of covered land." Thus, land is devalued and sunk costs are being poured into an infrastructure that inadvertently contributes to global carbon emissions, while losing money that could contribute to sustainable transportation at Chapman University.

Funneling funding away from the construction of parking structures could create the chance to invest in transportation alternatives. Despite the fact that sustainable vehicles utilize the parking structures as well, the general progression towards a decrease in the number of parking structures would contribute to reversing the trend of a car driven campus. This chapter of the Chapman University 2017 Environmental Audit explores the costs associated with parking infrastructure, and addresses the issues with this positive feedback loop, where negative externalities continue to create larger negative externalities, thereby magnifying the problem.

The goals of this chapter are:

- Assess student behavior in regards to commuting to and from Chapman
- Analyze the costs associated with the construction, maintenance, and land value of parking infrastructure
- Identify ways in which the money that goes towards the above can be used towards sustainable transportation
- Identify what sustainable alternatives are feasible and would most likely be used
- Assess the difference between below grade and above grade parking structures and their individual impacts

6.2 HISTORY OF TRANSPORTATION

6.2.1 Overview

As Chapman University becomes more well-established, its merit is constantly increasing, creating a wider pool of students to attend the university. From 2008 to 2016, the undergraduate student population alone increased by almost 70% (Chapman University). This influx of students fills the campus sidewalks, bike racks, and ultimately parking structures. As illustrated in the 2015 Transportation Survey, the majority of students who live more than a mile away use a personal vehicle as their primary source of transportation, to and from Chapman. This calculates out to 91.01% of students living 2-10 miles from campus that drive individual vehicles (Chapman University). Many students find parking to be a stressful component of the day due to its limited availability during peak hours, and have long resorted to street parking, which incidentally, has strained Chapman's relations with the City of Orange. As a result, Chapman implemented an opt-out option for a parking permit, in which, if a student does not fill out the opt-out parking waiver, they are automatically billed for a parking pass, and will subsequently receive one, regardless of the need for this pass. Thus, this chapter is centered around the analysis of parking infrastructure costs, and evaluating the total economic cost attached to the land itself, its excavation, as well as the ongoing maintenance costs and the capacity towards funding alternative transportation options with the costs incurred.

6.2.2 Past Accomplishments

Despite the fact that it might not be widely known, Chapman does offer many incentives that attempt to curb single-passenger vehicle transportation and replace it with more sustainable options.

- Chapman offers a carpool program for staff, faculty, and students; whereby a group of students, staff and/or faculty can carpool to school, and each receive a parking pass at a discounted rate of $175 per person. The group receives a carpool tag that can be hung from the rearview mirror, and can be swapped between drivers on various days, depending on the agreement within each group. Not only does this decrease the number of cars in the parking lot, but it also reduces the number of cars on the road, furthering the goal of reducing Chapman's carbon footprint.
- If carpooling isn't an option, Chapman also offers discounted public transit passes. Chapman's U-pass plan with OCTA allows faculty, staff, and students to receive a discount on all OCTA transportation up to a maximum cost of $69 for faculty, and $45 for students. According to the 2013 transportation Audit, Orange County’s local train service, The Metrolink, offers a Corporate Quick Card program that provides commuter students, staff and faculty with a monthly subsidy of $50 to the first 60 people.
- Zipcar is another alternative being offered at Chapman, where anyone can rent a car for a limited amount of time. This offer includes, gas, insurance, and up to 180 miles a day, all for a rate discounted for students, faculty, and staff. There are two memberships offered: the occasional driving plan, which costs $70 a year, with driving rates of $8.50 an hour or $69 a day, or the monthly plan, which is $7 a month, with the same rate as the one prior.

- The bike voucher is another program that can encourage more students to look to alternative transit. Those who wish to do so can fill out an application and if they qualify, will receive $350 to use at one of the local bike shops to cover the cost of a bike, helmet, lock, and any other bike accessories. Once receiving the voucher, the student must relinquish their right to a parking permit for the next two years.

Additionally, everyone is eligible for one raffle ticket for every school day they forgo driving their car to school in exchange for walking, biking, etc

6.3 CURRENT STATUS OF TRANSPORTATION

6.3.1 The Costs of Parking Infrastructure

Many people tend to overlook the costs associated with the infrastructure that houses their cars throughout the day, but it can become increasingly costly, depending on the complexity of the structure, as well as the location. Generally speaking, below grade infrastructure tends to be costlier, while above grade construction runs slightly cheaper. According to Gary Cudney, C.E.O. and president of Carl Walker parking consultants, "The median construction cost for a new parking structure is $18,599 per space," around $1,000 more for cities like San Diego and Los Angeles," and $55.66 per square foot." Additional features that drive up the cost are brick exterior parking structures, enclosed stair towers, deep foundations, WiFi and cellular service, LED variable message, etc. Building these structures is a timely, costly process that continues to be expensive as each structure requires ongoing maintenance.

Chapman University has five parking structures throughout its campus, and this chapter will be comparing two of them. The West Campus structure was built in 2015 costing $6,247,165, containing 357 spaces, and 5 floors. Despite the fact that this parking structure is slightly below grade, it will be used as the comparison for an above-grade parking structure. The majority of the space that is taken up is primarily above-ground, and nothing additionally can be built on top of it, rendering the 119,392 square feet unusable for anything other than parking. In contrast, the Lastinger parking structure was built in 2006, and the total cost of constructing it was $18,000,000. Within this completely below-grade parking structure, there are two floors, containing 892 parking spaces. Unlike the West Campus structure, the entire area that Lastinger encompasses can still be utilized as additional land. According to Jaymee Miller, the project coordinator for Chapman's parking structures, "Within this cost is a $1.4M premium for the field turf and running track. There was also an included premium for the entire structure being subterranean," but this amount was not available.

Additionally, it would still be nice to have a breakdown of the cost-incurred services that can increase the total of a parking structure's construction costs, which is currently being working on. A report by the Victoria Transit Policy Institute titled 5.4 Parking Costs, identifies possible cost incurred services as, "Higher quality construction/design and materials, storm water management including on-site retention, below grade construction, enclosed stair towers due to local code requirements, enclosed parking structure with mechanical ventilation and fire sprinklers, and user amenities such as way finding." The Chapman Structures contain:

- Both structures contain higher quality construction, design and materials
- Storm water management with bioswale in the West Campus Structure
- Below grade construction- 2 floors for Lastinger, 1 floor for West Campus
- Enclosed stair towers
- Enclosed parking structure with mechanical ventilation and fire sprinklers
- Car counting systems

In summary, "Most structured parking spaces (all the ones on the Chapman campus) cost more than the cars that occupy them." The cost per parking space in the West Campus structure is roughly $17,500 a space and the cost per space in Lastinger is $20,179 per space. According to CarGuru, a current and up to date pricing site, the average used sedan costs roughly $15,000 (Used Car Price Trends). This is used with the assumption that most college students do not own a brand new car, and there are more students than faculty. Clearly, it is not possible to go back and unbuild parking structures, but with these numbers, it is possible to move forward in a direction away from parking structures.

6.3.1.a The Costs of Maintaining a Parking Structure

Admittedly, building the parking structure is most likely the most expensive part of creating parking infrastructure, but there are continual costs. Chapman University utilizes the Whitestone Facility Maintenance and Repair Cost Reference 2013-2014 as a guide of the ongoing costs. Ongoing costs of the Lastinger and West Campus structure are outlined in **Figure 6.1**. The costs total up to roughly $10.61 a square foot per year. Maintenance costs vary from structure to structure depending on what features it contains. For example, the West Campus structure has planters and grounds all around it that must be continually maintained, and that maintenance goes into the cost of the parking structure, as well security required for monitoring on a regular basis. Daggett and Gutkowsk, both transportation and engineering professionals at Colorado Universities, assert that, "The primary mission of all colleges and universities is academics. It is arguably not maintaining surface parking," and it is therefore something that is not only costly, but quite possibly a waste of time. As Chapman continues to meet the growing needs of the its student population, its parking infrastructure continues to be costly to upkeep, and remains inconvenient all the while.

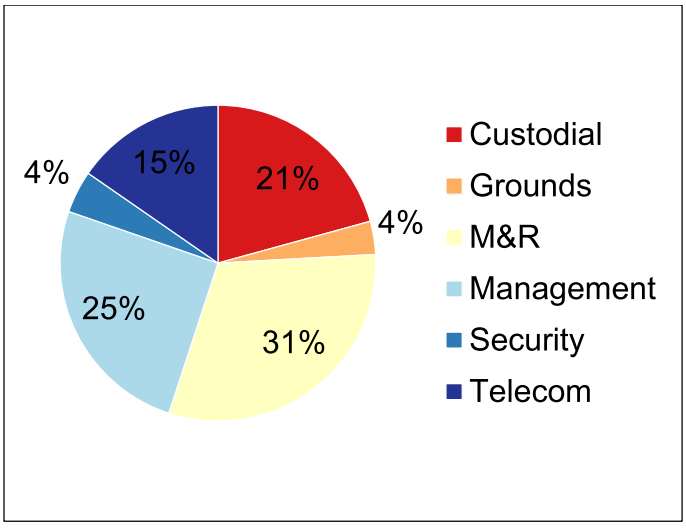

***Figure 6.1** - Annual cost breakdown per square feet*

6.3.1.b Below Grade vs. Above Grade

Another assessment that needed further investigation was whether a below-grade or above grade parking structure would be more ideal. While an above-grade parking structure is much less costly, it further devalues the land because, as previously mentioned, the land is rendered unusable. Conversely, a completely below grade parking structure such as Lastinger, is roughly triple the cost of an above grade one, but that might just be the cost of maintaining the availability of viable land, while still assembling a parking structure. The cost per space in the West Campus structure is $17,499.06, while the cost per space in the Lastinger parking structure is $20,179.37. That is per per parking space, creating a $2,676,00 difference, just for the use of the land above the parking structure. Whether the almost 3 million is worth it though, that is debatable. A breakdown of the difference is outlined in **Figure 6.2**, statistics courtesy of the Victoria Transport Policy Institute.

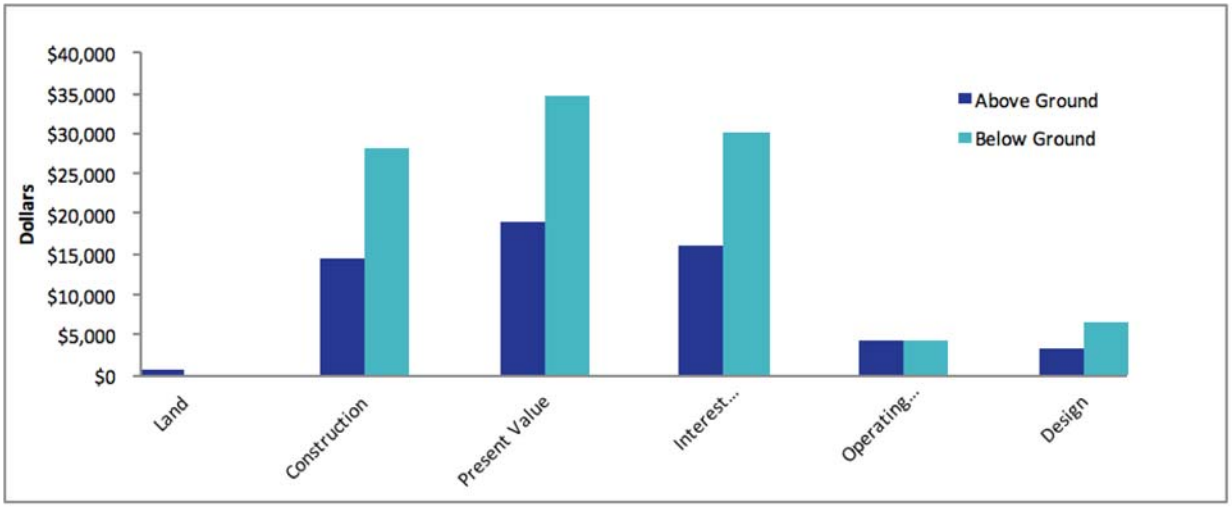

Figure 6.2 - *Comparison of above ground and below ground cost breakdown of constructing a parking structure. This is the total cost in 1997 dollars. (5.4 Parking Costs)*

6.3.1.c Land Value

Along with the costs included in building parking infrastructure, are the costs of the land that is being taken up by these structures. According to Daggett and Gutkowsi, parking is viewed as an intrinsic right of the vehicle driver, creating the need for prime locations of land in desirable areas. By turning these prime locations into parking locations, the value of the land drops considerably in value, which can hardly ever be recovered, regardless of parking pass fees. This leads to the assessment and differentiating between below-ground and above-ground parking structures. The former create a much larger bill, but provides usable land, while the latter is much cheaper, but removes any possibility of utilizing the land where the parking structure sits. This poses the question, how much is the land, where these parking structures are built, worth, both intrinsically and financially?

Data available is the square feet of each of the parking structures minus the underground parking structure portion of the Sandhu dorms, as well as the cost of a land parcel that Chapman University purchased. One of the land parcels is North West of Rampart St. and North East of I-5

Freeway near Panther Village. The other is an empty lot in Irvine located at 9750 Jeronimo, which is the Rinker Campus. The reason being for obtaining two land parcel costs is due to the fact that the first one, though it is located in Orange not far from Chapman University, is right next to the freeway, which could devalue the land costs, as well as it being near the block, while the other, though it is located in Irvine, is generally more suburban and is not close to a large mall and the land is closer in likeness to the parcels of land that make up Lastinger and West Campus. **Table 6.1** illustrates the square footage of each of the five parking structures, as well as the cost of the land parcel. That is $57,999,015.99 spent on the land alone for parking structures, and only one of them has viable land for something other than a structure.

Table 6.1 - *Square footage of each parking structure and the calculated costs of the land parcels purchased for these structures*

Structure	Square Feet	Land Parcel Cost
West Campus	119,392	$7,187,107.52
Jim Miller	190,574	$11,469,696.19
Barrera	219,688	$13,221,922.28
Lastinger	434,000	$26,120,290

6.3.2 Chapman Opinion

When surveying the Chapman community, these questions were found to be insightful when considering plausible solutions. Not surprisingly, the majority of those polled park in Lastinger, the largest parking structure on campus, as you can see in **Figure 6.3**. Not only is it the biggest, it is the most centrally located, and therefore appeals to many people. Despite the fact that it is the largest, Lastinger is constantly filled with parking congestion. This is interesting, because there are three parking structures on campus available to those who drive to campus, totaling roughly 2,000 parking spaces. Regardless of the fact that there are many more students than this, not every single student is on campus all day every day. Chapman follows the requirements of enough parking per building capacity due to its additional parking lots as well. According to Chapter 7.34 Off-Street Parking and Loading of the City of Orange Parking Requirements, the requirements for parking per at a university are, "1 space/employee, plus 4 spaces/10 students based on maximum classroom capacity, and for student housing it is 0.5 space/student resident, plus 1 space/each resident staff person." Yet, somehow, the majority of students say there is not enough parking. **Figure 6.4** shows the opinions of those surveyed.

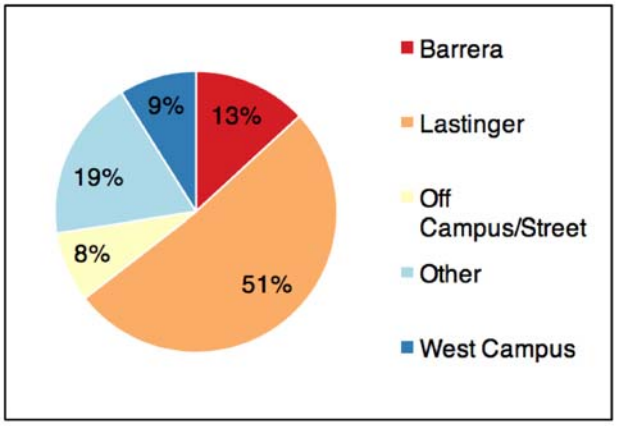

Figure 6.3 - *Survey data. Polled asking "Where do you usually park when you come to campus?" n = 263*

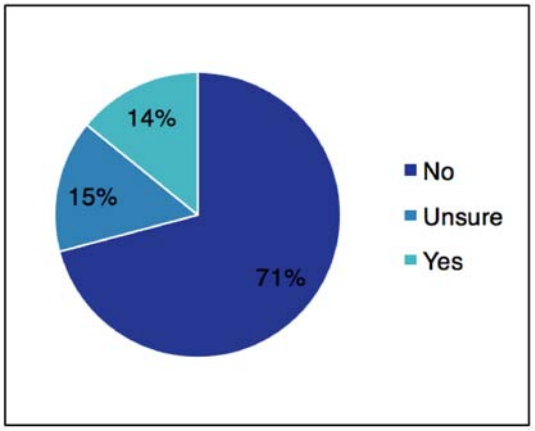

Figure 6.4 - *Poll asking "Do you feel there is enough parking?" n = 58*

6.4 CONCLUDING ASSESSMENTS ABOUT ….

6.4.1 Where Chapman is Doing Well

Chapman University's population has increased considerably over the past few years, and has done a respectable job at trying to meet the growing demands of transport, while keeping sustainability in mind. Chapman built the Lastinger parking structure in 2006, and then the West Campus Parking Structure in 2013, which has five floors of parking, complete with automatically updating LED signage advertising parking availability. Additionally, Chapman has bike servicing stations on campus, to promote the use of bicycles by creating this convenience.

6.4.2 Areas to Improve

Though the university has made great strides towards increasing transportation options and availability, there seems to be a lack of awareness that many of these incentives exist. The Panther Shuttle, though an excellent idea, does not go very far off campus, nor nearly as often as students would like it to, to be a viable source of transportation. While students can venture off campus periodically on Saturdays and Sundays, there is no option for this to be done during the week, and provides a great inconvenience for those whose schedules are more available on weekdays. Being a small campus, Chapman doesn't lend itself to the usage of bicycles as freely as larger campuses, but also being situated in a moderately-sized suburb that is spread out, the implementation of bicycle use to and from campus would create a better solution.

6.4.3 Existing Gaps in Knowledge

Gaps in knowledge suspected to be present, are the differences between students who say they feel a certain way about something/claim they would act in this manner towards a hypothetical scenario, versus how they would react, and gaging survey participant responses' legitimacy. Additionally, intrinsic land value of where the parking structures are land value method that is yet to be determined. Another major problem is awareness. Even though most

students feel there is not enough parking, there is. Even with campus, color coded maps and constant emails from public safety and parking, everyone continues to parking Lastinger, leaving many spaces open in the West Campus Structure.

6.5 Recommendations about Transportation

6.5.1 Best Practice Examples

In locations that are not highly urbanized, it is important to make transportation convenience for students to use. At the University of Washington they are discussing a bundle package strategy, "SDOT(Seattle Dept. of Transportation) Director Scott Kubly called the “Holy Grail” of a “mobility bundle” – a collection of transportation modes that could seamlessly interact to move people efficiently to where they need to go...with a few swipes of your thumb, pay to jump in a car to a transit station, take a train ride, then hop in another car to your ultimate destination – all in one transaction...one card could pay for all your transportation needs, ranging from transit to car-sharing to bike-sharing," (Matt). Other schools have implemented alternative transportation initiatives as well. At Occidental College, they provide a service called the Bengal Bus and, "("Green Business, Green Values, and Sustainability). The Bengal Bus shuttle will take students anywhere within a 10 mile radius of campus," not to mention, it is open seven days a week, every evening. In addition, Occidental provides a Free for a Week bike share program that includes free repair, helmet, and a lock. Additionally, the employees will teach you how to use everything, and inform you about group rides that they organize, along with great bike trails around the city. They help students learn to navigate the busy streets of Los Angeles.

6.5.2 Low Cost/Effort

One way to easily expand sustainable transportation at Chapman would be to expand the shuttle routes further down Glassel. This would enable commuters who don't live too far to take advantage of the Panther Shuttle, while allowing on-campus students to get to the store during the week, as well as on the weekends. An initial map of a 3 mile radius around the center of Chapman University as a rough estimate of shuttle route expansion might serve as a guide for where to increase routes (Figure 1.7). With this expansion, it should cover much of the area that encompasses students' residences.

6.5.3 Medium Cost/Effort

A bundle package for commuter and on campus students- different types. It could include, but is not limited to, Zipcar credit, voucher to purchase bike and supplies, passes for public transit, map of public transit around school, and a few parking passes for those rainy days.

6.5.4 High Cost/Effort

A bike share program would be a worthwhile investment for Chapman University- one that allows students to rent bikes for extended periods of time, and take them off campus, while being able to easily return them to various locations that are conveniently located around Chapman. (Sean's Bike Chapter) This could be a partnership with the City of Orange that could ultimately improve our relations with the city. Places that they could be

located would be: The circle, panther village, Angels stadium, the train stations, one at La Veta and Grand, one at Glassel and Katella, etc.

6.6 CONTACTS

6.6.1 Contacts

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6.6.2 Future Areas of Research

- Parking lots- their impact on space and land development, as well as the costs associated with these.
- Driving culture in Orange, California- how to change community perceptions about transportation.
- Alternative energy for transportation- Solar energy for electric vehicles, biodiesel fuel, etc.
- Advertising alternative forms of transportation- increasing awareness of the alternatives at Chapman University and in Orange.

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7 MOVING FORWARD: ANALYSIS OF GROWING PARKING AND TRANSPORTATION DEMAND

Danielle S. Platt

7.1 INTRODUCTION

Chapman University has impressive goals for institutional growth over the next 5 and 10 years, both in the geographic space the university occupies, and the number of students that it admits and services. While these growth goals are both impressive and attainable, there are numerous concerns over the transportation and parking services that the university offers to address both current transportation and parking challenges, and those that will become more acute in the next decade. Having spoken with numerous campus transportation-department employees, and campus-planning experts, there are a number of recommendations suggest in this chapter to alleviate current transportation issues, and prepare for others in the future.

7.2 HISTORY OF CHAPMAN UNIVERSITY GROWTH: BY THE NUMBERS

Chapman University is growing: having grown from 4,500 enrolled in 2000, Chapman now enrolls over 8,000 students, hopes to expand the student body to 11,650 by 2025. Spatially, Chapman is preparing to expand as well. Not only has the university developed new off-campus apartments at the Orange Panther Village location, but it plans to build new dormitories there, complete with a dining commons and more campus-like amenities, and a more frequently-driven shuttle to ferry thousands of students to and from these new dorms and main campus. Additionally, Chapman's Center for Science and Technology, new Panther Village dorms, and new academic buildings located at the several acres adjacent to the Digital Arts Building will add approximately 17 new acres to the Orange Campus location. Additionally, as Chapman continues to grow, more students have brought personal cars to campus. This must change so that as student body growth continues, the University doesn't face future parking and transportation issues in the future.

7.2.1 Spatial Growth

With exception of the building of the new Panther Village Dormitories, Chapman's campus is expansive, but still very walkable, especially for those living within a mile of campus. However, local students still choose to drive to campus, which exacerbates campus parking demand, local air pollution, and parking challenges with local permanent residents and neighbors. While this particular 'local parking' challenge is of growing importance to address and alleviate, chapman's expansion of Panther Village will require more creative parking and driving-alternatives, since its distance from campus incentivizes students to drive, rather than wait the few minutes to take the campus shuttle service.

Sheryl Boyd of Campus Parking and Transportation Services, in a series of meetings, spoke extensively about the ongoing challenges of communicating to students the importance of avoiding individual car usage and transit around Chapman's Campus, and around Orange in general. For local students, on rainy or hot days, or on days when students expect to spend late nights on campus, even if their residence is easily walkable, students often choose to drive. Students living at Panther Village also choose to drive to campus if possible, and as residency at

Panther Village increases, so too will car usage in between campus and Panther Village. **B**oyd highly recommends that a PR and incentive campaign be developed to encourage local students to refrain from driving, and to use carpool, rideshare, public transit, and campus shuttle services to reach campus.

7.3 Current status of Existing Plans and Student Interest in Alternative Transit Options

From this research, a number of recommendations and programs have been discussed as potential options to help students develop an interest in alternative transit.

7.3.1 Public Relations and Incentive Campaigns

Boyd spoke repeatedly about the need to communicate the importance of using alternatives to driving whenever possible; speaking about student's parking spatial competition with neighbors, constant complaints about parking demand and pricing, and student's hesitation to use public transit, even when its available to them, she recommends that Chapman develop an excellent program to reward students for

- Limited car usage on school days and
- Decisions to not bring a car to campus at all.

Such incentives might be a 'stick' incentive that penalizes local students for parking during certain hours during certain days, or they might be 'carrot' incentives, that directly reward students who don't purchase parking passes, or refrain from using their cars for a certain number of days.

To supplement these incentive programs, Chapman also must develop an excellent advertisement campaign to force students to recognize both the demands they place on campus resources, and the benefits of using transit alternatives; such educational advertisement information might include information about health and vitality from walking and biking for x hours/miles each week, compared to exercise at a gym; information might include the overall annual savings from public transit usage compared to the enormous monies paid over the entire lifetime of a car; information might also include data about local OCTA routes and where they might be used for student transit.

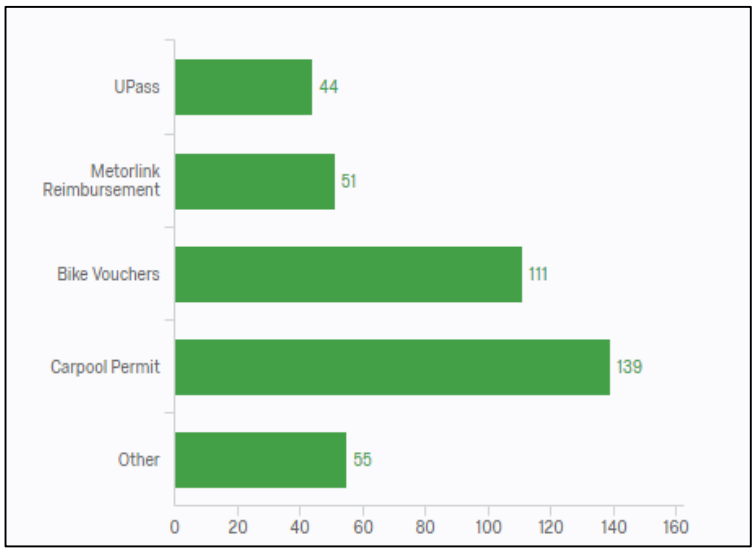

Figure 7.1 - *Out of all respondents of our transportation audit survey respondents, the greatest majority was familiar with carpool parking permit incentives, but less familiar with other vouchers and opportunities that are present and relatively easy to access. In fact, most students aren't familiar with other existing programs on campus.*

7.3.2 OCTA and Public Transit Options

Having met several times with Jack Raubolt to discuss campus planning, I have concluded that another initiative that may assist Chapman with car ridership and alternative transportation initiatives, would be the development of a Chapman-OCTA (Orange County Transit Authority) partnership that would provide more direct bus services to high-traffic locations that students use and go to around campus and around Orange, Anaheim, and Irvine. This could supplement more chapman shuttle services, and train students to use public infrastructure, which easily ties into the development of the chapman student global citizenship ethos taught on campus. We are working with and currently discussing various options with OCTA to determine which options might be most appropriate and even possible for chapman students.

These possible public transit growth options also would supplement the Metrolink, Amtrak, Chapman shuttle, and Santa Ana light rail system (to be completed in 2020). Ideally, Chapman students and faculty living within close proximity to Chapman would be able to replace their car usage with more convenient public transit usage. The combination of public transit availability to students, and student body awareness of these opportunities may help Chapman become more of a public-transit using school, such as University of Minnesota, which has an on-campus urban light rail that helps students avoid driving and individual car ownership.

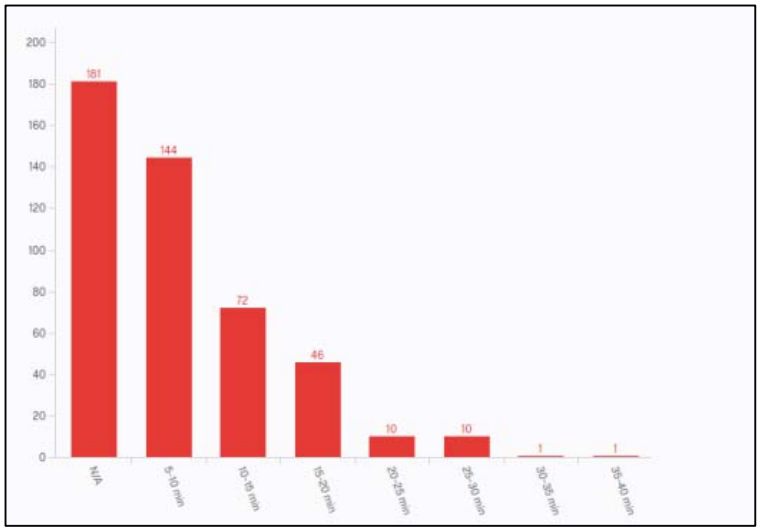

Figure 7.2 - *The closer to ones' residence and destination, and the more frequent a transit option is available, the more likely individuals are to use it; this graph indicates ratios of students who would use an OCTA bus if the bus ran in x minute increments close to their residence. Therefore, if an OCTA-Chapman bus or alternative transit program ran close to student's residences, at very consistent times, students might be more likely to use such a program.*

7.3.3 Ridesharing and Theoretical Alternative Transit Initiatives

As Chapman's Student body grows, student residence will grow both at Panther Village and in the surrounding community as students seek off-campus living options both for the social and affordability benefits of off campus living. It may benefit chapman to build several programs and initiatives to help students living both at Panther Village and in the surrounding residences of Orange, Irvine, Anaheim, Fullerton, and Tustin, use alternative transit to driving.

For students living at Panther Village, to supplement or replace usage of the panther shuttle, Chapman may benefit from developing a bigger fleet of busses to shuttle the growing population to and from PV and Campus; to supplement this fleet, Chapman might also develop an on-campus job for students with private automobiles, to shuttle students to and from campus and PV during off-hours (early in the morning and late at night). This would reduce automobile emissions, as small personal vehicles use less fuel per mile than larger shuttle vehicles and busses, but would also incentivize students to rideshare with other students at moment's notice, rather than wait for the shuttle.

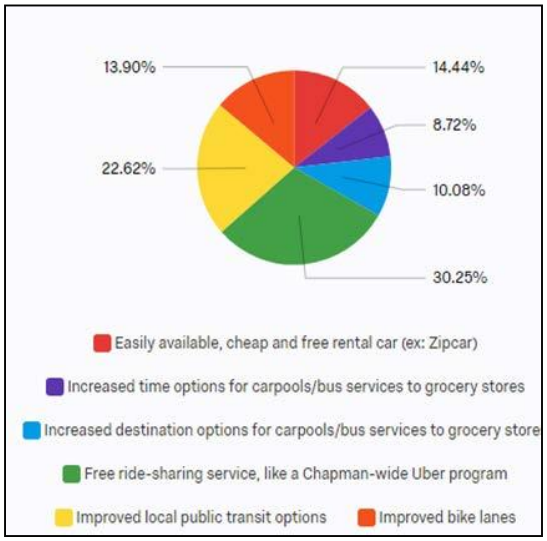

Figure 7.3 - *A number of options combined into a package of transit alternatives might convince drivers to avoid automobile usage. This figure indicates which transit options students might be interested in adopting, by percent.*

7.3.4 Zipcar and Rideshare options for a Growing Carless Student Population

Chapman students are known for their involvement in community service, public and private internships, and employment, both on and off campus. Unfortunately, those without a car are at a direct disadvantage when seeking out resume-building experiences. Many students bring cars to campus specifically for this reason, to avoid missing out on these unique experiences. To prepare for an automobile-less student body (or at least a student body with a significant reduction in car ownership and usership), Chapman must develop a cheap rides-share program, Zipcar program, or a combination of the two to help students reach internships without worry that public transit will leave them stranded.

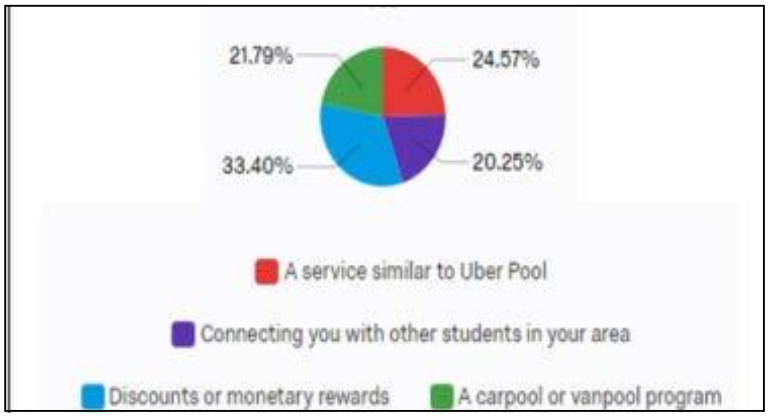

Figure 7.4 - *Survey results indicate that both low-cost options and on-demand transit options are most desired by students with regard to carpool and ridesharing options.*

7.3.5 Faculty Automobile Usage

Data from Sheryl Boyd indicates that long term employees of chapman (30+ years of employment) hold approximately 10% of the parking permits that adjunct faculty hold. While there are significantly fewer tenured faculty than there are adjunct faculty, adjunct individuals do drive more to campus and drive from further away from long-term faculty members who live close by. However, there is a clear distinction between tenured faculty and long-term employees who may be faculty or staff in any department. To reduce ownership of faculty parking permits, and to reduce distance driven by adjunct faculty, Chapman may wish to invest in affordable housing close to Chapman for its adjunct employees. OCTA also is currently working with Chapman to develop a vanpool transit program for Chapman faculty and staff to use.

7.4 Concluding Assessment of Development Potential for Alternative Transit Programs

Having spoken with numerous students, and campus planning officials, I have concluded that Chapman must develop a myriad of excellent strategies to both provide the student body with alternatives to car usage, and inform and incentivize use of these alternatives within the student body. It's clear that many car-owning and using Chapman students feel that they must have a car to reach various destinations, including internships, and current public transit and Chapman transit alternatives do not yet provide the resources to help students navigate Orange

County without a car. Survey data will help us determine how best we might structure these upcoming initiatives and programs, as well as communicate them to students.

7.5 Recommendations: Alternative Transit Incentive Programs

7.5.1 Low Cost/Effort: $10,000/yr

Develop an on-campus job for students to work as Chapman rideshare drivers to transport students around town and disincentivize them from using their own cars. Perhaps only students that give up their parking passes will have access to this program. Additionally, improve publicity and advertising of existing alternative transit options

7.5.2 Medium Cost/Effort: $500,000/yr

Continue developing a campus rideshare program, and better develop Chapman's carpool and Zipcar programs to help students reach off campus locations without use of a personal, owned vehicle.

7.5.3 HighCost/Effort: $2,000,000/yr

Continue developing 1st and 2nd tier recommendations and develop an OCTA-Chapman transit partnership to improve transit to other areas of Orange County that are high traffic areas for students.

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