Undergraduate Faculty-Mentored Academic Grant Proposal

CENG 4391: Independent Study

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How Supply and Demand of Angelo State University’s Parking Spaces Impact Future Parking Needs on Campus
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1. **Abstract**

This undergraduate faculty-mentored research requires the student to dive into the role of a city traffic engineer to determine how supply and demand of Angelo State University’s parking spaces impact future parking needs on campus. The data on parking accumulation, parking duration, and parking turnover of the existing parking facilities will be collected by means of a ten-piece camera system. The goal is to recommend strategies for managing the parking facilities on campus effectively. This study will be beneficial to ASU Facilities in planning improvements for the parking facilities and their operation. Most importantly, an efficient parking facility on ASU campus will be beneficial to the students, faculty, staff, and visitors.

2. **Project Context and Description**

   **A. Theoretical Context**

   Space for vehicles in densely built areas such as university campuses is limited and must be allocated smartly, especially for parking purposes, because the high parking demand during peak hours results in some users being denied parking spaces. Such users drive around looking for a space to park, contributing to environmental pollution and inefficient use of time for themselves and drivers around them. For these reasons, Angelo State University has previously conducted research on its parking situation.

   Surprisingly, according to the ASU document *Centennial Master Plan 2028*, the campus has a parking surplus. However, the document states that “ASU has a deficit of parking spaces in the areas where students and faculty prefer to park. This is, to some extent, both an unavoidable and an irremediable situation. If parking lots of sufficient size were to be intermixed with the academic core of campus, then the quality and continuity of the campus would suffer tremendously,” (Angelo State University, 41). The surplus parking spots are located further way
from the busiest locations on campus, leaving them half-full even at peak hours. Building large garages under the busy areas is not an option financially. On a short-term basis, the university encourages bicycling to classes from residential halls to relieve the stress from academic parking areas. Long-term, the Master Plan proposes three new parking lots on the west side of campus. According to the plan, “this effort will relieve pressure on the current academic, housing and staff lots in that area. As a larger percentage of the student body lives in campus housing, the number of spaces provided for those students must grow, as well,” (Angelo State University, 41).

B. Objective and Hypothesis

The purpose of determining how supply and demand of Angelo State University’s parking spaces impact future parking needs on campus is to come up with more effective strategies for managing the parking facilities. To attain this objective, this study will recommend several methods, described as hypotheses below, to solve the challenges ASU Facilities, faculty, students, staff, and visitors are facing now.

The primary object of the research study is to come up with recommendations for improving the parking system on campus. Possible recommendations may include increasing the total number of parking spaces by purchasing land for ASU’s property to build new parking lots around the busy campus locations. Another recommendation would be replacing inefficiently used space and deserted facilities into parking lots. A third recommendation would be identifying peak parking hours and putting a shuttle bus system into effect that transports faculty, students, staff, and visitors from the distant less occupied parking lots to the hotspot locations on campus. The third hypothesis can be complemented by developing an intelligent alert system that will communicate lots with available spacing during certain times of the day to drivers.
3. Methodology

The primary tools for this research project are the ten *Wyze Cam V2* cameras which will collect data on parking accumulation, parking duration, and parking turnover of the existing parking facilities as well as Microsoft Excel which will be used to document and plot the data. Secondary tools are the ten solar chargers and 12-inch long mounting straps made from stainless steel. Their purpose is to charge and support the cameras, respectively. Furthermore, ASU’s documents about future plans, like the *Centennial Master Plan 2028*, contain information about student growth and the construction/demolition plans for buildings and existing campus facilities. Those student enrolment predictions and future plans are crucial information to determine future parking needs. The textbook *Traffic and Highway Engineering* and especially Chapter 4.7: Parking Studies is a resource for this study. Lastly, this study will require the use of parking information from previous years from the ASU Facilities Planning and Construction office, academic journals found in scientific databases, and drivers’ interviews about their personal experience at ASU’s parking facilities.

The steps for this parking study will be performed in the following manner and order:

1. Retrieving an inventory of existing parking facilities from ASU’s Facilities Planning and Construction office. Adding from other sources of information if needed to create an accurate and detailed inventory including both on- and off-street facilities.
2. Studying and applying ‘Chapter 4.7: Parking Studies’ from the textbook *Traffic and Highway Engineering*, provided by faculty-mentor Dr. Apronti.
3. Collecting and recording data in Excel on parking accumulation, parking turnover, and parking duration using the system of ten cameras that will capture vehicle occupancy at certain intervals on several parking lots around campus.
4. Identifying parking generators such as big academic buildings, dining locations, and residence halls as well as locating these on the map of the study area.

5. Surveying parking facility users to gain insight about their parking experiences. A hypothetical participant will have the following experience.

6. Analyzing parking demand and supply after averaging, summarising, and plotting the data in Excel.

7. Drawing conclusions to improve the ASU parking facilities.

8. Create poster which summarizes findings for research symposium.

9. Communicating results through report with ASU’s Facilities Planning and Construction office and submit report to ASU journal.

An important note is that all nine of these steps will be performed with guidance and feedback of the faculty-mentor Dr. Apronti.

4. Experience and Relevance to Future

A. Role of Project in my Development

My career goal is to positively impact our environment and our society by specializing in environmental engineering. By currently pursuing a bachelor’s degree in Civil Engineering, I am working towards getting accepted into an Environmental Engineering Master’s Degree program. After taking Engineering Mechanics (Statics and Dynamics), I realized, however, that I am also interested in the structural branch of civil engineering. Moreover, this semester, I am working with three other civil engineering students on the preliminary design of new ASU tennis courts under the supervision of Dr. William Kitch. This project made me discover some parts of the
world of construction management and geotechnical engineering, two other branches of civil engineering. The classes and the project convinced me to learn more about other branches of civil engineering to see which one I like most. After all, every branch can have a sustainable side to it in which I can positively impact the environment without necessarily specializing in environmental engineering. Choosing this parking study was a good opportunity to learn more about transportation engineering and possible impact my decision on my master’s degree specialization.

This parking project will improve my problem-solving and analytical skills, as it will be a challenge to gather all the parking accumulation and turnover data on ten different locations at multiple time intervals. Moreover, this project will help improve my communication skills because communicating project advancements with the faculty-mentor as well as getting help from the ASU Facilities Planning and Construction office will be crucial for a successful outcome. Lastly, the project will increase my knowledge about the parking studies in transportation engineering.

B. My Experience

The most related experience for this project is the tennis court design project (January-April 2020) that I mentioned earlier. The goal of that four-person project, supervised by Dr. William Kitch, was to fix or redesign the ASU tennis courts while meeting the client’s requirements of fixing the surface and expanding the surface area at the most efficient cost while respecting ADA and environmental requirements. The tennis court project required me to connect with the ASU Facilities Planning and Construction office employees (Cody Guins, Richard Stinnett, and Samuel Guevara). This will help tremendously for the parking studies because I already
established a working relationship with them. Secondly, the tennis court project required us to create Gantt charts, timetables, and a work breakdown structure, just like the parking study will require of me to do. Finally, the parking studies will make me dig deep into a topic I know little about just as the tennis court project did when we had to learn profoundly about the construction and technical aspect of tennis courts.

Being a student-athlete with a 3.95 GPA and a part-time tutoring job and having 70 credit hours done after one and half year in college was only possible with good time management, efficient organization, and total avoidance of procrastination. I will implement that time management into this parking study to complete tasks in a timely manner to make this a successful project.

5. Timetable and Budget

The time allotted to each portion/task of this research project is listed in the following timetable.

Table 1: Timetable for Tasks

<table>
<thead>
<tr>
<th>Activity/Task</th>
<th>Time to Complete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define project goal and required tasks</td>
<td>3 days</td>
</tr>
<tr>
<td>Confirm project tasks with faculty member</td>
<td>2 days</td>
</tr>
<tr>
<td>Submit project proposal to the Institutional Review Board for review and approval</td>
<td>1 week</td>
</tr>
<tr>
<td>Work with faculty mentor to order equipment (ten cameras with solar charges and mounting straps)</td>
<td>1 week</td>
</tr>
<tr>
<td>Read theory in <em>Traffic and Highway Engineering</em></td>
<td>3 weeks</td>
</tr>
<tr>
<td>Mount and activate ten cameras on ten campus locations</td>
<td>1 day</td>
</tr>
<tr>
<td>Collect information from ASU Facilities Planning about ASU parking</td>
<td>1 week</td>
</tr>
<tr>
<td>Document inventory of existing parking facilities</td>
<td>1 week</td>
</tr>
</tbody>
</table>
Collect data on parking accumulation, parking turnover, and parking duration using the system of cameras | 2 weeks

Communicate data results with faculty mentor | 1 day

Identify parking generators | 3 days

Interview drivers on different parking locations | 1 week

Estimate and plot parking demand in Excel | 2 days

Work with faculty mentor to analyse parking demand and supply to make recommendations to improve the ASU parking facility | 3 days

Prepare poster for presentation at the research symposium | 2 weeks

Draft final paper for submission to ASU’s journal | 2 weeks

Revise final paper and review with faculty mentor | 3 days

Submit final paper to ASU’s journal | 1 hour

A certain budget is needed to perform the undergraduate faculty-mentored research. The following budget form, reviewed and approved by Dr. Dick T. Apronti, displays the costs of the permanent equipment to conduct the data analysis. This research does not require any other supplies nor travel costs.

Table 2: Budget Form

<table>
<thead>
<tr>
<th>Item</th>
<th>Purpose</th>
<th>Cost per Unit</th>
<th>Quantity</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wyze Cam V2</td>
<td>Determine occupancy of parking lots</td>
<td>$25</td>
<td>10</td>
<td>$250</td>
</tr>
<tr>
<td>Solar charger</td>
<td>For the cameras</td>
<td>$25</td>
<td>10</td>
<td>$250</td>
</tr>
<tr>
<td>Stainless Steel Mounting Strap 12in</td>
<td>Strapping the camera and solar charger to a pole</td>
<td>$25</td>
<td>20</td>
<td>$200</td>
</tr>
<tr>
<td>Poster</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Permanent Equipment Subtotal</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>$700</strong></td>
</tr>
</tbody>
</table>

The total expense for this research is expected to be $700.

6. Approvals and Funding
• Does your project involve human subjects (e.g. interviews, surveys, focus groups, oral history)?

Yes – I will apply for IRB approval and will provide Student Research with a copy of this approval.

• Does your project involve animal subjects (i.e. vertebrate animals)?

No.

• Does your project involve the use of recombinant DNA or biohazardous materials?

No.

7. Student Information

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When will you graduate? Fall 2021

8. References

Angelo State University. (2019). Centennial Master Plan 2028. Retrieved from

https://www.angelo.edu/services/campusmasterplan/