Increasing Mobility in Dubuque:

Developing Alternative Mode-sharing Opportunities

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PROJECT STATEMENT

The City of Dubuque, Iowa has partnered with The University of Iowa's School of Urban and Regional Planning and The Iowa Initiative for Sustainable Communities (IISC) on a project to compliment the City's recent transit system redesign by examining car-sharing, bike-sharing, and infrastructure improvement options that the City can pursue. The goal of this project is to provide a set of recommendations to the City of Dubuque for diversifying and expanding transportation options in the city.

According to the Reasonable Mobility sustainability principle, one of the 11 core principles of the Sustainable Dubuque Initiative, the community values safe, reasonable and equitable choices to access live, work, and play opportunities. Last year's award winning Sustainability Indicators Progress Report produced by IISC established and defined four sustainability themes for the Reasonable Mobility sustainability principle: affordability, modal diversity, safety, and decreasing net pollution (measured in terms of reducing vehicles miles traveled).

Our project addresses the affordability of transportation in Dubuque by examining opportunities such as car-sharing and bike-sharing that will give individuals and families options to decrease household transportation costs. Our project addresses modal diversity by recommending infrastructure improvements that will encourage biking and walking, and by exploring the feasibility of bike-sharing systems for the city. This increased modal diversity will also serve to reduce net pollution by giving individuals the opportunity to leave their car at home and utilize less-polluting forms of transportation.

Reducing net pollution, encouraging modal diversity, and improving the infrastructure network will create an environment of safety on city streets, which will further increase the attractiveness of non-motorized travel. More citizens utilizing non-motorized transportation could lead to people living a less sedentary lifestyle and an overall healthier community. In addition to the health and safety benefits, a transportation network with a more diverse set of options will boost Dubuque's desirability as a place to live and help the city attract and retain young professionals and students.

To develop the recommendations in this report, we undertook three major tasks. (1) We completed an accessibility analysis of Dubuque's current transportation system to identify areas of poor connectivity. (2) We solicited feedback from focus groups comprised of likely end-users to determine what these individuals find most important about car- and bike-share systems, and infrastructure improvements. (3) We synthesized demographic data to assess locational feasibility, the goal being to identify areas with an increased likelihood of usage.

EXECUTIVE SUMMARY

Improving Dubuque's transportation network through the introduction of car-sharing, bike-sharing, and targeted infrastructure improvements is the focus of recommendations in this report. Following these recommendations can help Dubuque become an even more desirable place for young professionals and students to reside, settle down, and raise their families. Studies show that students and young professionals are more likely to be early adopters of car- and bike-sharing programs. We targeted residents in these two key target populations for focus group feedback that provided the foundation for our final recommendations.

Infrastructure improvement recommendations will address the safety and convenience concerns expressed by focus groups. Locating facilities on streets with lower daily traffic counts instead of acquiring land to build dedicated paths or trails the city will improve upon sustainability themes of health and safety of the reasonable mobility principle.

It is our recommendation that car-sharing facilities first be placed in the 9 block groups near downtown and on college campuses. It is also our recommendation that a private vendor system is best suited to for the city of Dubuque. Private firms would eliminate the need for large initial capital investments and would minimize the legal responsibility of the City.

With regard to bike-sharing, it is our recommendation that the City continue to support local non-profit efforts such as the Dubuque Bike Coop. The bike library model is an effective method of providing reliable bicycles to members of the community and has the flexibility to emulate the most desirable elements of a kiosk-based system without requiring large capital investment from the City.

These opportunities to increase modal diversity, improve the health and safety of residents, decrease net pollution, and make transportation more affordable will benefit all of Dubuque's residents and help the city achieve its vision of providing safe, reasonable, and equitable choices for citizens to access live, work, and play opportunities.

INFRASTRUCTURE IMPROVEMENTS ANALYSIS

A fragmented or disconnected network affects the accessibility for any mode, but can be especially hard for cyclists and pedestrians. Improving the on- and off-street infrastructure is one of the most direct actions the City can take to improve the quality of the local transportation network.

In this report, “infrastructure improvements” refers to facilities that can be used by non-motorized forms of transportation, specifically biking and walking, or general infrastructure improvements that can benefit all users of a roadway such as lighting or signage.

Pedestrian infrastructure is primarily comprised of sidewalks and road crossings. Multi-use trails can also serve as pedestrian infrastructure, provided they provide access to destinations. Bicycle infrastructure comes in multiple forms; the form used is a function of traffic volume and speed limit on a roadway.

Bicycle infrastructure generally takes one of two forms: on-street or off-street. Shared lane markings, or “sharrows” are road markings often used as tool to communicate to motorists and cyclists alike to share the existing roadway. This type of treatment is adequate for low traffic streets, or where space for a dedicated or separate facility isn’t available. Sharrows are a tool to indicate where cyclists should be riding in the street, and can also be used as a way-finding tool to help cyclists navigate the urban bicycle network.

Bike lanes are similar to sharrows in that they are painted on the existing roadway. However, sharrows go beyond indicating a shared street by designating a portion of the roadway specifically for cyclists. These designated portions are indicated using stripping, signage, and pavement markings to indicate that certain space is preferred or potentially exclusive for cyclists. Bike lanes can be a shared roadway space (no physical barrier), or a dedicated facility for cyclists (often referred to as a “buffered bike lane”). Bike lanes can also be implemented on one way streets in a “contra-flow” orientation to increase accessibility to destinations for cyclist.

While sharrows and bike lanes tend to be painted on the existing road way, cycle tracks and recreational trails are often dedicated off-street facilities. These facilities can be implemented adjacent to roadways to combine convenience of on-street infrastructure with the safety of separated facilities. Trails can offer more direct and/or scenic bicycle route options through urban areas. All forms provided a safe and exclusive space for cyclists away from motor vehicle traffic.

ACCESSIBILITY ANALYSIS

The accessibility analysis of Dubuque's current transportation systems helped identify potential areas in need of improved connectivity for pedestrian and bicycle travel. The analysis measured how many destinations could be reached within a travel time of 15 minutes for cyclists and 10 minutes for pedestrians who are using the existing road network. This analysis was done for every parcel within the city boundary. The results of this analysis established a baseline for what is currently in place, as well as provided a quantitative method for evaluation of how planned infrastructure improvements will affect access to destinations.

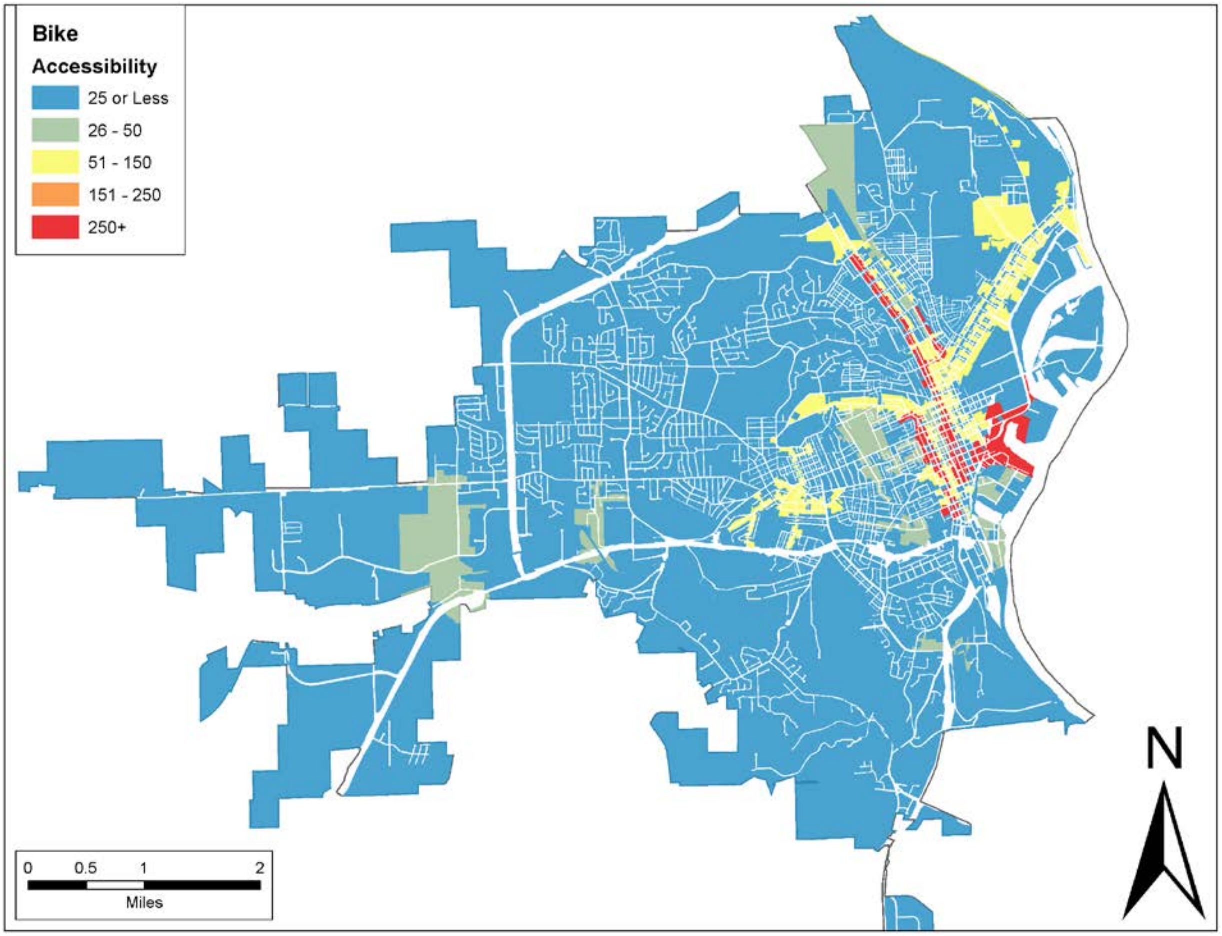

***Figure #1*: Parcel-level accessibility analysis for cyclists**

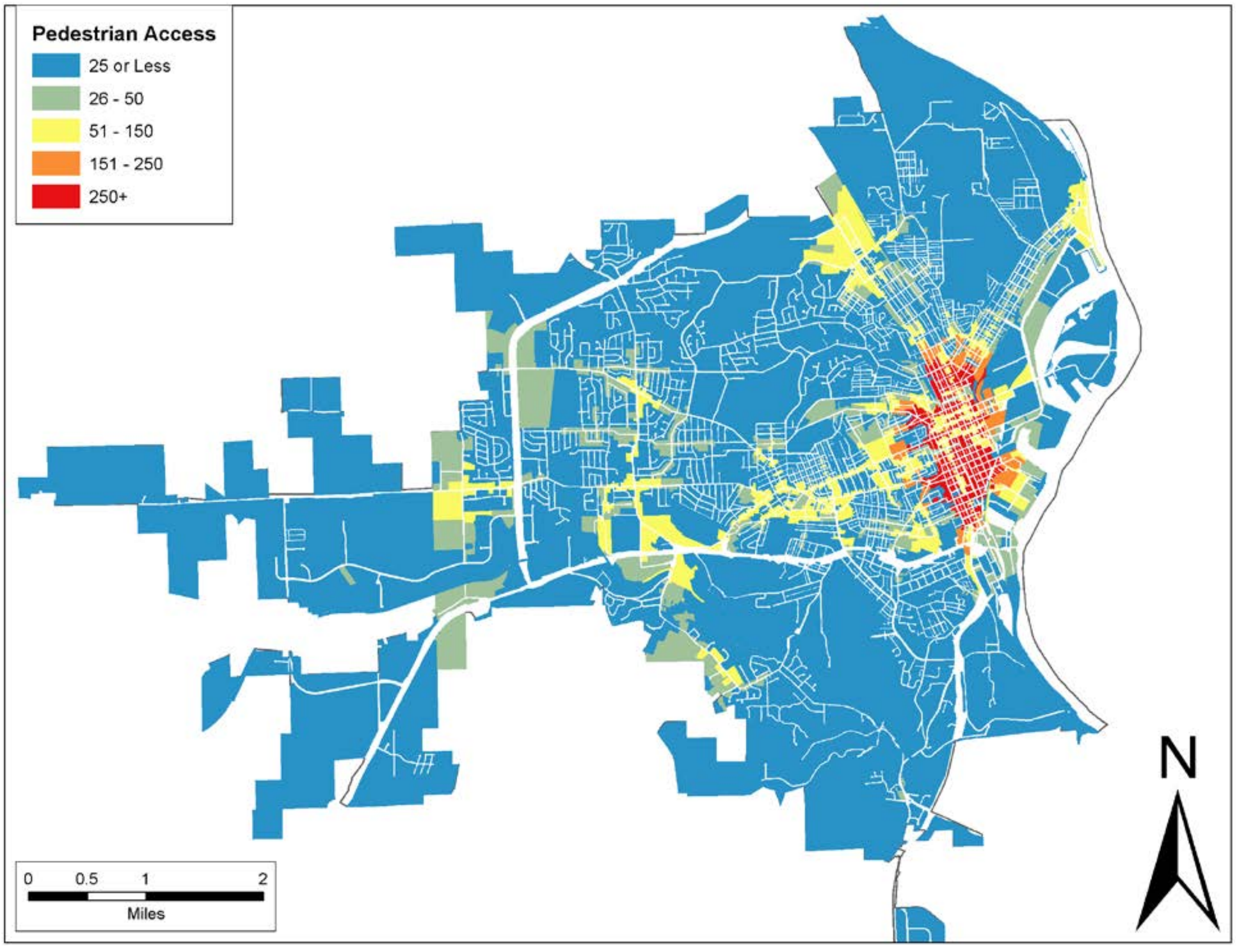

***Figure #2*: Parcel-level accessibility analysis for pedestrians**

Figures #1 and *#2* show the results of our accessibility analysis for bike and pedestrian travel. The analysis revealed that when traveling by bike, 3% of the parcels within Dubuque's city boundary have access to 250 or more destinations within the city. When traveling on foot, 4% of the parcels have access to 250 or more destinations. Pedestrian access in the downtown is slightly higher due to the fact that traffic volume on the roads was used as a limiting factor in the bike accessibility model. Roadways with a higher traffic volume were omitted from the bicycle network because perceptions of poor safety would prevent the average rider from traveling on the roadways. *Figures #1* and *#2* show that regardless of mode, residents utilizing non-motorized transportation in Dubuque face decreasing average accessibility as they move out of general downtown area.

CURRENT AND PLANNED INFRASTRUCTURE

The East Central Intergovernmental Agency (ECIA) has included a series of infrastructure improvements proposed to enhance the bicycle network in the City of Dubuque as part of the 2040 Long Range Transportation Plan. According to the plan, Dubuque has approximately 92 miles of bicycle infastructure improvements planned or proposed for future development. These improvements are shown in *Figure #3*.

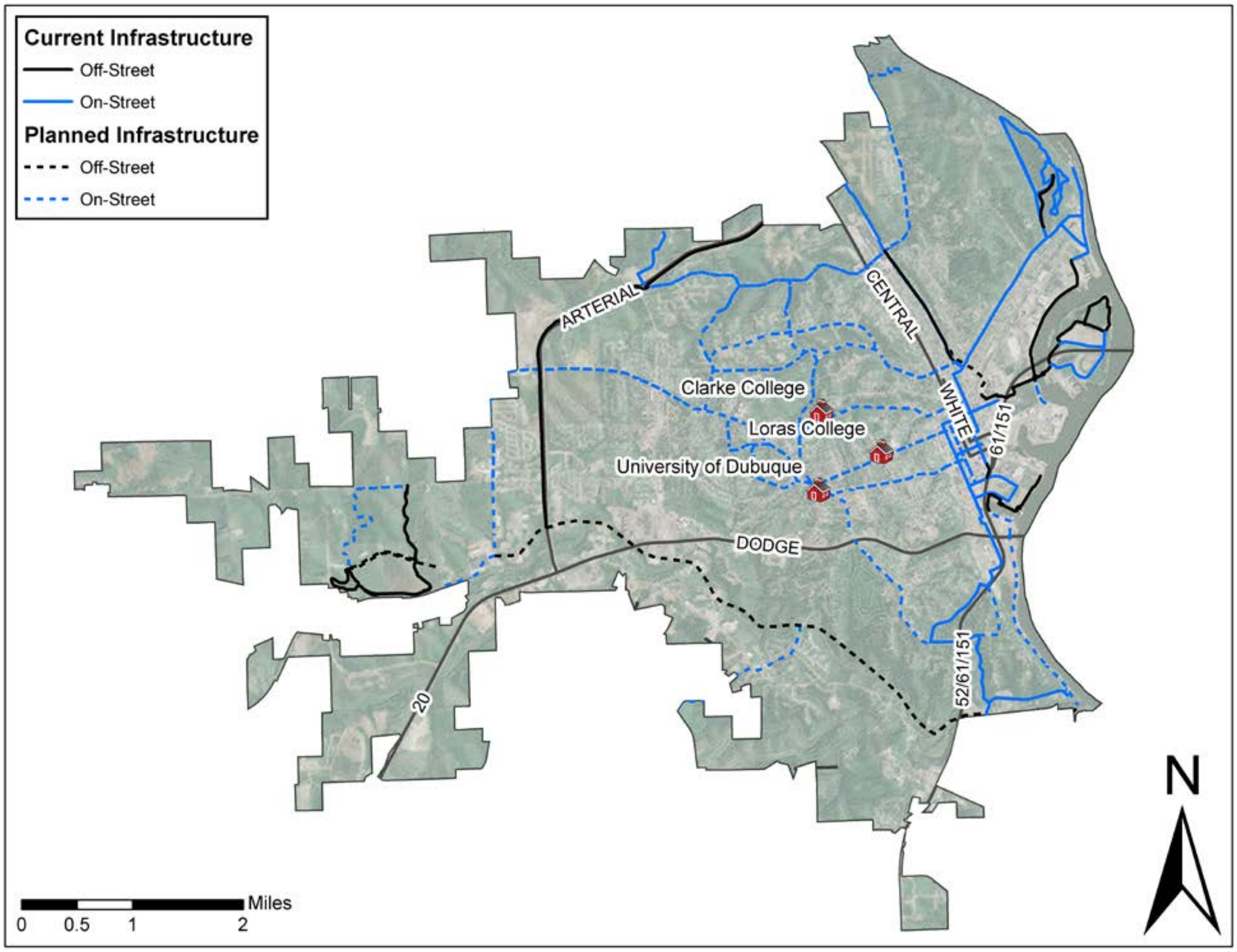

Figure #3: **Current and Planned Bicycle Infrastrucuture in Dubuque.**

The planned infrastructure improvements would give cyclists a higher degree of route options, which is especially important for non-motorized modes of transportation.[1] Our study shows that simply by implementing these proposed facilities, the number of parcels that can reach 250 or more destinations triples from 3% to 9%.

[1] (Litman, 2012)

While the location of the infrastucture improvements will impact the improvement in bike culture and usage in the city, the type of infrastructure to be implemented is also important. Because the most recent federal budget proposals call for a cut to infrastructure expenditures, proposed bicycle infrastructure improvements will need to be cost effective, yet still provide cyclists with a safe route to and from destinations.[2]

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[2] (Thompson, 2013)

FEASIBILITY ANALYSIS

Our feasibility analysis examined cycling's interactions with, and improvement upon, transit catchment. We also used community feedback to identify the type of infrastructure that is most important to cyclists and pedestrians in the city.

INFRASTRUCTURE AND TRANSIT

Increased interaction with transit can augment the effect of infrastructure improvements because bicycles and transit operate very effectively with one another when paired correctly. Increasing bicycle accessibility and safety through infrastructure improvements provides an opportunity for bicycles and transit to further complement one another in the city's transportation network. Linking these two modes can increase the catchment area, efficiency, and patronage of transit, as well as the overall demand for cycling.[3]

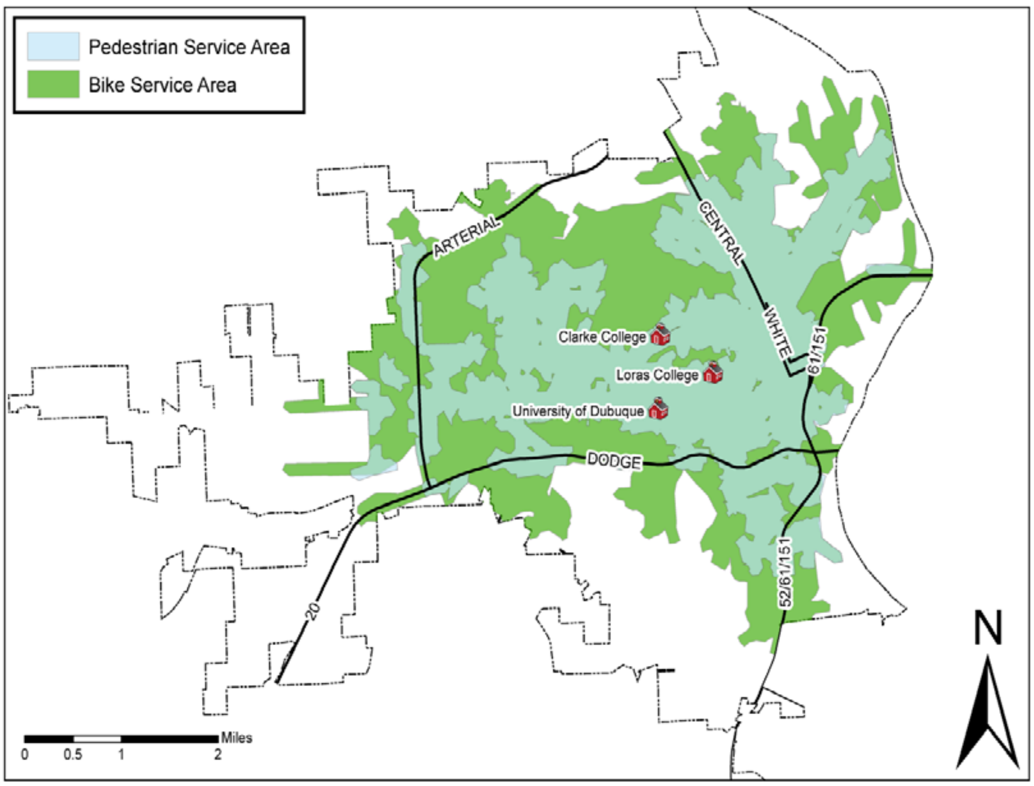


***Figure #4*: Comparison of Pedestrian and Bicycle Transit Stop Catchment Areas**

[3] (Krizek & Stonebraker, 2010)

Figure #4 shows the increase in transit catchment area that can result from having an integrated cycling community. Transit catchment is a measure of the percent of the city's total area that is within a 5 minute commute of a transit stop. Assuming riders are accessing the current of transit routes by foot, just over 28% of the city's total area is currently served by transit. Service area increases if transit riders use a bicycle to access transit stops. Transit service area increases to nearly 56% of the city area when we assume that riders are within a 5 minute bicycle trip to a transit stop. *Table #1* shows a comparison of transit catchment area assuming pedestrian and bicycle access.

Table#1: Transit Catchment Area Comparison – Pedestrian and Bicycle

	Current Coverage	Coverage with Bicycles Integrated	Total City Area
Catchment Area	8.86 mi^2	17.38 mi^2	31.09 mi^2
Percent Coverage	28.5%	55.9%	

FOCUS GROUP PREFERENCES

The community engagement aspects of the project focused on the solicitation of community input through focus groups with select segments of Dubuque's population. Because Dubuque's current land use patterns and transportation network were built around personal auto use, it is our belief that the odds of early success of infrastructure improvements will be greater if they are tailored to meet the preferences of likely early-adopters, so our team targeted young professional and college student populations as the main demographic groups for community input.

The primary goal of the focus groups was to move beyond a qualitative, ideas-based feedback session to quantify the preferences of our focus group participants toward infrastructure improvements. To do this, each focus group held a brain-storming session to generate a list of the attributes that they feel are most important to the subject being discussed. The participants then voted for their top choices to shorten the list and build a group consensus on attributes that could then be measured in a survey. The process then turned to assigning a range of values by which to measure each element. The final list of attributes and their measurable ranges were then used to build 9 hypothetical "situations", or combinations of values, which the respondents ranked in terms of their personal preference.

Once the surveys were complete, our group used a preference ranking tool known as conjoint analysis to quantify the results. Conjoint analysis uses the survey results to quantify the importance of attributes relative to one another. This relative importance comes from the preference that respondents gave to each attribute when ranking the hypothetical scenarios; the higher the relative importance, the more weight that element had when the focus group members were ranking the hypothetical scenarios. This analysis allowed us to more objectively determine how members of the focus groups make trade-offs between different attributes of infrastructure improvements. For more detailed lists of attributes along with their ranges, and the specific methodology of conjoint analysis, see *Appendix B.*

STUDENTS

On Tuesday, February 19th, we held our first college focus group at Loras College. The students present at the focus group were all part of the student senate, but also represented a wide range of campus student groups. The discussion focused on barriers to pedestrian and bicycle mobility that are specific to student concerns. The infrastructure improvements considered in the final survey looked at pedestrian and bicycle concerns with relatively equal weight.

The facility improvement attributes that this group found to be the most important are (1) Traffic, (2) Lighting, (3) Topography, and (4) Dedicated Pathways. *Table #2* shows these attributes along with their relative importance.

Table #2: Student's Preferred Facility Improvement Attributes

Attribute	Relative Importance
Traffic	31.5
Lighting	30.6
Topography	25.5
Dedicated Pathways	12.5

Traffic level and lighting had the highest relative importance. These are the facility aspects that the students in our focus group consider most important when deciding whether or not to commute by bicycle or on foot.

YOUNG PROFESSIONALS

On Wednesday, November 7th, we held our first focus group with the Green Drinks Sustainability Group in Dubuque. There were 22 members present at our young professional focus group. These individuals were divided into two separate focus groups (A and B) in order to provide a broader range of feedback. The two groups had fully independent discussions, and thus generated two unique lists of attributes and ranges. The discussions were centered on barriers to pedestrian and bicycle mobility in the City of Dubuque. The final survey found participants ranking trade-offs between different sets of desired facility improvements for cyclists and pedestrians in the city.

YOUNG PROFESSIONALS (GROUP A)

Discussion in Group A resulted in (1) Parking Availability (2) Route Connectivity, (3) Ease of Route, and (4) Education of Drivers and Cyclists as the facility improvement attributes that are most important to the young professionals. *Table #3* shows these attributes along with their relative importance.

Table #3: Young Professional Group A's Preferred Facility Improvement Attributes

Attribute	Relative Importance
Parking Availability	29.5
Route Connectivity	29.3
Ease of Route (Hills, Traffic)	27.3
Education of Drivers and Cyclists	13.9

Parking availability, route connectivity, and ease of route had the highest relative importance. These importance rankings show that the participants find these three aspects almost equal in importance when deciding whether or not to commute by bicycle or on foot. Education, which refers to the education of both cyclist and drivers, has the lowest importance value to the participants in this focus group; meaning respondents would rather have physical elements of their commute addressed before the education level of drivers or their fellow riders.

YOUNG PROFESSIONALS (GROUP B)

Young professional Group B developed a more extensive list of six main attributes with regards to facility improvements. The facility improvement attributes that they found to be the most important were (1) Intersection Traffic Levels, (2) Intensity of Hills, (3) Lighting Levels, (4) Signage Visibility, (5) Pavement Condition, and (6) Type of Dedicated Lanes*. Table #4* shows these attributes along with their relative importance.

Table #4: Young Professional's (Group B) Preferred Facility Improvement Attributes

Attribute	Relative Importance
Signage Visibility	23.4
Type of Dedicated Lanes	22.9
Intersection Traffic Levels	19.8
Pavement Condition	15.8
Lighting Levels	12.6
Intensity of Hills	5.5

The visibility of bike signage, the type of dedicated lanes, and traffic levels at intersections had the highest relative importance. These are the primary facility aspects that the participants consider when deciding whether or not to commute by bicycle or on foot.

Even though the importance values cannot be compared directly between the different focus groups, we were able to look for trends and patterns between the three sets of results. The young professional Group A placed higher importance on convenience attributes (parking, route connectivity, and ease of route) while Group B placed the most importance on safety issues (signage, lane type, traffic). The student group had a mix of both safety issues (lighting, traffic level) and convenience issues (traffic levels and topography). While several attributes did overlap to a certain extent between two of the three groups, the attribute with the strongest overlap between all three groups was traffic level. This shows that respondents are more willing to ride their bikes or walk if they know there are acceptable routes that let them avoid heavy traffic streets.

SCENARIO PREFERENCE SCORES

Our recommendations are based on models that were constructed to compare different hypothetical infrastructure scenarios based on the focus group feedback. The model gives us a preference score for a given scenario. Preference scores are best understood as the amount of personal benefit an individual will enjoy from a certain combination of attributes. The preference scores were derived from the conjoint analysis done to the survey results, and our models were designed such that we can hold all attributes constant and change one specific part of the scenario to see how the benefit to the individual changes.

Table #5 shows that respondents receive more personal benefit if they are able to avoid streets with high traffic, which corresponds well to revealed preferences of cyclists in other studies.[4] Young professionals gave highest preference to streets with low traffic levels, while students indicated that they are willing to tolerate medium traffic levels in exchange for a more favorable combination of other attributes.

[4] (Dill, 2009)

Table #5: Preference Values for Traffic Levels

	Scenario Preference Scores of Young Professionals	**Scenario Preference Scores of Students**
Low Traffic	**63.2%**	45.6%
Medium Traffic	55.3%	**64.8%**
High Traffic	58.1%	48.1%

Another interesting finding from the focus group preferences is that the presence of dedicated pathways may not provide as much immediate benefit as other factors. *Table #6* below indicates that young professionals prefer shared facilities such as sharrows and bike lanes to dedicated off-street pathways such as cycle tracks or trails. Results also indicate that students are willing to trade dedicated facilities for other attributes as well. For a description of the preference models, see *Appendix B.*

Table #6: Preference Values for Dedicated Facilities.

	Scenario Preference Scores of Young Professionals	**Scenario Preference Scores of Students**
No facilities	65.2%	--
Shared facilities	**68.6%**	--
Dedicated facilities	63.3%	--
Dedicated Facilities Present	--	61.9%
Dedicated Facilities Not Present	--	**64.8%**

RECOMMENDATIONS

To address the safety and convenience concerns of the different focus groups and the health and safety concerns from the Reasonable Mobility sustainability principle, it is our recommendation that the City continue to implement the planned infrastructure improvements that are contained in the 2040 Long Range Plan. This plan calls for an appropriate application of on-street infrastructure on lower-traffic roads. Continuing to implement the planned routes will result in the highest benefit being returned to the citizens who utilize those facilites. The planned infrastructure also gives consideration to maintaining and creating routes which will provide connectivity and access to common destinations.

Focus groups also indicated that topography is a concern to cyclists due to Dubuque's uniquely challenging topography. One of the primary points of discussion in the infrastructure focus groups was how to address Dubuque's topography as a major barrier to cyclists and pedestrians. There were two unique solutions offered by the focus group participants, both involving finding ways for cyclists to use existing motorized transportation systems to get up the bluff. One idea involved incorporating a bike rack on the 4th street elevator that is similar to those currently used on JULE buses for the Rack & Ride program. The second idea involved working with local transit providers and the existing Rack & Ride program to possibly develop a discounted pass for riders who simply want to use the buses to catch a ride up the bluff but not ride a whole route. This "up the bluff pass", as it was called by focus group members, would give cyclists an extra incentive to utilize the existing Rack & Ride facilities. A program of this nature would also have the benefit of being more flexible for cyclists because individuals could utilize a transit route that is more in line with their regular commuting route.

These are only two options Dubuque could examine to allow cyclists who want to commute but are intimidated by Dubuque's formidable topography options to bypass the bluff and make bicycle commuting an attainable goal. The detailed structure and pricing scheme for these systems would need to be the subject of future study by City and ECIA planners.

CAR-SHARING ANALYSIS

WHAT IS CAR-SHARING?

Car-sharing is a system through which members can rent an automobile for a short period of time, usually on an hourly basis. In the last several years, car-sharing has become popular in the United States primarily through the expansion of private firms, like Zipcar and Hertz On-Demand, in multiple large cities.

However, car-sharing systems have also been established as non-profits in cities like Chicago, Illinois and Madison, Wisconsin. Smaller communities such as Iowa City, Iowa and Aspen, Colorado have also successfully implemented car-sharing, demonstrating the popularity of mode-sharing in various community sizes.

Peer-to-peer car-sharing, a form that operates entirely free of city involvement, has also grown in popularity. These systems allow users to rent vehicles from other participating individuals using a mostly-online process.

Regardless of the structure, car-sharing provides several benefits to a city's transportation network; these benefits include lower emissions, increased transit ridership, cost savings for households, and greater mobility. Additionally, car-sharing provides an attractive option for young professionals who seek to live in a pedestrian-friendly urban area.

VENDOR RESEARCH: AVAILABLE VENDOR OPTIONS

We looked at many different car-sharing models to find one that would provide the most benefit to Dubuque and its residents. These models included private firms, non-profit organizations, and peer-to-peer platforms. The group compiled the benefits and drawbacks to each industry's system.

PRIVATE FIRMS

The most common type of model in the car-sharing industry is private firms. Some private firms include Zipcar, U-Haul Ucarshare, and Hertz On Demand. These firms are located all over the country and have experience in developing car-sharing in new cities. During implementation, there is little cost to the city, except the loss of a few parking spaces. However, many companies pay the city for the use of these parking spaces, so there is no loss of revenue that would have been created from these spots. In addition to the minimal costs of implementation, the city will not have any legal responsibility since all private car-sharing firms provide insurance for their drivers in the case of an accident. Users will see benefits from a national or regional private firm because their membership rights will easily transfer between cities. This will allow anyone who is a member in Dubuque to use the system anywhere else the vendor has a system in place.

NON-PROFIT ORGANIZATIONS

A non-profit car-sharing organization is also an option for Dubuque. Non-profits have been established in cities like Boulder and Denver, Colorado (eGo CarShare), Chicago (I-GO), Madison (Community Call), and Philadelphia, Pennsylvania (PhillyCarShare). Non-profit models are primarily local systems partnered with the city they serve and other local organizations like transit services or higher education facilities. Having local partners organizing the system would benefit the city and residents by allowing for location-specific ideas to be incorporated into the car-sharing model. The I-GO system in Chicago, for example, was created by the Center for Neighborhood Technology, but is partnered with the City of Chicago, Chicago Transit Authority, Chicago Park District, and many of the local universities. Such partnerships, such as the ones that could be made with Clarke University, The University of Dubuque, or

Loras College, could benefit those users in the community and help distribute the large implementation cost of the system. This cost would include purchasing of the fleet, loss of parking, and administrative costs. In addition to the cost of implementation, the city and all partners would have some legal responsibility for the renters. The final challenge of implementing a new, local model would be establishing all of its rules, regulations, and practices to make it competitive with a private model. Research and additional public participation may be required to determine what would make a car-share program successful for Dubuque's residents.

PEER-TO-PEER MODELS

The final option for Dubuque is a peer-to-peer model. Some of these systems include Wheelz, Jolly Wheels, Getaround, and RelayRides and are mainly successful in larger cities than Dubuque. These systems are similar to private and non-profit models, but utilize members' personal vehicles as their fleet. This allows participating vehicle owners to make money when their car is not in use. This system is predominately online and would require little to no management from the city and no infrastructure improvements or dedicated parking spaces. Since the size of the fleet is based on the number of participating individuals, success of a system depends not only on renters, but also the number of participating vehicle owners.

FEASIBILITY ANALYSIS

The feasibility analysis to determine whether a car-sharing system can be successful in the City of Dubuque required the synthesis of the results of the accessibility analysis, evaluation of locations and vendors which would allow for a successful system, and quantification of community preferences.

ACCESSIBILITY ANALYSIS

The accessibility analysis of Dubuque's current transportation systems helped identify potential areas in need of improved connectivity. The analysis measured how many destinations could be reached within a travel time of 20 minutes if a driver was driving the posted speed limit. This analysis was done for every parcel within the Dubuque City Boundary. The results of this analysis established a baseline for what is currently in place, as well as provided a quantitative method for evaluation of how planned infrastructure improvements will affect access to destinations.

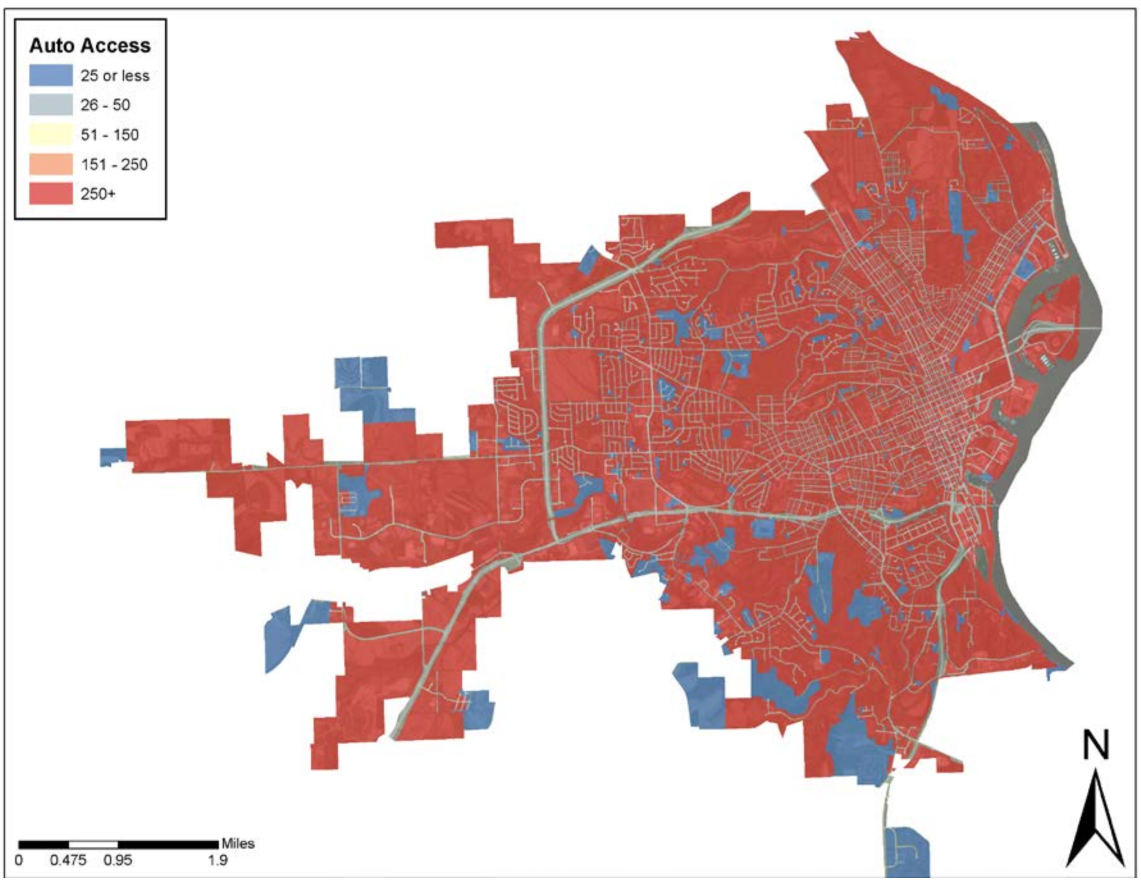


***Figure #5*: Parcel-level accessibility analysis for motorists**

Figure #5 shows that our accessibility analysis for auto travel revealed 92% of the parcels within Dubuque's city boundary have access to 250 or more destinations, or 86%, within the city. These results confirm that residents utilizing auto travel in Dubuque do not face many barriers to accessibility. This high auto access creates an opportunity for car-sharing to bring equality to auto usage. Membership in a car-share program is far less expensive than owning a personal vehicle and bringing a car-sharing program to the city could utilize the existing auto network to extend accessibility to individuals that cannot afford a personal car.

CAR-SHARING AND TRANSIT

There have been concerns expressed that bringing car-sharing into Dubuque might result in a drop in transit ridership. Research shows that car-sharing and transit operations are complementary modes of transportation. Transit provides access to car-sharing, and by reducing vehicle ownership and travel, car-sharing can actually shift trips to transit.[5] Similar to bikes, car-sharing is seen as a “last mile” option for transit users who take transit to reach a car-sharing vehicle.[6]

FOCUS GROUP PREFERENCES

The community engagement aspects of the project focused on the solicitation of community input through focus groups with select segments of Dubuque’s population. Because Dubuque’s current land use patterns and transportation network were built around personal auto use, it is our belief that the odds of early success of mode-sharing programs will be greater if they are tailored to meet the preferences of likely early-adopters. Our team targeted young professional and college student

[5] (Millard-Ball, et al., 2005)

[6] (Millard-Ball, et al., 2005)

populations as the main demographic groups for community input because studies show that these individuals are more likely to be early adopters of car- and bike-sharing programs.[7]

The primary goal of the focus groups was to move beyond a qualitative, ideas-based feedback session to quantify the preferences of our focus group participants toward car-share options. To do this, each focus group held a brain-storming session to generate a list of the attributes that they feel are most important to the subject being discussed. The participants then voted for their top choices to shorten the list and build a group consensus on attributes that could then be measured in a survey. The process then turned to assigning a range of values by which to measure each element. The final list of attributes and their measurable ranges were then used to build 9 hypothetical “situations”, or combinations of values, which the respondents ranked in terms of their personal preference.

Once the surveys were complete, our group used a preference ranking tool known as conjoint analysis to quantify the results. Conjoint analysis uses the survey results to quantify the importance of attributes relative to one another. This relative importance comes from the preference that respondents gave to each attribute when ranking the hypothetical scenarios; the higher the relative importance, the more weight that element had when the focus group members were ranking the hypothetical scenarios. This analysis allowed us to more objectively determine how members of the focus groups make trade-offs between different attributes of car-share systems. For more detailed lists of attributes along with their ranges, and the specific methodology of conjoint analysis, see *Appendix B.*

STUDENTS

On Sunday, February 24th, we met with members of the Clark University Student Life staff, including 18 student Resident Assistants. The focus of this discussion was car-sharing. Since all respondents live on campus, they were able to provide insight into some of the car-related concerns of campus-restricted students. The final survey found participants ranking trade-offs between different hypothetical car-sharing systems.

[7] (Millard-Ball, et al., 2005)

The car-sharing attributes that students at Clarke University found to be the most important were (1) Ease of Use (measured in reservation wait time), (2) Accessibility (proximity of cars to campus), and (3) Hourly Cost. *Table #7* shows these attributes along with the importance values from the conjoint analysis.

Table #7: Student's Preferred Car-Sharing Attributes

Attribute	Relative Importance
Ease of Use (Reservation Wait Time)	38.8
Accessibility (Proximity)	36.3
Cost (hourly)	24.9

Ease of use and accessibility had the highest relative importance to the participants of the focus group. This tells us that the students feel that the time they had to wait to use the car after making a reservation and proximity of a car share location to campus are more important than the hourly cost when deciding to use car-sharing.

YOUNG PROFESSIONALS

On Wednesday, April 10th, we held our final young professional focus group to have a discussion on car-sharing. After extensive attempts to schedule meetings with several young professional groups in Dubuque, these individuals were gathered through word-of-mouth volunteers. Because of the small group size, the discussion was more intimate and went into more detail about many of the attributes that made the final list. As with the Clarke University group, the final survey found participants ranking trade-offs between different hypothetical car-share systems.

The car-share attributes that this group found to be the most important were (1) Location Proximity, (2) Scheduling Availability, (3) Type of Car, (4) Membership Cost, and (5) Hourly Cost. *Table #8* shows these attributes along with their relative importance.

Table #8: Young Professional's Preferred Car-Sharing Attributes

Attribute	Relative Importance
Hourly Cost	27.0
Scheduling Availability	22.5
Location Proximity	17.7
Membership Cost	16.9
Type of Car	15.8

Hourly cost had the highest relative importance, followed by scheduling availability. This shows that the participants feel that the cost per hour of use is the most important factor when deciding to use car-sharing, followed by having a system with lower reservation wait times.

Even though the importance values cannot be compared directly between the different focus groups, we were able to look for trends and patterns between the sets of results. The attributes that overlap between the two groups are reservation wait time, proximity of the cars to the user, and the hourly cost. The young professionals placed the most importance on hourly cost, which is a reflection of their discussion about the importance of having a system that is equitable to people at different income levels. The student group placed the highest importance on reservation wait time and proximity over hourly cost. This tells us that students value proximity and convenience over cost and would be willing to pay a slightly higher cost if it means the cars are placed closer to campus and are more readily available.

VENDOR PREFERENCE SCORES

Our vendor recommendations are based on models that were constructed to compare different car-sharing vendors based on the preferences of the focus groups. The model gives us a preference score for each vendor. Preference scores are best understood as the amount of personal benefit an individual will enjoy from a certain combination of attributes. The preference scores were derived from the conjoint analysis done to the survey results and our models were designed such that we can hold all attributes constant and change one specific part of the scenario to see how the benefit to the individual changes. In this case, we can compare the specific characteristics of different vendors to see which will provide the most benefit to the individual. *Table #9* shows the preference scores for the five major private vendors that we researched.

Table #9: Preference Scores for Car-Share Vendors

	Vendor Preference Scores of Young Professionals	**Vendor Preference Scores of Students**
WeCar	**58.0%**	**66.3%**
UCarShare	**58.0%**	**66.3%**
Car2Go	53.2%	66.3%
Zipcar	51.6%	66.3%
Hertz On Demand	44.2%	60.9%

UCarShare and WeCar received the highest preference scores from both students and young professionals because these vendors most closely matched the respondents' preferred hourly rental rates. Students showed little to no difference in preference between vendors because evaluations were made on broader attributes where all vendors have similar characteristics. For a description of the preference models, see *Appendix B.*

LOCATION SUITABILITY

Location suitability for the placement of car-sharing vehicles within the City of Dubuque was based on demographic data provided through the U.S. Census. According to case studies on car-sharing suitability, users of successful mode-sharing systems share key demographic attributes. These attributes were analyzed at the block-group level to determine block-groups with the highest probability of creating a successful system.

Based on TCRP Report 108: *Car-Sharing: Where and How it Succeeds*, the typical characteristics of car-sharing members in successful models, shown in *Table #10,* allowed the group to evaluate the feasibility of car-sharing in Dubuque based on the demographic attributes of different block groups.

Table #10: Typical Car-Sharing member Characteristics

Characteristics	**Typical Car-Sharing Member**
Age	Mid-30s to mid-40s
Income	Upper middle class (but real variations here)
Education	Upper levels (college degree(s))
Household Size	Smaller than average (1 - 2 persons)
Auto Ownership	Half own one vehicle
Gender	Slightly more attractive to males

The use of demographic data that describes the typical car-sharing user was supported by cities conducting car-sharing feasibility studies without private vendors. Many cities, such as Madison, Wisconsin, included housing density in the evaluation of locations for car-sharing.[8] In addition to housing density, we also considered the populations in and around the three main colleges in Dubuque

[8] (Grossberg, et. al., 2002)

(Clarke University, University of Dubuque, and Loras College) because universities are "one of the most fertile environments for car-sharing."[9]

Based on these findings, we determined the attributes and corresponding "most feasible" thresholds used to evaluate the feasibility of block groups within the City of Dubuque that may be successful locations for car-sharing (*Table #11*).

Table #11: Most Feasible Thresholds for Relevant Demographic Attributes

Attribute	Most Feasible Threshold
Target Population (Age 18-34)	> 30%
Median Household Income	>$60,000
Education (% of population with some college or more)	> 30%
Housing Density	> 7.5 Units/Acre
Auto Ownership (0 or 1 vehicle households)	> 75%

Each of these attributes was mapped to reveal where the feasibility of car-sharing is most likely. The individual feasibility maps for all the attributes can be found in *Appendix D*.

After examining each attribute, we assigned a relative value to each level of the thresholds for each attribute to determine the overall suitability score by block group of car-sharing in the City of Dubuque. For example, block-groups with 30% or greater of their population aged 18 to 34 would be assigned the suitability value of four (4), 26% to 30% would be assigned the value of three (3), etc. The suitability map shown in *Figure #6*, compiles the value for each attribute in the block group and presents the sum of the suitability values. Block groups in *Figure #6* that are most suitable are shown in red and the least suitable in blue.

[9] (Millard-Ball, et. al., 2005)

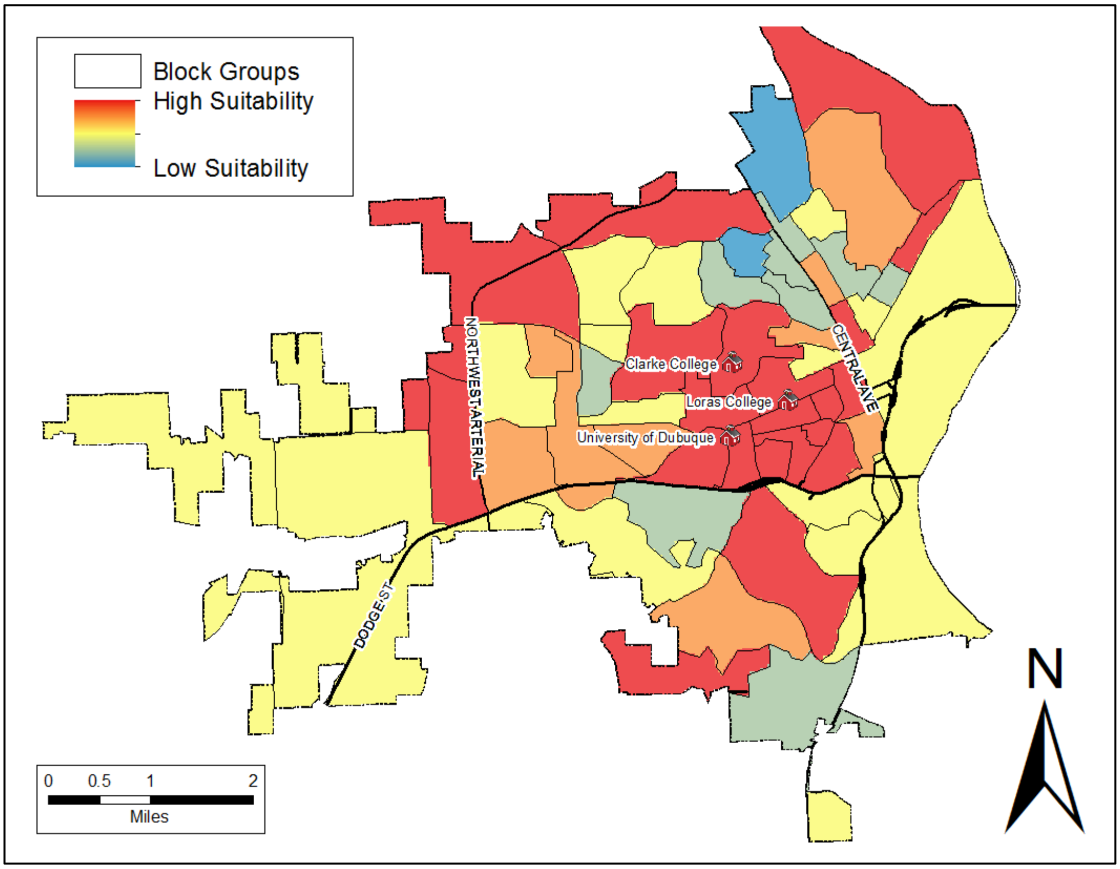


Figure #6 **Relative suitability of car-sharing by block group based on overall feasibility score.**

Our results suggest that car-sharing in the City of Dubuque has the potential to be successful in 21 of 61 block groups, or nearly 35 percent of the city. Of these 21 block groups, 13 are located in or near the downtown or contain college campuses. These 13 block groups include each of the higher education institutions in Dubuque and will provide the most likely use of a car-sharing program.

To get a sense of how a car-sharing system might perform in the future, we projected the targeted population (persons age 18 to 34) to the year 2020. Our projections show that the 18 to 34 year old population will remain stable throughout the projected period. Based on this projection, block groups near downtown and along the Mississippi River will continue to provide locations for potential growth of the system. For more information on the population projections, see A*ppendix C.*

RECOMMENDATIONS

LOCATIONAL RECOMMENDATIONS

In order to create a successful system, we recommend that car-sharing facilities be placed in the 13 downtown and college campus block groups shown in *Figure #6*. These block groups feature the greatest collection of demographic and land use characteristics seen in the users of successful car-sharing systems. These block groups also correspond well with information we received from our targeted interview with the Director of Parking and Transportation at the University of Iowa who recently oversaw the implementation of car-sharing on The University of Iowa Campus. In his observations of the usage statistics, cars located near residential areas have seen higher usage. Depending on membership growth, potential expansion areas include all of the other block groups shown in red in *Figure #6*. These block groups would expand the car-sharing system outside of downtown and campus student use and invite others to join as well.

VENDOR RECOMMENDATION

After evaluating the feedback from our focus groups, we have determined that a private vendor system would work best in the City of Dubuque. This option will provide the best service to the residents of Dubuque while limiting the responsibility of the City. Private firms such as WeCar and UCarShare have developed many practices, policies, and regulations that improve the efficiency of the system and increase the benefits to the users and the City. Unlike a local non-profit system, these practices have been proven in cities across the county. Contracting with a private firm would also eliminate the need for large initial capital investments by the City, and would minimize its legal responsibility as well.

Regardless of which vendor is selected, we recommend partnering with the higher education facilities and local transportation organizations like the ECIA to determine goals and objectives that benefit all residents. Our vendor preference model shows that students show little change in preference between specific vendors, however having cooperation from the universities will likely increase the usage of the system. Proximity and ease of use are highly important to students and cooperation with campus parking and facilities personnel can ensure that cars are placed as close to campus as possible. Having the campuses on board is also important because high residential density is an indicator of success for car-sharing and the college dorms are some of the highest-density residential areas in the city.

BIKE-SHARING ANALYSIS

WHAT IS BIKE-SHARING?

Bike-sharing is a system through which members of the community can rent a bicycle for personal use. There are various options for bike-sharing systems in urban settings, but the ultimate goal of a bike-sharing system is to better integrate cycling into the transportation system, making it more readily available as a daily mode of transportation.[10] Generally, the rationale for introducing a bicycle-sharing system is to promote cycling, increase mobility choices, and improve air quality. Additionally, these systems can serve as an “extension” of the existing transit system, helping both choice transit riders and dependent transit riders cover the “first/last” mile of their commute. Bike sharing systems can bridge the gap between distances that are deemed too far to walk, but too close to justify a car trip. These systems can increase transit stop catchment areas by allowing transit riders to access transit stops and destinations that would be otherwise too far to walk to.[11]

Local efforts are an important step to implementing a city-wide bike-share system. Cities with systems currently in place have observed an increase in physical activity among system subscribers, as well as a reported decrease in commute time, especially for those using transit. Both a bike library and City-wide bike-share system remain equitable choices for lower income individuals, as bikes from these systems are available 24 hours a day and either system can be modified to offer a reduced or subsidized fee structure.

[10] (Shaheen, Gusman, & Zhang, 2010)

[11] (Shaheen, Gusman, & Zhang, 2010)

MODEL RESEARCH: AVAILABLE SYSTEM OPTIONS

In our bike-sharing analysis, we looked at multiple bike-sharing systems on the macro level as opposed to focusing on specific vendors within one type of system. These models included Kiosk-based models, bike libraries, and peer-to-peer platforms. Our system research compiled the benefits and drawbacks to each system, and participants in the focus group sessions considered attributes that were used to compare different bike-sharing models as opposed to different vendors.

KIOSK

This type of system effectively provides an introduction for those interested in using a bicycle as transportation. This type of system requires a strong "casual user" base (users that are not annual members) to support annual members. These systems provide reliability on par with other public transport modes.[12] Moreover, kiosk-based bike-share systems are often only operational during warmer months. The capital costs of implementing a system of this type range from $4,200 to $5,400 per bicycle, with monthly operational costs ranging from $150 to $200 per bicycle.[13]

Kiosk systems also provide a flexible and demand responsive system. Docks utilize solar power to operate and are therefore not tied to one specific location after installation. If a system is underperforming, the dock and bikes can be removed from a location in roughly 30 minutes. Dock/Kiosk systems are also highly visible and offer the opportunity for a public-private partnership, which has been successful in larger cities such as Washington D.C. and Boston.

[12] (Quay Communications Inc, 2008)

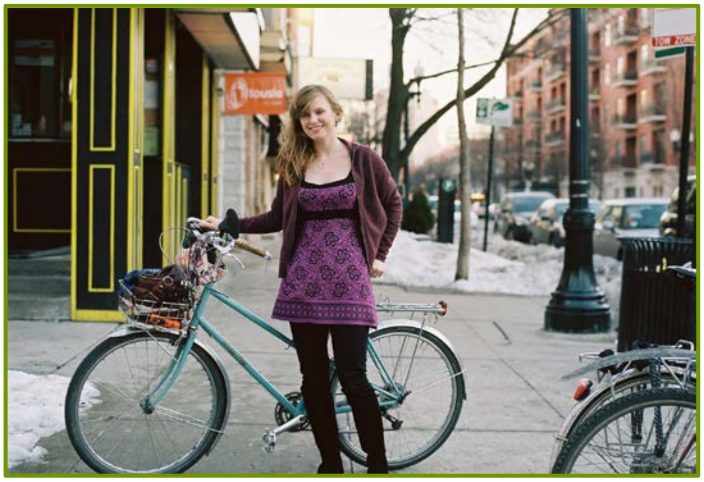
[13] (Toole Design Group and the Pedestrian and Bicycle Information Center, 2012)

BIKE LIBRARY

The bike libraries generally operate a long-term rental check out system. Individuals pay a deposit to check out a bike for an extended period of time, and when the bike is returned at the end of that period the deposit is refunded. Bike Libraries operate in multiple forms, but mostly in the non-profit realm. Bike libraries such as the Iowa City Bike Library and the Dubuque Bike Coop rely on community involvement and support through volunteers and donations. Non-profit organizations of this nature offer the opportunity to provide the entire community with access to a reliable bicycle for transportation. This type of system does not necessarily require heavy capital expenditures on behalf of the City due to the volunteer workforce and bicycles coming from donations.

PEER TO PEER

Peer to Peer systems are relatively new and rely on a web interface, such as Velolet, to connect travelers/tourists with local residents that have a bicycle. [14] These types of systems weren't meant as a permanent means to improving bicycle accessibility and mobility, but may help serve a need before a kiosk system can be implemented.



[14] For more information on Velolet, visit: (http://www.velolet.com)

FEASIBILITY ANALYSIS

The feasibility analysis to determine whether a bike-sharing system can be successful in the City of Dubuque required the synthesis of the results of the accessibility analysis, evaluation of locations and systems which would allow for a successful system, and quantification of community preferences.

ACCESSIBILITY ANALYSIS

The accessibility analysis of Dubuque's current transportation systems helped identify potential areas in need of improved connectivity. The analysis measured how many destinations could be reached within a travel time of 15 minutes if a cyclist is following the existing road network. This analysis was done for every parcel within the Dubuque City Boundary. The results of this analysis established a baseline for what is currently in place, as well as provided a quantitative method for evaluation of how planned infrastructure improvements will affect access to destinations.

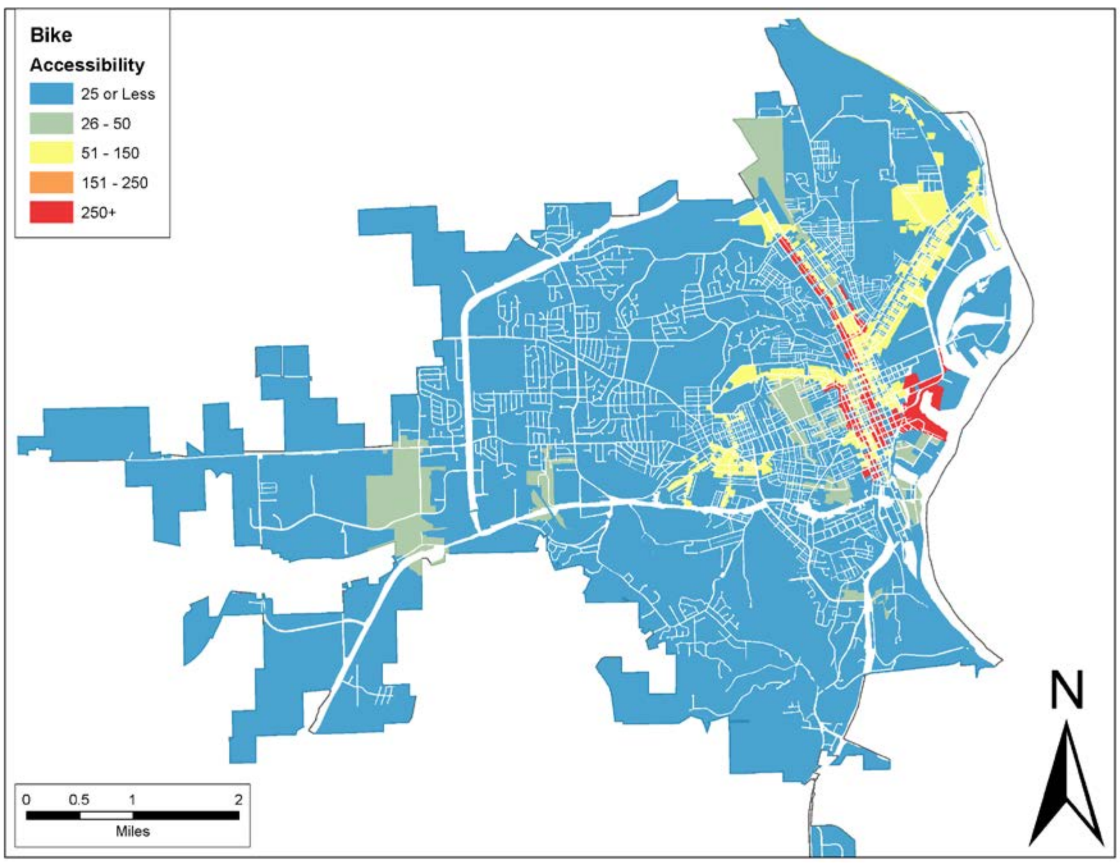


***Figure #7*: Parcel-level accessibility analysis for cyclists**

Figure #7 shows that our accessibility analysis for bike travel revealed 3% of the parcels within Dubuque's city boundary have access to 250 or more destinations within the city. This shows that residents utilizing bicycle travel in Dubuque do not face many barriers to accessibility in the downtown area, but as they move west through the city accessibility decreases.

FOCUS GROUP PREFERENCES

The community engagement aspects of the project focused on the solicitation of community input through focus groups with select segments of Dubuque's population. Because Dubuque's current land use patterns and transportation network were built around personal auto use, it is our belief that the odds of early success of mode-sharing programs will be greater if they are tailored to meet the preferences of likely early-adopters. Our team targeted young professional and college student populations as the main demographic groups for community input because studies show that these individuals are more likely to be early adopters of bike-sharing programs.[15]

The primary goal of the focus groups was to move beyond a qualitative, ideas-based feedback session to quantifying the preferences of our focus group participants toward bike-share options. To do this, each focus group held a brain-storming session to generate a list of the attributes that they feel are most important to the subject being discussed. The participants then voted for their top choices to shorten the list and build a group consensus on attributes that could then be measured in a survey. The process then turned to assigning a range of values by which to measure each element. The final list of attributes and their measurable ranges were then used to build 9 hypothetical "situations", or combinations of values, which the respondents ranked in terms of their personal preference.

Once the surveys were complete, our group used a preference ranking tool known as conjoint analysis to quantify the results. Conjoint analysis uses the survey results to quantify the importance of attributes relative to one another. This relative importance comes from the preference that respondents gave to each attribute when ranking the hypothetical scenarios; the higher the relative importance, the more weight that element had when the focus group members were ranking the hypothetical scenarios. This analysis allowed us to more objectively determine how members of the focus groups make trade-offs between different attributes of bike-share systems. For more detailed lists of attributes along with their ranges, and the specific methodology of conjoint analysis, see *Appendix B.*

STUDENTS

On Monday, February 25th, we sat down with the Web of Life group at The University of Dubuque for a focus group on bike-sharing. Web of Life is a sustainability-focused student group at UD, and they were able to give some valuable insight into what students would find important in a bike-sharing system. As with the young professional group, the final survey found participants ranking trade-offs between different hypothetical bike-share systems.

[15] (Millard-Ball, et al., 2005)

The bike share attributes that Web of Life students found to be the most important are (1) Availability (proximity to campus), (2) Monthly Cost, (3) Variety of Bikes, and (4) Upfront Cost. *Table #12* shows these attributes along with their relative importance.

Table #12: Student Bike-Share Attributes

Attribute	Relative Importance (out of 100)
Availability (Proximity)	38.9
Monthly Cost	27.7
Variety of Bikes	19.7
Upfront Cost	13.7

The top element is the availability in terms of the proximity of the system to campus. The second most important element was monthly costs. The least important of the 4 attributes was upfront cost, specifically whether upfront costs are a deposit that can be returned or a membership cost that is cumulative and not returned. These rankings show that the students are willing to sacrifice having a variety of bikes and are willing to pay a higher monthly cost if the bikes are located in close proximity to campus.

YOUNG PROFESSIONALS

On Tuesday, December 4th, 14 volunteers solicited from ECIA's Bike-to-Work Week list serve and Petal Project's Sustainable Dubuque list serve met to discuss bike-sharing. This focus group debated the merits of different styles of bike-sharing systems including short-term kiosk-based rentals, long-term checkouts from a bike library facility, and grassroots peer-to-peer bike-sharing. The final survey found participants ranking trade-offs between different hypothetical bike-share systems.

The bike share attributes that the young professional group found to be the most important are (1) Cost, (2) Type of Use, (3) Access, and (4) Community (ownership). *Table #13* shows these attributes along with their relative importance.

Table #13: Young Professionals Bike-Share Attributes

Attribute	Relative Importance (out of 100)
Hourly Cost	33.6
Type of Use (Tourism, Daily, Leisure)	26.9
Access (Travel Distance to bikes)	21.1
Community (Ownership)	18.4

Hourly cost and type of use had the highest relative importance from this focus group. These rankings tell us that the participants feel more strongly about the cost of a system than any other element. This is a reflection of their discussion about the importance of having a system that is equitable to people at different income levels.

The attributes that overlap between the two groups are hourly cost and proximity of the bikes to the user. The young professionals placed the most importance on hourly cost, while the student group placed the highest importance on proximity. This indicates that willingness to pay is slightly higher among students if it means the bikes or kiosk facilities are placed closer to campus, while young professionals value a low-cost system over everything else.

SYSTEM PREFERENCE SCORES

Our recommendations are based on models that were constructed to compare different hypothetical infrastructure scenarios. The model tells us what the preference score is for a given scenario. Preference scores are best understood as the amount of personal benefit an individual will enjoy from a certain combination of attributes. The preference scores were derived from the conjoint analysis done to the survey results. Our models were designed such that we can hold all attributes constant and change one specific part of the scenario to see how the benefit to the individual changes.

Table #14 below shows that members of the young professional focus group would receive more personal benefit from a bike library model over a kiosk or peer-to-peer model. Results from the student focus groups show that they have virtually equal preference for a kiosk or bike library model. For a description of the preference models, see *Appendix B.*

Table#14: Combined Preference of Model Types from Focus Group Responses

	System Preference Scores of Young Professionals	**System Preference Scores of Students**
Kiosk Model	37.8%	**44.9%**
Bike Library Model	**46.9%**	44.4%
Peer-to-Peer Model	30.9%	35.6%

RECOMMENDATIONS

Based on the focus group preference rankings, it is our recommendation that Dubuque continue to support local non-profit efforts such as the Dubuque Bike Coop, a bike library that has been operating in Dubuque since September of 2012. The bike library model is a cost-effective method of providing reliable bicycles to members of the community, and it also responds well to the proximity concerns expressed by the focus groups as bike library bikes are effectively owned by the user and do not have to be returned to a central kiosk after every use.

Additionally, a bike library could also potentially partner with local businesses to check out bikes for employees to use for short trips, effectively emulating the most desirable elements of a kiosk-based system without the capital investment from the City. This would also allow the system to fill the niche of tourism and daily-use bicycles, which was an important consideration for the young professional group.

Compared to the current non-profit model of the Dubuque Bike Coop, start-up costs would be greater for a kiosk-based bike-share system, particularly when there are little to no gains in preference between the two systems. If the City is interested in looking into a kiosk-based bike-share system, information on locational feasibility and basic cost projections can be found in *Appendix E.*

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APPENDIX A: NETWORK ANALYSIS METHODOLOGY

The accessibility analysis of Dubuque's current transportation systems helped identify potential areas in need of improved connectivity. This analysis established a baseline for what is currently in place, as well as provided a quantitative method for evaluation of how planned infrastructure improvements will affect access to destinations. For this analysis, access to destinations was evaluated for every parcel within the Dubuque city boundary.

In order to compare different modes of transportation, travel costs must be assigned to each mode. We used travel time and distance to compare different modes.

ASSIGNING TRAVEL COSTS

Time and distance are familiar factors for people to consider when evaluating what mode to choose. Travel time and length were calculated for each network link based on travel speeds specific to each mode. Travel costs rely on mode-specific rates of travel, which are outlined in *Table A1*, along with network travel distances and time constraints.

Table A1: Rate of Travel, Travel Distance and Travel Time Values

Mode	Rate of Travel (mph)	Radius (miles)	Time (minutes)
Walking	3.0[16]	0.5	10
Bicycle	12.5[17]	3.0	15
Motor Vehicle	Posted Speed Limit	10.0[18]	20

With the networks built and travel times assigned to each link based on the mode-specific rate of travel, the networks were ready for evaluation using network analysis.

The Network Analyst extension in ArcGIS is a powerful tool for conducting network-based spatial analysis.[19] This extension is capable of:

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[16] (Fruin, 1971)

[17] Studies vary regarding average speeds for bicycles. This rate of travel is midway between observed travel speeds on urban streets (El-Geneidy, Krizek, & Iacono, 2007) and rates of travel observed on roadways with high levels of services (Krizek, Iacono, El-Geneidy, Fu Liao, & Johns, 2009)

[18] 51% of commuting trips are 10 miles or less (Research and Innovative Technology Administration (RITA))

[19](ESRI)

- Determining shortest routes of travel (based on distance or time)
- Locating closest facilities
- Performing location-allocation to determine optimal locations for facility placement
- Determining network travel costs from each origin to all destinations

Instead of performing these analyses individually, a tool was used that combines these processes: The Urban Network Analysis (UNA) Toolbox. The UNA Toolbox is capable of performing five types of network analysis measures: reach, gravity, betweeness, closeness, and straightness.[20] Reach, the measure used for this analysis, is the measure of how many destinations can be reached from any origin within a given travel distance or time on the network (*Figure A1*). Because this tool allows for the incorporation of buildings or parcels on an urban network, two adjacent parcels can have different accessibility results.[21] This gives us the ability to determine with high precision where gaps in accessibility are for each mode.

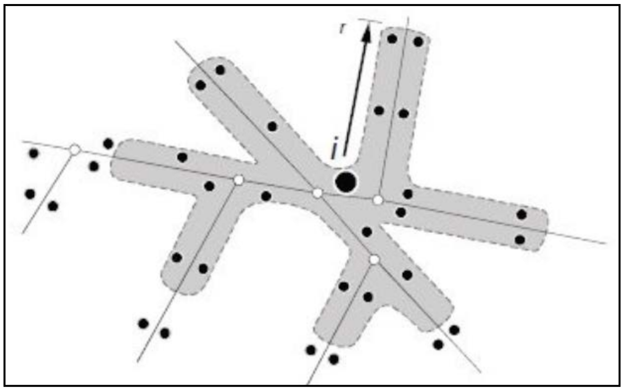


***Figure A1*: Reach graphic from UNA Help Menu.**

The UNA Toolbox allows for consistent, flexible, and replicable analysis of Dubuque's urban network. All three mode-specific networks were evaluated using the UNA Toolbox to calculate the number of potential destinations that could be reached from any residential parcel on a specific network.

The Urban Network Analysis Toolbox was used to conduct the parcel level accessibility analysis for pedestrian, bicycle, and automotive modes of transportation. Results from this analysis indicate pedestrian and bicycle accessibility to be high in the downtown area of Dubuque, but decline quickly as distance from the downtown increases. Results of the automotive analysis revealed access to destinations to be ubiquitously high throughout Dubuque, indicating that access to a car provides the greatest accessibility.

Comparison of accessibility between the current and planned bicycle network indicated the planned facilities increase the average accessibility for cyclists by 192%. Data was not available for planned pedestrian infrastructure improvements at the time. Individuals with access to automobiles are able to reach roughly 50% of all potential destinations in Dubuque within a 20-minute drive.

[20](Sevtsuk & Mekonnen, 2012)

[21](Sevtsuk & Mekonnen, 2012)

APPENDIX B: FOCUS GROUP, CONJOINT ANALYSIS, AND LOGIT MODEL METHODOLOGY

GENERAL FOCUS GROUP, CONJOINT ANALYSIS, AND LOGIT MODEL PROCESS

Focus group sessions consisted of anywhere from five to twenty-two individuals and were designed to allow the recommendations made in this report to reflect the input and expertise of our target populations. The primary contacts established at Clarke University, The University of Dubuque, and Loras College have been Student Life and Resident Life Directors, while the contacts in young professional networks are comprised of a diverse array of advocacy groups, cyclists, and sustainability enthusiasts.

During our focus groups, two members of the team facilitated discussion among the participants and guided them to determine attributes relevant to the topic of interest. Our team relied on a dual moderator system, with one member serving as a lead moderator and the other serving as a scribe to assist in documenting notable attributes generated during group brain-storming.

During all sessions, moderators guided the participants through a group discussion to determine three to five essential attributes of the topic at hand. These attributes were then defined, and units and ranges were assigned for the purpose of measurement and to ensure a ranking system that was understood by those taking the survey.

After the discussion, Mobility Group members use SPSS, a statistics software package, to generate nine unique combinations of these attributes and their respective ranges. We then enter these combinations into the Qualtrics Online Survey Software to allow each individual from the focus group to personally rank the unique, hypothetical combinations. The results of these focus group participant surveys were then analyzed using conjoint analysis, a statistical technique used primarily in marketing to determine how people make trade-offs between different features. It helps those partaking in the study to more easily decide how they perceive certain attributes by having them rank combinations of attributes rather than doing so individually. Using this type of analysis allowed us to determine which attributes of potential facility improvements, car-sharing models, and bike-sharing models are most preferred by those participating in the focus groups. From these rankings we are able to generate utility estimates and importance values (weighted preferences) for each major element.

The importance value comes from the preference that respondents gave to each attribute when ranking the hypothetical scenarios; the higher the relative importance, the more weight that element had when the focus group members were ranking the hypothetical infrastructure, vendor, and system scenarios.

The preference values were calculated using the estimated utility coefficients that conjoint analysis produced for each range of each attribute. *Equation #1* below shows how utilities were used to generate preference values for each individual range.

$$Preference_{range_i} = \frac{e^{Ui}}{\sum_i^x e^{Ux}} \qquad \text{(Equ. \#1)}$$

The preference values for various range elements were then entered into a logit model and weighted against all combined variables to generate a preference score for a scenario or vendor. The general formula is shown in *Equation #2* below.

$$Pref_{system} = Prefa_{1_{range_i}} + Prefa_{2_{range_j}} + \cdots + Prefa_{i_{range_\propto}} \quad \text{(Equ. \#2)}$$

It should be noted that when building the logit model for each scenario, vendor, or system, only one range option was selected for each attribute. The example below shows how the logit model was built for the student preference for the three different bike-share systems.

$$Pv_{Bike\ Library} = Pref_{availabiilty_{Onsite}} + Pref_{variety_{more\ than\ 1\ bike}} + Pref_{up\ front\ cost_{Deposit}} + Pref_{Monthly\ Cost_{less\ than\ \$25}} \quad \text{(Equ. \#3)}$$

$$Pv_{Kiosk} = Pref_{availabiilty_{less\ than \frac{1}{4} mile}} + Pref_{variety_{\ 1\ bike}} + Pref_{up\ front\ cost_{cumulative}} + Pref_{Monthly\ Cost_{less\ than\ \$25}} \quad \text{(Equ. \#4)}$$

$$Pv_{P2P} = Pref_{availabiilty_{less\ than \frac{1}{4} mile}} + Pref_{variety_{more\ than\ 1\ bike}} + Pref_{up\ front\ cost_{cumulative}} + Pref_{Monthly\ Cost\ _{\$25-\$50}} \quad \text{(Equ. \#5)}$$

The preference values shown can be interpreted as the individual's preference for certain facilities, systems, or vendors given the presence of an attribute and holding all other variables constant. These preference values were then used to generate the preference scores for the different vendors and model scenarios found in the recommendation sections of this report.

GROUP-SPECIFIC CONJOINT AND LOGIT RESULTS

INFRASTRUCTURE FOCUS GROUP RESULTS: YOUNG PROFESSIONALS A AND B, AND STUDENTS FROM LORAS COLLEGE

Table A2 shows the attributes, the respective ranges that the participants chose, and the importance and preference values from the conjoint analysis and logit models for the young professional Group A.

Table A2: Young Professionals Group A Infrastructure Attribues, Conjoint Analysis & Logit Results

Attribute	Importance Value (%)	Range	Preference Value (%)
Ease of Route	27.3	Easy	11.6
		Medium	3.7
		High	6.5
Connectivity	29.3	Low	6.4
		Medium	9.8
		High	4.4
Parking	29.5	Not at all	1.8
		Close	37.5
		On Site	4.2
Education	13.9	Low	4.4
		High	9.8

To build the logit model to determine young professional Group A's preferences for different traffic levels, we used the preference values for medium connectivity, close parking, and low education. Holding these values constant between all three models, we changed only the traffic level (ease of route) to see how much preference levels changed. The overall preference for the low-traffic scenario was 63.2%. For medium traffic the combined preference was 55.3%, and for heavy traffic it was 58.1%.

To build the logit model to determine young professional Group A's preferences for dedicated lanes, we used the preference values for ease of route, close parking, and high education. Holding these values constant between all three models, we changed only the dedicated lane designation (connectivity) to see how much preference levels changed. The overall preference for the low connectivity (no dedicated lanes) scenario was 65.2%. For medium connectivity (shared lanes) the combined preference was 68.6%, and for heavy connectivity (dedicated lanes) it was 63.3%.

Table A3 shows the attributes, their respective ranges that the participants chose, and the importance and preference values from the conjoint analysis and logit models for the young professional Group B.

Table A3: Young Professionals Group B Infrastructure Attributes, Conjoint Analysis & Logit Results

Attribute	Importance Value (%)	Range	Preference Value (%)
Intersections	19.8	Light	2.26%
		Heavy	14.45%
Hills	5.5	32nd Street	6.15%
		W Locust St	5.32%
Lighting	12.6	Day	6.97%
		Night	4.69%
Signage	23.4	None	2.89%
		Placard	5.08%
		Reflective Sign/Sharrows	12.72%
Pavement	15.8	>2" depth and >18" long	9.93%
		New Surface	3.29%
Lanes	22.9	None	15.77%
		Shared	1.29%
		Dedicated	9.17%

To build the logit model to determine young professional Group B's preferences for different traffic levels, we used the preference values for 32nd street-level incline, day lighting, no signage, new pavement surface, and no dedicated lanes. Holding these values constant between both models, we changed only the traffic level to see how much preference levels changed. The overall preference for the light-traffic scenario was 37.3%, and for heavy traffic it was 49.5%

To build the logit model to determine young professional Group B's preferences for dedicated lanes, we used the preference values for light traffic levels, West Locust-level incline, day lighting, reflective signage, and new pavement surface. Holding these values constant between all models, we changed only the dedicated lane type to see how much preference levels changed. The overall preference for the scenario with no dedicated lanes was 46.3%. For the shared-lanes scenario the combined preference was 31.9%, and for dedicated lanes it was 39.7%.

Table A4 shows the attributes, their respective ranges that the participants chose, and the importance and preference values from the conjoint analysis and logit models for the student group.

Table A4: Student's Infrastructure Attributes, Conjoint Analysis & Logit Results

Attribute	Importance Value (%)	Range	Preference Value (%)
Traffic	31.5	Midnight	3.0
		Midday	22.2
		Rush Hour	5.5
Lighting	30.6	Day	25.4
		Dawn/Dusk	3.3
		Night	4.3
Topography	25.5	Bluff St	8.5
		JFK Rd	6.7
		Loras Blvd	6.5
Dedicated Pathways	12.5	Present	5.9
		Not Present	8.7

To build the logit model to determine student's preferences for different traffic levels, we used the preference values for Bluff Street-level incline, day lighting, and no dedicated pathways. Holding these values constant between all models, we changed only the traffic level to see how much preference levels changed. The overall preference for the midnight-level traffic scenario was 45.6%. For midday (medium) level traffic the overall preference was 64.8% and for rush-hour traffic it was 48.1%

To build the logit model to determine student's preferences for dedicated pathways, we used the preference values for Bluff Street-level incline, day lighting, and midday traffic. Holding these values constant between all models, we changed only the dedicated pathways to see how much preference levels changed. The overall preference for the scenario with dedicated pathways present was 61.9%. For the scenario with no dedicated pathways, the combined preference was 64.8%.

BIKE-SHARING FOCUS GROUP RESULTS: YOUNG PROFESSIONALS AND STUDENTS FROM UNIVERSITY OF DUBUQUE

Table A5 shows the attributes, their respective ranges that the participants chose, and the importance and preference values from the conjoint analysis and logit models for the young professionals' group.

Table A5: Young Professionals' Bike-Share Attributes, Conjoint Analysis & Logit Results

Attribute	Importance Value (%)	Range	Preference Value (%)
Cost	33.6	Low	8.8
		Medium	16.0
		High	4.4
Type of Use	26.9	Leisure	4.5
		Tourism	12.2
		Daily Use	11.2
Access (Travel Distance)	21.1	Low	10.8
		Medium	8.8
		High	6.5
Community (Ownership)	18.4	Local	8.9
		Corporate	8.1

To build the logit model to determine young professionals' preferences for a kiosk system, we used the preference values for low cost, medium travel distance to bikes (access), tourism use, and corporate ownership. The combined preferences for these attribute ranges gave an overall preference value of 37.8%.

To build the logit model to determine young professionals' preferences for a bike library, we used the preference values medium cost, low travel distance to bikes (access), daily use, and local ownership. The combined preferences for these attribute ranges gave an overall preference value of 46.9%

To build the logit model to determine young professionals' preferences for a peer-to-peer system, we used the preference values for low cost, medium travel distance to bikes (access), leisure use, and local ownership. The combined preferences for these attribute ranges gave an overall preference value of 30.9%

Table A6 shows the attributes, their respective ranges that the participants chose, and the importance and preference values from the conjoint analysis and logit models for the student group.

Table A6: Student's Bike-Share Attributes, Conjoint Analysis & Logit Results

Attribute	Importance Value (%)	Range	Preference Value (%)
Availability (Proximity)	38.9	On site	7.7
		Less than 1/4 mile	11.5
		Greater than 1/4 mile	10.4
Monthly Cost	27.7	Less than $25	13.6
		$25 to $50	5.7
		Greater than $50	11.9
Variety of Bikes	19.7	1 Bike	10.5
		More than 1 Bike	9.1
Upfront Cost	13.7	Deposit	10.3
		Cumulative	9.3

To build the logit model to determine student's preferences for a kiosk system, we used the preference values for less than ¼ mile availability, monthly cost of less than $25, one variety of bike, and a cumulative upfront cost. The combined preferences for these attribute ranges gave an overall preference value of 44.9%.

To build the logit model to determine student's preferences for a bike library, we used the preference values for on-site availability, monthly cost of less than $25, more than 1 variety of bike, and an upfront deposit. The combined preferences for these attribute ranges gave an overall preference value of 44.4%

To build the logit model to determine student's preferences for a peer-to-peer system, we used the preference values for less than ¼ mile availability, monthly cost of $25 to $50, more than 1 variety of bike, and a cumulative upfront cost. The combined preferences for these attribute ranges gave an overall preference value of 35.6%

CAR-SHARING FOCUS GROUP RESULTS – YOUNG PROFESSIONALS AND STUDENTS FROM CLARKE UNIVERSITY

Table A7 shows the attributes, their respective ranges that the participants chose, and the importance and preference values from the conjoint analysis and logit models for the young professionals' group.

Table A7: Young Professionals' Car-Sharing Attributes, Conjoint Analysis & Logit Results

Attribute	Importance Value (%)	Range	Preference Value (%)
Hourly Cost	27.0	$2 to $5	2.2
		$5 to $15	16.0
		Greater than$15	10.2
Scheduling Availability	22.5	Less than 1 hour	15.2
		1 hour to 1 day	9.0
		Greater than 1 day	2.6
Location Proximity	17.7	Greater than 1 mile	5.9
		Less than 1 mile	8.4
Membership Cost	16.9	Less than $40	10.9
		Greater than $40	4.6
Type of Car	15.8	1 vehicle type	5.0
		Multiple vehicle types	9.9

To build the logit model to determine young professionals' preferences for Zipcar as a vendor, we used the preference values for hourly cost of $5 to $15, less than 1 hour scheduling lead time needed, greater than 1 mile proximity, membership cost of greater than $40, and multiple vehicle types. The combined preferences for these attribute ranges gave an overall preference value of 51.6%.

To build the logit model to determine young professionals' preferences for Ucarshare as a vendor, we used the preference values for hourly cost of $5 to $15, less than 1 hour scheduling lead time needed, greater than 1 mile proximity, membership cost of less than $40, and multiple vehicle types. The combined preferences for these attribute ranges gave an overall preference value of 58.0%.

To build the logit model to determine young professionals' preferences for HertzOnDemand as a vendor, we used the preference values for hourly cost of $2 to $5, less than 1 hour scheduling lead time needed, greater than 1 mile proximity, membership cost of less than $40, and multiple vehicle types. The combined preferences for these attribute ranges gave an overall preference value of 44.2%.

To build the logit model to determine young professionals' preferences for Car2Go as a vendor, we used the preference values for hourly cost of $5 to $15, less than 1 hour scheduling lead time needed, greater than 1 mile proximity, membership cost of less than $40, and only one vehicle type. The combined preferences for these attribute ranges gave an overall preference value of 53.2%.

To build the logit model to determine young professionals' preferences for WeCar as a vendor, we used the preference values for hourly cost of $5 to $15, less than 1 hour scheduling lead time needed, greater than 1 mile proximity, membership cost of less than $40, and multiple vehicle types. The combined preferences for these attribute ranges gave an overall preference value of 58.0%.

Table A8 shows the attributes, their respective ranges that the participants chose, and the importance and preference values from the conjoint analysis and logit models for the student group for the young professionals' group.

Table A8: Student's Car-Sharing Attributes, Conjoint Analysis & Logit Results

Attribute	**Importance Value (%)**	**Range**	**Preference Value (%)**
Ease of Use (Reservation Wait Time)	38.8	Less than 1 hour	23.2
		1 to 12 hours	15.5
		12-24 hours	1.6
Accessibility (Proximity)	36.3	On Campus	31.6
		Within 2 blocks	8.3
		More than 2 blocks away	2.2
Cost (hourly)	24.9	$4 to 5	6.1
		$6 to 7	11.45

To build the logit model to determine student's preferences for Zipcar as a vendor, we used the preference values for hourly cost of $6 to $7, less than 1 hour scheduling lead time needed, and cars being located on campus. The combined preferences for these attribute ranges gave an overall preference value of 66.3%.

To build the logit model to determine student's preferences for Ucarshare as a vendor, we used the preference values for hourly cost of $6 to $7, less than 1 hour scheduling lead time needed, and cars being located on campus. The combined preferences for these attribute ranges gave an overall preference value of 66.3%.

To build the logit model to determine student's preferences for HertzOnDemand as a vendor, we used the preference values for hourly cost of $4 to $5, less than 1 hour scheduling lead time needed, greater than 1 mile proximity, membership cost of less than $40, and multiple vehicle types. The combined preferences for these attribute ranges gave an overall preference value of 60.9%.

To build the logit model to determine student's preferences for Car2Go as a vendor, we used the preference values for hourly cost of $6 to $7, less than 1 hour scheduling lead time needed, and cars being located on campus. The combined preferences for these attribute ranges gave an overall preference value of 66.3%.

To build the logit model to determine student's preferences for WeCar as a vendor, we used the preference values for hourly cost of $6 to $7, less than 1 hour scheduling lead time needed, and cars being located on campus. The combined preferences for these attribute ranges gave an overall preference value of 66.3%.

APPENDIX C: POPULATION PROJECTION METHODOLOGY

In order to project the future feasibility for car- and bike-sharing in Dubuque, we used the cohort component technique to project Dubuque's population over the next ten years. The base data was collected from the American Community Survey and the Iowa Data Center, and includes Dubuque County 5-year population estimation by age and sex, the City's Census data by age and sex in 2000 and 2010, life tables for the state of Iowa between 1989 and 1991, and the City's population at the block group level in 2000 and 2010.

The cohort population projection is based on three components of demographic change: births, deaths, and migration. Due to data availability, we were forced to make several assumptions in this analysis: (1) the survival rates have remained consistent since 1989, (2) women between the ages of 15 and 45 determined fertility rate, and (3) the City's migration rate is in line with the county as a whole. In addition, it was assumed that the university populations will stay relatively stable over the next ten years. We obtained the migration rate for each age group by sex according to 2000 and 2005 Census data in Dubuque County, and then projected the City of Dubuque's population data by age and sex for every five years from 2000 to 2020.

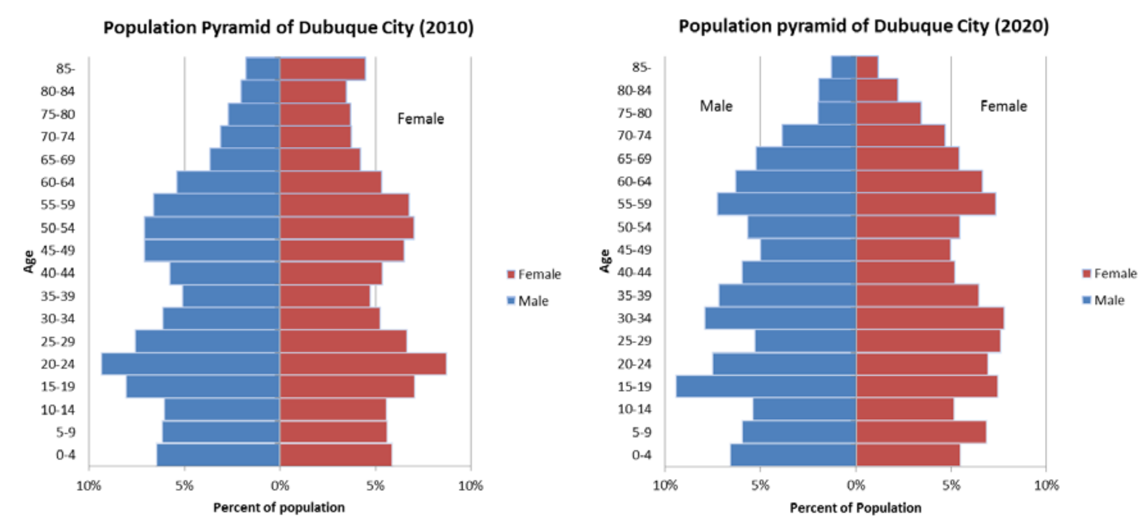


***Figure A2*: Population Pyramid for City of Dubuque in 2010 and 2020.**

According to the Census data, the overall population in the City of Dubuque is slightly decreasing from 57,686 in 2000 to 57,637 in 2010. This trend could be continued in the next ten years. However, as displayed in *Figure A2*, the cohort population projection shows that the population of young professionals (defined as age group 18-34) will remain relatively stable. It is worth noting that the aggregate population of the three universities is about 4,000, which is undercounted by the census. Therefore, we averaged the university population and added them to the 15-19 and 20-24 age groups to make the projection more realistic.

APPENDIX D: CAR-SHARE SUITIBILITY MAPS AND METHODOLOGY

The Mobility Group's feasibility analysis included an in-depth examination of the current demographics within Dubuque. Our group collected Census data at the block group level to further direct recommendations by identifying geographic areas with higher percentages of the target populations. Since location plays a large role in the success of mode-sharing systems, data was compared and analyzed to determine appropriate positions for infrastructure.

In order to create the maps to determine potential locations, our group began by collecting demographic data that is relevant to the success of car-sharing. Many of these variables and desirable ranges were determined from case studies or other literature regarding car-sharing programs across the county. TCRP Report 108: *Car-sharing: Where and How it Succeeds* provided characteristics and ranges of a typical car-sharing user in a successful system. Additional variables were added from other studies.

Using the U.S. Census Bureau's DataFerrett website, our group was able to collect U.S. Census and American Community Survey data. This website allows for the collection of many different pieces of data collected from multiple datasets across the county. Data was collected at the block group level, which is the smallest available level of relevant American Community Survey variables. The smaller the level of data, the more accurate our recommendations can be. The variables collected include age, education, housing density, household income, and number of vehicles per household. This data was then organized by block group, and joined with a block group shape file in ArcGIS.

After compiling the data in ArcGIS, Model Builder was used to determine the suitability of car-sharing based on vehicle ownership, housing density, household income, educational attainment, and target population. For each attribute a raster layer was created extracting the attributes value for a given block group and giving all the cells located in the block group that value. Next, each of these raster layers had the cell values reclassified to give each cell the relative suitability value. Finally, the raster calculator was used to sum the value of each cell within the block-groups.

Figures A3 to *A7* break down each variable that went into our Overall Suitability Map (*Figure #6, page #28*) and which block groups are the most feasible for that piece of data.

VEHICLE OWNERSHIP

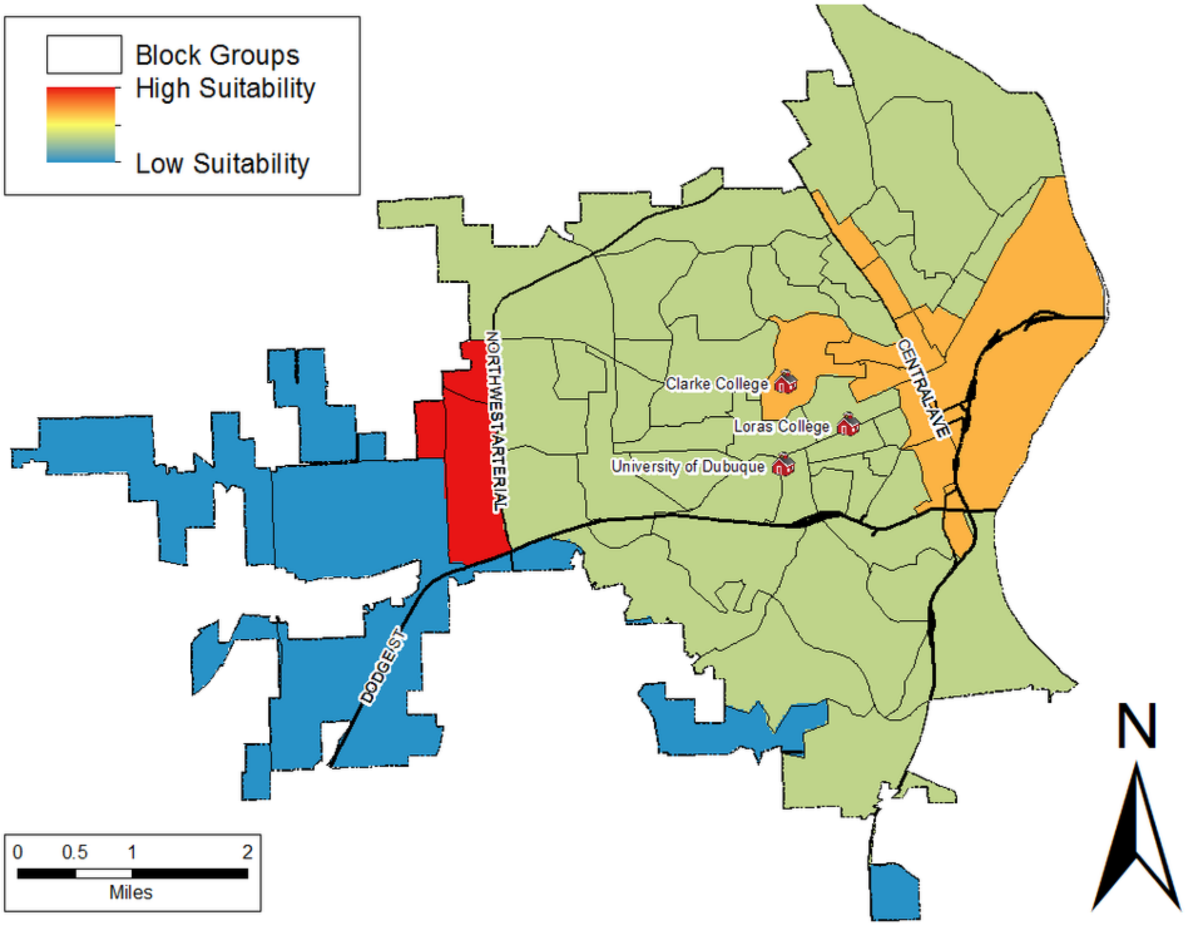


***Figure A3*: Locational Feasibility at the Block Group Level based on Vehicle Ownership**

Figure A3 shows the locational suitability of car-sharing based on vehicle ownership. The map was created based on the percentage of households in a block group with access to 0 or 1 vehicle. Based on studies of successful car-sharing systems, an average member has access to less than one vehicle. Block groups that appear in red have over 75% of households in the block group with 0 or 1 vehicles.

HOUSING DENSITY

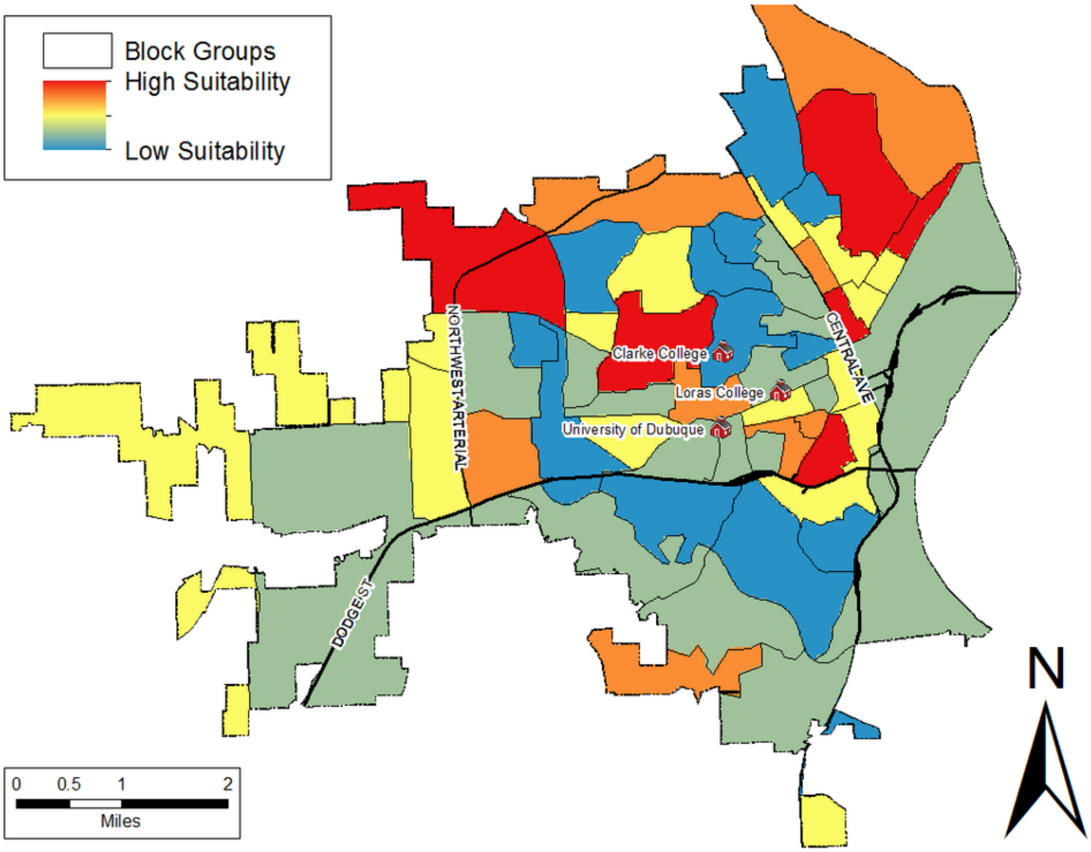


***Figure A4*: Locational Feasibility at the Block Group Level based on Housing Density**

Figure A4 shows the locational suitability of car-sharing based on housing density. The map was created based on number of households within each block group. Based on studies of successful car-sharing systems, a housing density of greater than 5 housing units per acre promotes the growth of car-sharing. Block groups that appear in red have a density of greater than 7.5 housing units per acre.

HOUSEHOLD INCOME

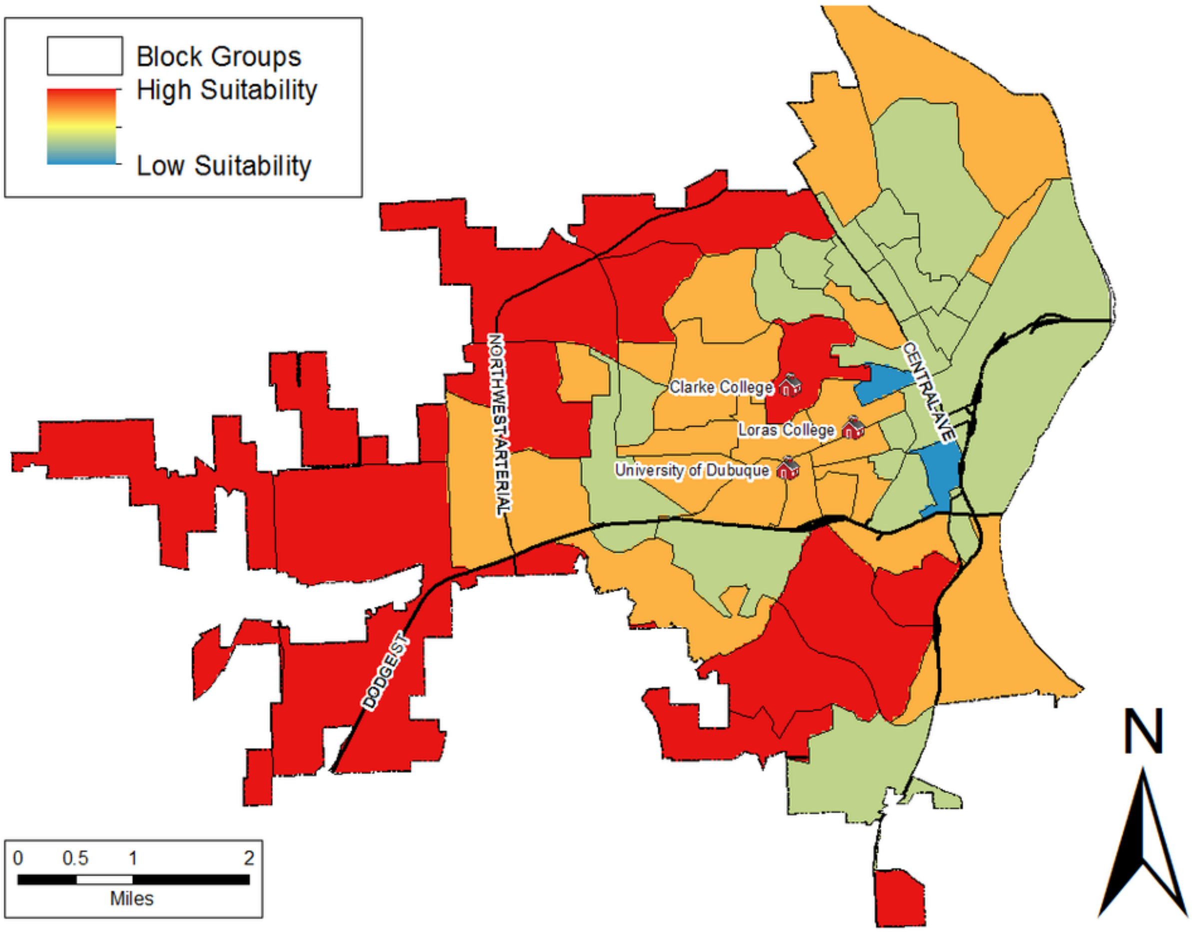


***Figure A5*: Locational Feasibility at the Block Group Level based on Household Income**

Figure A5 shows the locational suitability of car-sharing based on household income. The map was created based on the median household income within each block group. Based on studies of successful car-sharing systems, an upper middle-class average household income promotes the growth of car-sharing. Block groups that appear in red have greater than $60,000 median household income.

EDUCATIONAL ATTAINMENT

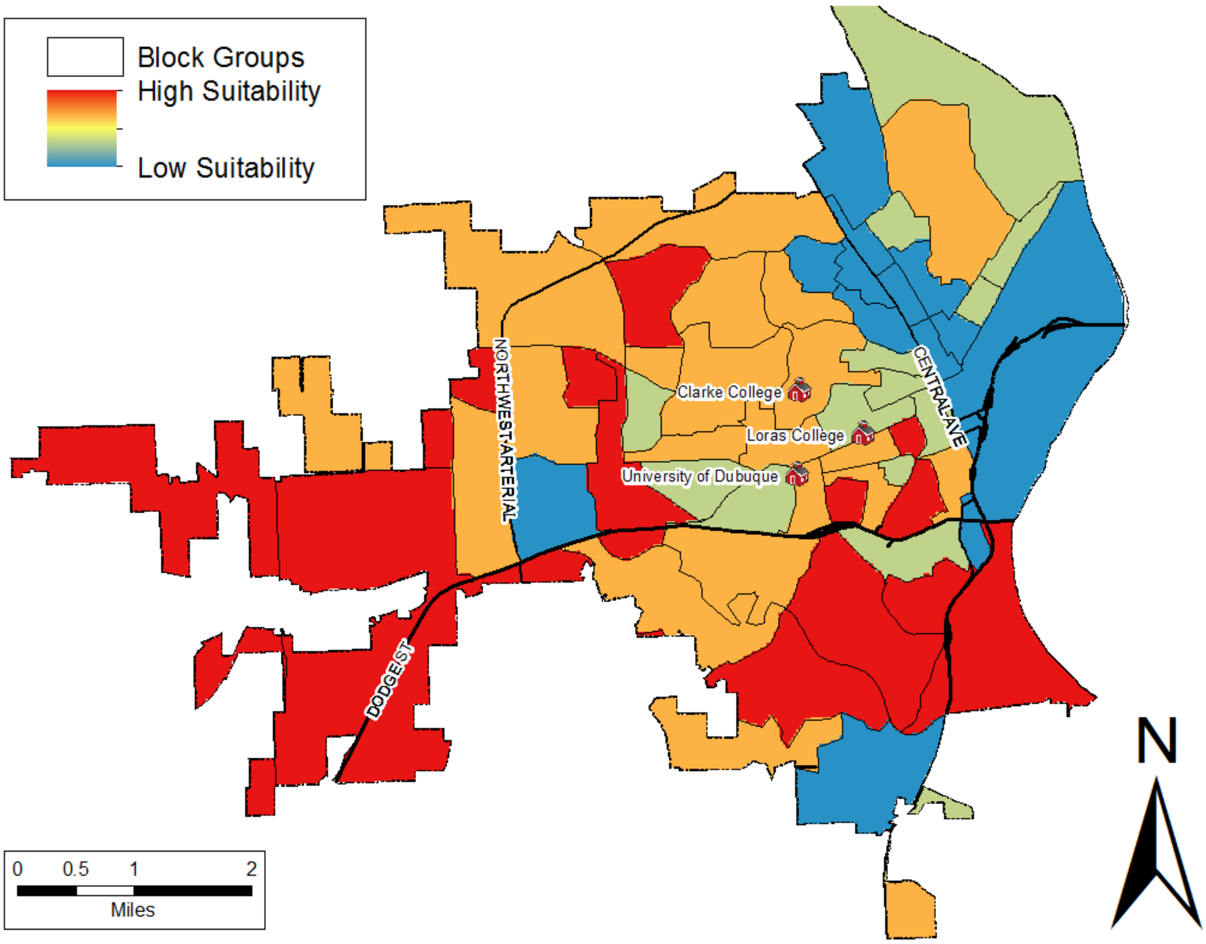


***Figure A6*: Locational Feasibility at the Block Group Level based on Educational Attainment.**

Figure A6 shows the locational suitability of car-sharing based on educational attainment. The map was created based on the percentage of individuals with greater than a high school education within each block group. Based on studies of successful car-sharing systems, most users are college educated. Block groups that appear in red have greater than 30% of the individuals within the block group having more than a high school education.

TARGET POPULATION

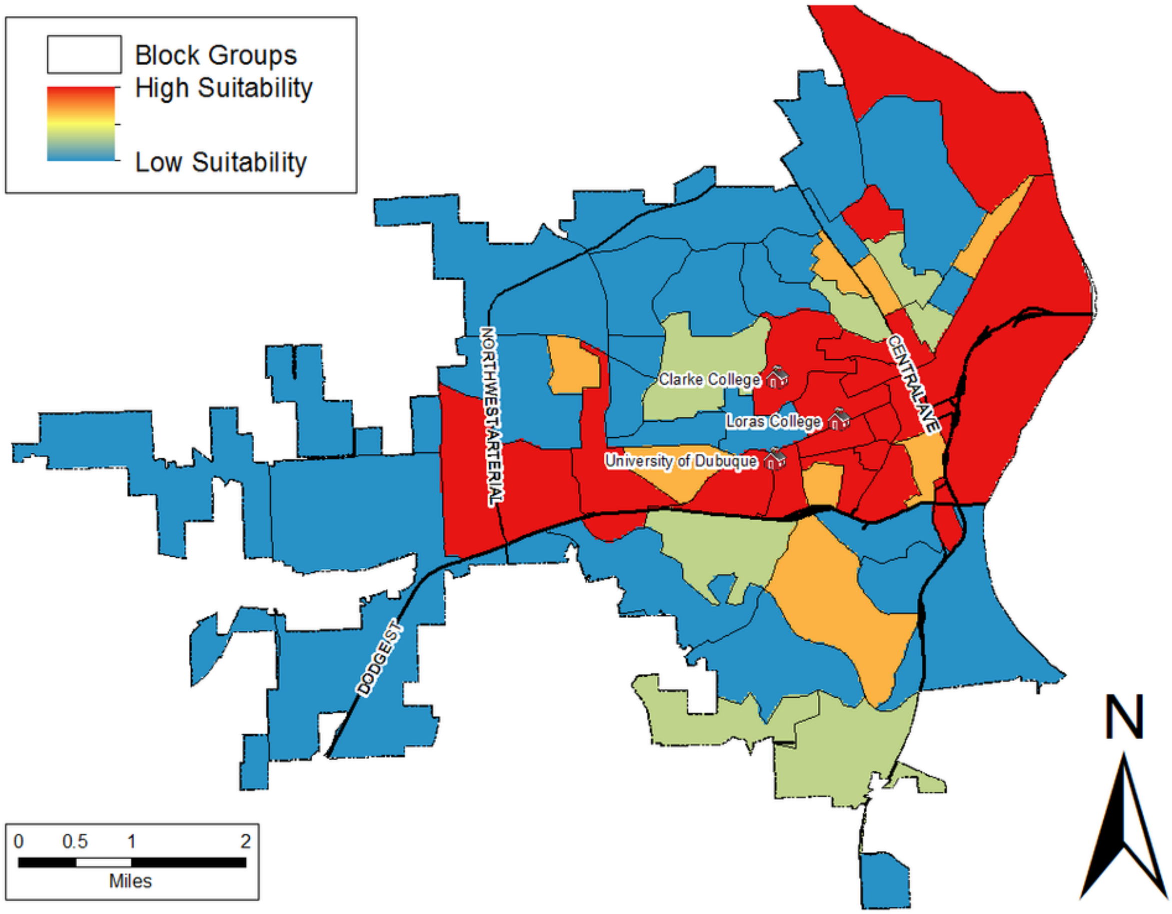


***Figure A7*: Locational Feasibility at the Block Group Level based on Target Population.**

Figure A7 shows the locational suitability of car-sharing based on our target population. The map was created based on percentage of residents within 18 and 34 years of age within each block group. Most users of successful car-sharing systems are within this age range. This also promotes our project partner's desire to attract and retain college students and young professionals. Block groups that appear in red have >30% of the population within the ages of 18 and 34 years old.

APPENDIX E: KIOSK MODEL BIKE-SHARE LOCATIONAL SUITABILITY

CURRENT LOCATION SUITABILITY

Similar to determining the location suitability of a car-sharing system, bike-sharing suitability also examined demographic data for the City of Dubuque. *Figure A8* shows the suitability for a kiosk-based bicycle-share system for Dubuque based on both demographic and geographic data including population, job, and housing densities; topography; proximity to transit, parks, and bicycle infrastructure; and the connectivity results from our accessibility analysis.

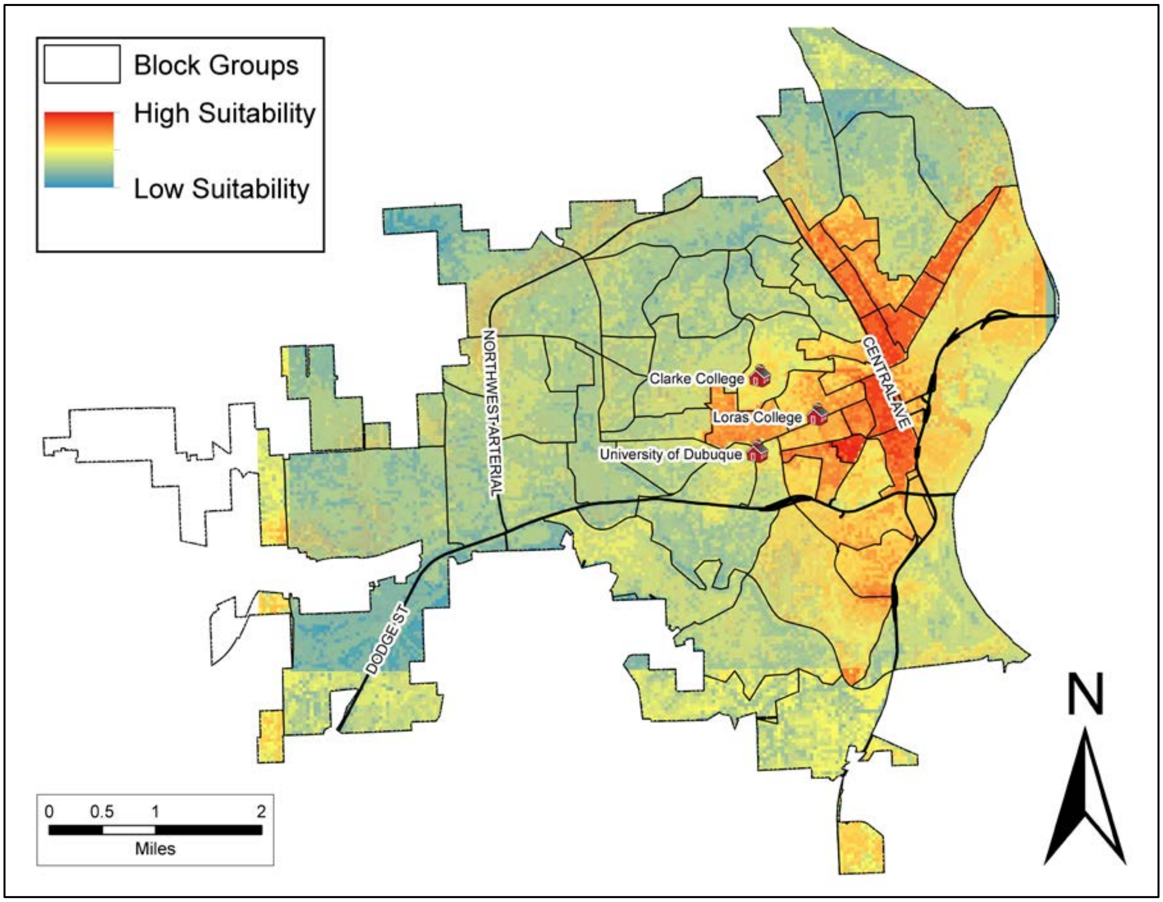


***Figure A8*: Relative suitability of kiosk-based bike-share system based on current bicycle network Future Suitability Scenario.**

Areas in red are most suitable for bike-sharing kiosk locations while areas in blue are least suitable. If the City chooses to pursue a kiosk-based system, this map will be a good starting point for determining where kiosks should be placed. For a more detailed methodology on this process refer to *Appendix F.*

This analysis was modeled after several case studies which found that areas with higher job and retail density, as well as access to transit and high accessibility for cyclists are currently the most suitable for a bicycle share system. This analysis did not project or estimate potential demand. One of the fundamental requirements for the success of a bicycle share system is to have a strong bicycle culture and on-road infrastructure.[22]

FUTURE LOCATIONAL SUITABILITY

Figure A9 shows location suitability for kiosk-based bike sharing in a future scenario where all planned bicycle infrastructure contained in the 2040 Long Range Transportation Plan has been built. While the planned infrastructure opens more residential areas to increased suitability, the areas of high suitability are still concentrated around the downtown and campus areas.

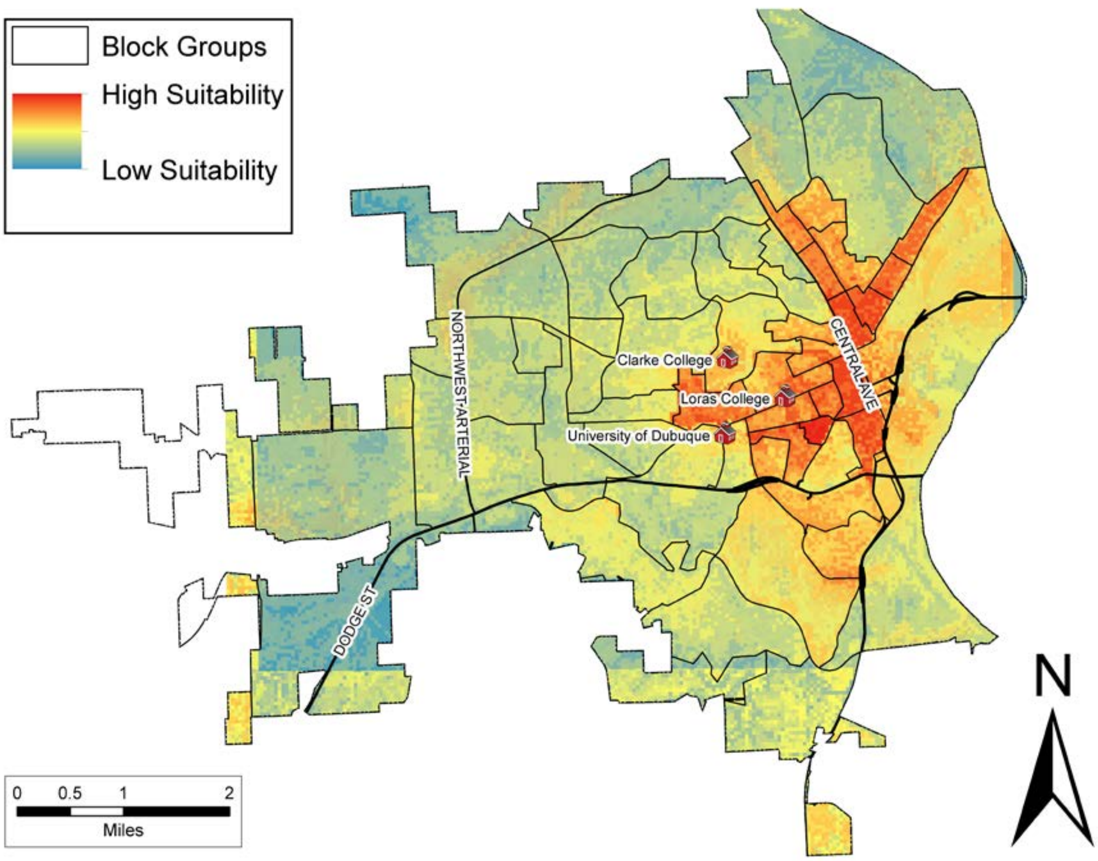


Figure A9: **Relative suitability of kiosk-based bike-share system based on planned bicycle network.**

[22] (Mullen & Robertson, 2013)

It should be noted that when implemented in other cities, kiosks are generally located in commercial/mixed-use areas. The demand in residential areas is likely to be low. Demand estimations in previous studies relied on peer cities. In the case of Dubuque, there are not many peer cities to look to for diversion rates.

POTENTIAL COVERAGE COST RANGES

Table A9 shows what a potential kiosk system might look like based on service area and station density characteristics of existing systems. Service area demographics are based on 2010 Census data for the City of Dubuque.

***Table A9*: System Specifics of a Potential Kiosk-Based System**

Potential System Size	
Service Area	1.5 sq. mi
Station Density (per sq. mi service area)	1 to 3[23]
Projected Number of Stations (start)	1 to 2
Projected Number of Bikes (start)	10 to 20
Service Area Demographics (per sq. mi)	
Job Density	13,119
Housing Density	640
Median Household Income	$35,678

[23] Station density in the US ranges from 3.5 to 5, but in smaller cities with bike share systems such as Spartanburg, SC and Fort Collins this station density is lower.

Table A10 shows a low and high cost system implementation scenarios based on station density and projected number of bikes in *Table A9*.

***Table A10*: Potential Cost Scenarios – Kiosk-Based System**

	Low	High
Bikes + Stations	$42,000	$108,000
Operating (Yr1)	$18,000	$48,000
Total	$60,000	$156,000

APPENDIX F: BIKE-SHARE SUITABILITY METHODOLOGY

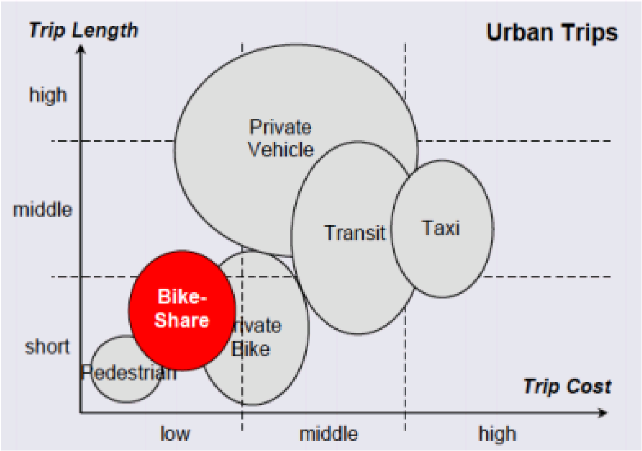
Cities with kiosk-based bicycle-sharing systems are often in large metropolitan areas such as Minneapolis, Boston, or Washington D.C. Very few, if any, cities similar in size to Dubuque have a bike-sharing system currently in place. Methodologies for evaluating suitability/feasibility of bike-sharing systems vary. Dubuque's bike-share suitability was modeled primarily from The Seattle Feasibility Study (Gregerson *et al*, 2010) due to the incorporation of topography in the feasibility analysis, but also included factors from Krykewycz *et al* (2010). Additionally, an accessibility analysis was done for Boston and Washington, D.C., as both cities have publicly available bike-share usage data. Usage data was regressed against parcel accessibility, and was found to be significant indicator of bike-share usage.

There are various options for bike-sharing systems in urban settings. The ultimate goal of a bike-sharing system is to better integrate cycling into the transportation system, making it more readily available as a daily mode of transportation.[24] Generally, the rationale for introducing a bicycle-sharing system is to promote cycling, increase mobility choices, and improve air quality. Additionally, these systems can serve as an "extension" of the existing transit system, helping both choice and dependent transit riders cover the "first/last" mile. Bicycle-sharing systems can bridge the gap between distances that are deemed too far to walk, but too close to justify a car trip (*Figure A10*).[25] These systems can increase transit stop catchment areas by allowing transit riders to access transit stops and destinations that would be otherwise too far to walk to.[26]

[24] (Shaheen, Gusman, & Zhang, 2010)

[25] (Daddio, 2012)

[26] (Shaheen, Gusman, & Zhang, 2010)



Quay Communications 2008

Figure A10: **Role of bike-sharing in Transportation**

The geographic suitability for bike sharing systems has been done in several feasibility studies. Each study incorporates similar factors such as population density, job density, proximity to transit, etc. However, oftentimes these studies incorporate local factors specific to the area. Seattle, for example, incorporated topography due to the hilly terrain of the city. Several indicators were used to determine geographic suitability of a bike-sharing system in Dubuque, several of which were used in the Seattle Bike Share Study. We included the results of our accessibility analysis.

FACTORS USED IN BIKE SHARING SUITABILITY ANALYSIS

POPULATION DENSITY

Population density is an indicator of the overall population of potential users.[27] Most of bicycle feasibility studies reviewed for this project incorporated population density in feasibility analysis.

JOB DENSITY

Job density provides an indication of where people are likely to be during the day, and has been used as one of the primary predictors of bicycle use.[28] Job density has a greater influence on mode choice than population density.[29]

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[27] (Gregerson, et al., 2010)

[28] (Gregerson, et al., 2010)

RETAIL JOB DENSITY

Bike-sharing can serve as mode for people to run errands during midday.[30] Retail job density is also an indicator of mixed land use. Greater intensity of retail activity has shown to encourage bicycle travel.[31]

PARKS

Parks serve as destinations. Data from Hubway in Boston and Capital Bike Share in Washington D.C. indicate that trips during the weekday are generally for work purposes.[32] If the focus of a bike share system is to promote more utility/work-based trips, placing stations near parks may not accomplish this goal.

PROXIMITY TO COLLEGES

Student populations were identified as part of our targeted demographic. Students can serve as a suitable market for bike-sharing systems due to lower automobile ownership.[33]

TOPOGRAPHY

More research has been done regarding the effect of topography on cycling rates. Both commuters and recreational cyclists will take detours to avoid a 2-4% incline.[34] This indicates ridership to be fairly elastic in response to hilliness/topography, with a 10% increase in slope correlated to a 10-15% reduction in percentage of people cycling to work.[35]

TRANSIT STOPS

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[29] (Gregerson, et al., 2010)

[30] (Gregerson, et al., 2010)

[31] (Cervero & Duncan, 2006)

[32] (Mullen & Robertson, 2013)

[33] (Toole Design Group and the Pedestrian and Bicycle Information Center, 2012)

[34] (Broach, Dill, & Gliebe, 2012)

[35] (Parkin, Ryley, & Jones, 2007)

Bicycles offer a method of transit extension. Bike-Sharing or access to a bicycle can help travelers get to "the last mile".[36] Many of the annual members of bike-sharing systems in Boston and Washington D.C. use bicycles in tandem with transit to reduce commute times.[37]

BICYCLE INFRASTRUCTURE

Proximity to bicycle infrastructure has been correlated to a higher likelihood or willingness to cycle.[38] Bicycle infrastructure was all treated equally. A Portland study revealed roughly half of all miles traveled by bicycle to be on streets labeled as bike friendly, or having bicycle infrastructure, even though these streets only comprised 8% of the street network at the time.[39]

ACCESSIBILITY

Accessibility was an entirely locally-derived attribute that accounts for the number of destinations accessible to each parcel. This is somewhat different to job and retail density, in that it is a measure of how many destinations are accessible on the current network.

Parcel Accessibility	Reclassification
0-25	1
26-50	2
50-150	3
150-250	4
250+	5

Figure A11: **Reclassification of parcel accessibility for bike share suitability analysis.**

[36] (Krizek & Stonebraker, 2010)

[37] (Mullen & Robertson, 2013)

[38] (Dill, 2009)

[39] (Dill, 2009)

Table A11 Suitability Analysis Methods

Indicator	Scale	Metric	Weights	Data Source
Population Density	Block Group	Population/Sq. mi.	1	US Census Bureau
Job Density	Block Group	Jobs/Sq. mi.	1	US Census Bureau
Retail Job Density	Block Group	Retail Jobs/Sq. mi.	1	US Census Bureau
Parks	10 meter cell size	Proximity Distance	0.5	ECIA
Topography	10 meter cell size	Percent slope	1	Iowa NRGIS Library
Transit Stops	10 meter cell size	Proximity Distance	1	ECIA
Bicycle Infrastructure	10 meter cell size	Proximity distance	1	ECIA
Parcel Accessibility	Parcel	Level of Access	1	ECIA

Table A11 shows the indicators used for the suitability analysis. All GIS data were converted to raster files and reclassified using a 0 through 5 (5 being closer/better suited) scale using quantile intervals for every indicators except parcel accessibility. Parcel accessibility was reclassified using the same intervals indicated in *Figure A11*. Keeping the same classification scheme for this indicator helped in showing how increased access through the planned bicycle network increases suitability.

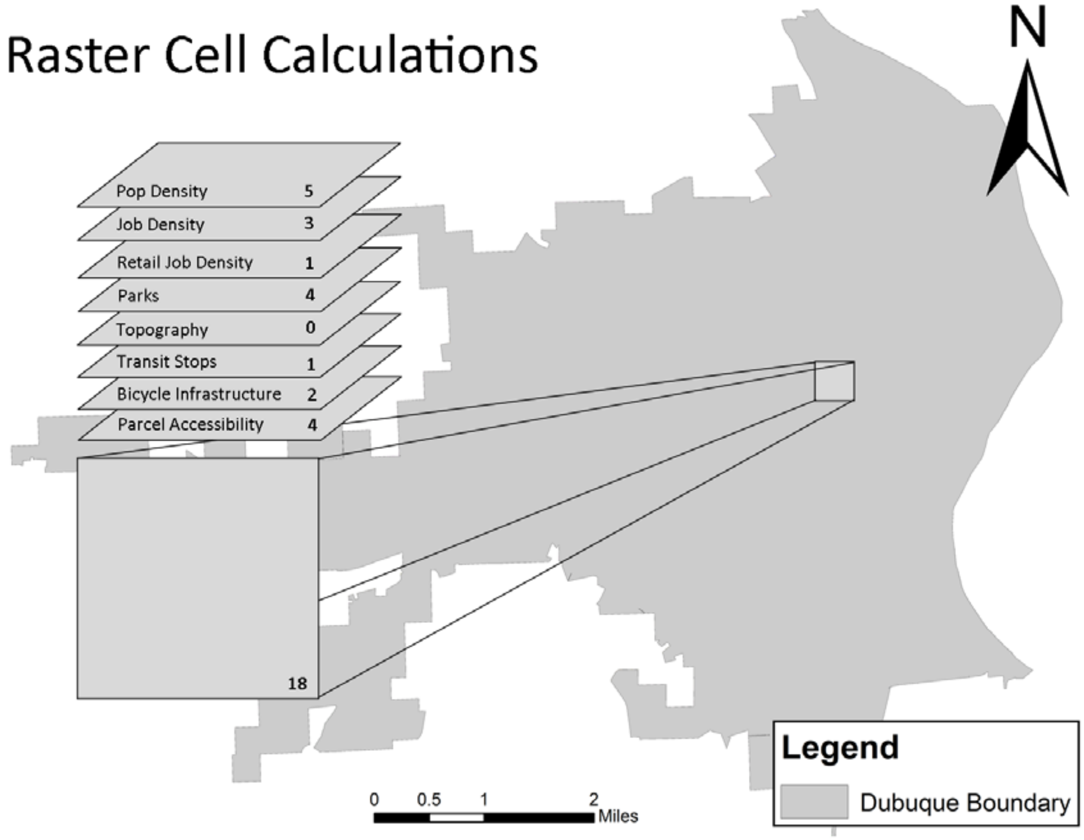

Figure A12: **Example of GIS raster calculations based on indicator attributes (adapted from the Seattle Bike Share Study).**

Figure A12 illustrates how the all the GIS layers are used to calculate a cumulative suitability score.

APPENDIX G: MARKET RESEARCH MATRICES

To simplify all of the aspects for each mode-share model, our group created separate comparison matrices for car- and bike-share models, which compared cost, location, responsibility, and availability aspects. We examined websites, membership handbooks, Frequently Asked Question pages, reviews, and online member assistance pages for information that allowed the team to collect information such as fees and policies specific to providers. This information was used and will continue to be used to better inform stakeholders and decision makers as they determine which models are the best potentially fit for the City of Dubuque.

See *Figure A13* for Car-Sharing Vendor Comparison Matrix and *Figure A14* for Bike-Sharing System Comparison Matrix.

FIGURE A13: CAR-SHARING VENDOR MATRIX (1/4)

Industry	Vendor	Location						
		Currently Exist in Dubuque?	Only Available at Universities?	Existance in Similar Cities (college or population)	Return Car to Same Parking Location?	Use Membership at other Locations	Share Cars between Cities?	One-time Registration Cost to User
Private Vendors	ZipCar	No	No	Yes	Yes	Yes	No	$25
Private Vendors	Uhaul Ucarshare	Yes, @ Loras College	Yes	Yes	Yes	Yes	No	$25
Private Vendors	Hertz on Demand	No	No	Yes	Yes, participating locations will allow one-way use	Yes	Yes	$0
Private Vendors	Car2Go by Daimler	No	No	No	No (when within area served)	Yes	No	$35
Private Vendors	WeCar by Enterprise (Costs dependant on Location; Costs based on Ames, IA prices)	No	No	Yes	Yes	No	No	$20
Non-Profit	I-GO (Chicago)	No	No	No	Yes	Yes	No	$0-30
Non-Profit	Community Call (Madisor	No	No	Yes	Yes	Yes	No	$35
Non-Profit	PhillyCarShare	No	No	No	Yes	No	No	$25
Non-Profit	eGo (Boulder, Denver)	No	No	Yes	Yes	Yes	No	$25
Non-Profit	City CarShare	No	No	No	Yes	Yes	No	$30
Peer to Peer Car Rental	Wheelz	No	No	No	Yes	No	No	$0
Peer to Peer Car Rental	Jolly Wheels	No	No	Yes	Yes	N/A	No	$0
Peer to Peer Car Rental	Getaround	No	No	Yes	Yes	N/A	No	$0
Peer to Peer Car Rental	RelayRides	No	No	Yes	Yes	N/A	No	$0

FIGURE A13: CAR-SHARING VENDOR MATRIX (2/4)

	Cost/Responsibility					
Registration Requirements	Annual Cost	Cost per Use: Hourly	Cost per Use: Daily	Grace Period	Late Fees?	Gas Responsibility
Apply online, Get Zipcard in the mail within 3 to 7 days, 21+, Valid license for >1 year, substance and violation/ accident requirements	$50	Start at $8.75/hr	Start at $63/day	Able to extend reservation if no one else is waiting	$50 /hour + hourly charges	None, gas card provided
~24 Hour Registration, driver's license 2+ years, accident and violation restrictions	$0	Start at $4.95/hour + $0.49/mile (Max: $8.50)	Start at $62/day	15 min / 5 min when member is waiting	$25 + hourly fee (If no call) + charges to take care of waiting member (after grace period)	None, gas card provided
Receive Access Card or Key FOB in 5-7 days,	$0	Starts at $5/hour (+$0.45 /mile after 180 mi)	Starts at $60/day	None / Allowed to extend time as needed if no other member is waiting	Charged for additional time	None, gas card provided
See Website: http://www.car2go.com/austin/en/files/car2go_austin_terms_and_conditions.pdf	$0	$0.38/min $13.99/hour	$72.99	15 min to cancel, can reserve at the car	None, Cancellations also free.	None, gas card provided
18 or older, must be part of the organization or city, Under 21 requires guardian consent form	$35	$8 - $8.50/hour	$56.00 ($35.00 6PM to 8AM Overnight Cost)	None / Allowed to extend time as needed if no other member is waiting	Late return penalty + cost to provide waiting member alternative transportation	Gas Card Provided, fill when less than 1/4
See Website: http://www.igocars.org/pricing/eligibility/	$25-360	$6.25-12 (depends on type of vehicle and plan)	$65-93	None / Allowed to extend time as needed if no other member is waiting	$20, plus fees if another reservation was affected	Gas Card Provided
Atleast 21, valid drivers license 2 of past 3 years, no more than 2 minor and/or 1 major moving violations in past 3 years, (student eligibility measured seperately)	$35	$3.50-9.95 (depending on plan and hour of day)	$85	None / Allowed to extend time as needed if no other member is waiting	$15 per every 15 min late, capped at $85	Gas Card Provided
21, valid driver's license, major credit card (under 21, additional restrictions apply)	$35-125	$4.45-7.50	$42-69	None / Allowed to extend time as needed if no other member is waiting	$40 /30 minutes late	Gas Card Provided, but if lost will reimburse cost
21, valid driver's license, clean driving record	$0-120	$2.50-6.50 (Plus $0.30/mile)	$49-75	None / Allowed to extend time as needed if no other member is waiting	With notificaiton: $7.50/15 min Without notifications: $20 + $7.50/15 min	Gas Card Provided
21, valid driver's license, clean driving record	$50-240	$5-7.75 (plus $0.10-0.35/mile)	$48-66	Possible to extend, but if late and other member is displaced there is an extra fee	$15-50 (based on time late)	Gas Card Provided
US license, "clean driving record"	$0	Set by user ($5- 50/ hour; Avg:$8.00/hour)	None	N/A	$10 fee within 2 hours; Reservation cannot be cancelled within 15 min	Use gas card provided, charged based on fuel economy and miles driven
18 or older, Credit or bank-issued debit card	$0	Not Available	Depends on provider/vehicle	3 hours with 1 opportunity for extention	$10.00/hour	User responsibiliy (Must be the same amount as when released, $15 refill charge if necessary)
19 or older, good driving record	$0	N/A	None	N/A	N/A	N/A
18+, some driving record restrictions	$0	$6-12/hour	None	N/A	N/A	User responsibility for gas used

FIGURE A13: CAR-SHARING VENDOR MATRIX (3/4)

Insurance Responsibility	Milage Limitation	Ticket or Parking Violations/ Tolls	Miscellaneous Costs	Car Types	Way of Reserving Vehicle
$750 Damage Fee, responsible for any damage over ZipCar coverage, Roadside Assistance included	180 miles/reservation + 20 miles/hour when exceeding 24 hours (+ charge/mile over)	Own Responsibility, toll passes in vehicles where necessary (account is charged)	Late Cancellation fee, regional charges may apply	30 Different Models, including pick-ups, Hand Control equiped vehicles for Disabled, hybrids, and Plug-in Hybrid electric	Online, mobile device, or by phone
$500 deductible	None for hourly, 180 miles/daily reservation (+$0.40/mile over)	Own Responsibility, additional penalty through Uhaul	Late Cancellation fee	hybrid, compact, cargo van, pick-up, SUV	Online
$250 deductible	180 miles/day	Own responsibility, EZ pass billed to user, up to $40 if ticket or violaiton is not resolved on time, administration charge for towed cars	$3.50 / reservation on the phone, $25 for returning vehicle with less than 1/4 tank of gas, No charge for cancellation if 5 minute or more before reservation	Electric vehicles, 4-door sedans	Online, iphone app, or phone (+$3.50); only 4 reservations in advance allowed, up to 6 months in advance
Up to $1000 deductible	150 miles ($0.45/mile over)	Members responsible for parking fines. If vehicle is towed, the last rental is assessed the fines.	See Website: http://www.car2go.com/austin/en/rates/fees/	Smart Cars	Online, phone, at the car
$1,000 deductible (Slightly higher rates reduce deductible to $0, at participating locations)	200 ($0.20/mile over)	Member responsibiility	Billed for reserved time less the time used by another member if reservation is cancelled within 4 hours of use	Sedans, Cars for the disabled with 48 hour notice	Online
$500 of deductible	150 miles ($0.40/mile) (depends on plan)	Member responsibility	Cancellation cost if within 4 hour of reservation	Electric vehicles, 4-door sedans, hybrids, SUV, Vans, pick-ups	Call or online
$500 of deductible	150 miles ($0.48/mile after)	Member responsibiility	$2 call fee, $0.35 for smartphone reservation extension or scheduling	Honda Fit & Civic, Toyota Prius & Yaris, Ford Ranger, Nissan Quest, Mini Cooper	Online, phone ($2 fee), Smartphone ($0.35 fee)
$500 deductible or $50 per month waiver	Depends on plan: 185 miles or $0.25/ mile	Member responsibility	$30 for taking car more than 5 minutes early	Chevy Volt, Mini Cooper, Cargo Vans, Nissan Rogue, Kia Optima, other various trucks and cars (30 types)	Online, phone
$250 deductible	100 miles for day rental	Member responsibiility	$15 if gas tank is below 1/4 when returned	Toyota Prius, Honda Fit, Nissan Versa	Online, phone, mobile site
$50-500 (Buck-to-Deduct option available)	None	Member responsibiility	N/A	23 types (including electric and hybrid)	Online or phone
$1 Mil Insurance Policy after $500 deductible	N/A	Own responsibility, tickets: +$5 fee; Toll: unauthorized use of device will result in $5 fee and cost of toll	$15 fine if gas is less than 1/4; if not returned to home parking zone ($50 re-parking fee); Car owners responsible for "wear and tear"	Depends on Member pool	Smart Phone App
User responsibility	Depends on provider/vehicle	User Responsibility	Partial Payment due on registration (Up to $25; Guarentees availability), Some cars require time/cost mins	Depends on Member pool	Website or Call
N/A	N/A	N/A	N/A	Depends on Member pool	Text, website, or Smart Phone App
$500 Deductible	N/A	User Responsibility	N/A	Depends on Member pool	Email, text

FIGURE A13: CAR-SHARING VENDOR MATRIX (4/4)

Availability			Other		
Length of Reservations	Midwest Cities	National Service	Household or Family Memberships	Corporate, group or business deals?	Additional Comments
1 hour to 4 days, 30 minute increments, greater than 4 days not guarenteed, Some Zipcars at busy locations are Hourly Only	12	130+ cities	Yes, $25 annual fee/ person	Self service access to cars 24/7, discounted rates M to F, Start up fee + annual additional driver fees	Unauthorized use will result in revoked membership. 30 day trial period
hourly or by day	7 cities border/within Iowa	33 cities	N/A	N/A	Pets allowed
hourly or by day	5 cities in IA or IL	74 cities and universities	N/A	N/A	GPS, Ipod, and Bluetooth in every vehicle, Hertz Gold Plus Rewards, 24/7 Member Care Center
Up to 24 hours	0	5 cities	Yes	Yes	N/A
1 hour minimum, 24 hour max (Can reserve for up to 7 consecutive days)	7 cities border/within Iowa	57	N/A	N/A	Spouses of members can drive, WeCar will locate alternate vehicle or switch reservation if reserved car is running late. 24/7 Roadside assistance and customer service phone number
N/A	Chicago	1	N/A	Yes	N/A
30 minute minimum, 15 minute increments	0	0	N/A	Yes	N/A
N/A	0	0	N/A	N/A	N/A
15 minute minimum	0	2 Cities in Colorado (Boulder, Denver)	N/A	N/A	N/A
15 minute increments	0	Bay Area	N/A	N/A	N/A
N/A	0	2 (LA and San Fran)	No	No	24 hour roadside assistance and support
Day, Week, Monthly Pricing	30 (MI, IL, WI, MO)	about 500 Locations	No	No	Cars can be delivered, AAA member discount, others available to drive if qualified
N/A	1 (Chicago)	5	N/A	N/A	International Licences Accepted
Hourly	N/A	N/A	N/A	N/A	Roadside Assistance

FIGURE A14: BIKE-SHARING VENDOR MATRIX (1/3)

Vendor	Location					
	Currently Exist in Dubuque?	Existance in Similar Cities	Return to Same Location?	Web Interface?	Initial Cost to User	Registration Requirements
Kiosk-based rentals. (i.e. Bcycle Madison, Nice Ride, Bixi, Capital Share)	No	Yes	No	Yes	$65-75/yr	Credit Card
Bike Library (Long-term bike rental)	Yes	Yes	Yes	Yes	$50-$150/ 6 mo checkout	Driver's License and Cash or Check
SpinLister (Peer-to-peer)	No	Yes	Yes	Yes	$0-18	Bike to share and PayPal
Velolet (Peer-to-peer)	No	Yes	Yes	Yes	$5-$50	Credit card/PayPal

FIGURE A14: BIKE-SHARING VENDOR MATRIX (2/3)

Cost/Responsibility							
Annual Cost	Free Duration	Cost per Use: Daily	Late Fees?	Limitations	Miscellaneous Costs	Cost to City	Bike Types
$65-75/yr	1 hr	$5	Yes	Meant for short trips (over 1.5 hrs starts at $10.50)	None	Depends on company	1 Durable type
none	6 Months	$1.83	Lose Deposit	Limited to Volunteer Organization's ability to provide bikes	Lock, Helmet, Lights	Some cost of support is usually involved	Donated bikes
none	1 Day	$18	No	Limited to bike owners who have a bike available on Spinlister	None	None	Depends on participating bike owners
none	none	$5-$50	N/A	Bike shops in area	None	None	Depends on participating bike owners

FIGURE A14: BIKE-Sharing VENDOR MATRIX (3/3)

Availability				Other	
Method of procurement	Length of Reservations	Regional Service	National Service	Year Round Availability	Additional Comments
Online	1 hr free	Yes	Yes	Potentially	Bcycle charges the city to run the system. There may also be systems that will set up a proprietary system that the city would manage.
In person	6 months	No	No	Yes	Non-profit, volunteer-based BLs generally require some sort of city support (often a work space. Cooperation in terms of police department bike impounded bikes also helps viability)
Web interface and in person meeting	1 day to 1 week	Yes	Yes	Yes	
Web interface and in person meeting	Up to week	Yes	Yes	Yes	