Enhancing Transportation Demand Management Options at the University of Nebraska at Omaha: The Costs, Benefits and Challenges of Implementation

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Executive Summary

As a growing metropolitan university, UNO faces the continuing and expanding challenge of automobile congestion and demand for convenient parking. The financial, environmental, aesthetic and opportunity costs of creating and maintaining parking structures are extremely high and space on campus is limited. In addition, due to affordability, disability, or desire, many students, faculty and staff require multi-modal options for getting to and around campus. Urban and other universities are increasingly encouraging the use of more sustainable transportation options through transportation demand management (TDM).

This research project examines the costs, benefits, and challenges of enabling and supporting sustainable modes of transportation—Public Transit, Biking, Walking, Carpool/Share—compared to the current focus on parking for Single-Occupancy Vehicles (SOV). The comparative costs and benefits were examined in several key areas: Direct fiscal costs and benefits for individuals and for university capital, operation, and maintenance; and indirect costs and benefits for Health, the Environment, and Community. Questions to be addressed in this study include:

1. What has UNO done in relation to TDM and how does it compare to peer and aspirational universities?
    - What strategies have been implemented and why?
    - How is TDM administered and financed?
    - What has been successful and what are the challenges?
2. What are the direct and indirect costs of supporting various modes of transportation at UNO? What is the return on investment of each mode?
3. What strategies and priorities should UNO consider in supporting sustainable transportation options?

To address these questions, data were gathered through interviews with key stakeholders on campus and with representatives of designated, aspirational and local peers; a survey administered as part of the sustainability master planning (SMP) process; and secondary data, including already-completed studies.

Findings included:

- Investing in sustainable transportation options is cost effective compared to investing in SOV parking. Benefit-to-cost ratios range from a low of 6.08 to a high of 7.67. **This means at a minimum, benefits of multi-modal options relative to costs are more than 6 to 1.**
- A multi-pronged approach to TDM is being pursued by most of UNO's university peers and to some degree by UNO. The more advanced peers do so in a planned and holistic manner and in partnership across campus and with partners outside of campus.
- Approaches that silo parking and transportation from facilities/planning make it difficult or impossible to take a more comprehensive approach to TDM.
- Leadership from the top can make all the difference in implementing TDM. One person in a key position can also be a major roadblock to implementing TDM.

- Addressing design issues that encourage or impede sustainable transportation options is necessary on and off campus.
- Coercive measures such as raising parking fees can be challenging politically and for other reasons. Non-coercive strategies to provide alternatives to driving-alone can help to reduce or avoid costs and the need to significantly raise parking fees; or make raising fees more palatable.
- Start early (at orientation or before) to educate students, faculty and staff about transportation options and issues.

Based on the "lessons learned" from the literature and findings, recommendations include:

1. Consider shifting funds from the "parking structure 3 savings fund" or obtain dedicated funding from other sources to invest in transit, carpooling, bicycling and walking. The largest return on investment appears to be to greatest for the MavRide program. That said, based on the literature review, the most effective strategy is a multi-pronged approach to TDM.
2. Get clear support for a multi-modal/TDM approach from the UNO Chancellor and key administration leaders, which will significantly enhance the success of TDM efforts on campus.
3. Change the focus of the Parking Department and Parking Advisory Committee to a (Multimodal) Transportation Department and Advisory Committee.
4. Integrate the promotion of multi-modal transportation into all UNO communications (including changing the Parking Department website to a Transportation website). Flyers promoting multi-modal transportation should be posted throughout campus. Orientations should provide multi-modal transportation information to help educate students, faculty and staff.
5. Consider modifying the parking fee model to better capture UNO's associated costs. The current monthly parking lot fee is $24.99, whereas the actual cost is between $176 and $229 per month. Similarly, the monthly parking surface pass at UNO is $20, whereas the associated cost is between $127 and $199 per month.
6. Work collaboratively with Metro Transit, the City of Omaha and the Metro Area Planning Agency (MAPA) to promote TDM and a complete streets policy locally and regionally.

Introduction and Purpose

As a growing metropolitan university, UNO faces the continuing and expanding challenge of automobile congestion and demand for convenient parking. The financial, environmental, aesthetic and opportunity costs of creating and maintaining parking structures are extremely high and space on campus is limited. In addition, due to affordability, disability, or desire, many students, faculty and staff require multi-modal options for getting to and around campus. Urban and other universities increasingly encourage the use of more sustainable transportation options through transportation demand management (TDM).

This research examines the costs, benefits, and challenges of enabling and supporting sustainable modes of transportation—Public Transit, Biking, Walking, Carpool/Share—compared to the current focus on parking for Single-Occupancy Vehicles (SOVs). The comparative costs and benefits are examined in several key areas: Direct fiscal costs and benefits for individuals and for university capital, operations, and maintenance; and indirect costs and benefits for Health, the Environment, and Community.

Questions to be addressed in this study include:

1. What has UNO done in relation to TDM and how does it compare to peer and aspirational universities?
    a. What strategies have been implemented and why?
    b. How is TDM administered and financed?
    c. What has been successful and what are the challenges?
2. What are the direct and indirect costs of supporting various modes of transportation at UNO? What is the return on investment for each mode?
3. What strategies and priorities should UNO consider in supporting sustainable transportation options?

Literature Review

Transportation (or Travel) Demand Management (TDM) is primarily aimed at decreasing the percentage of commuters who travel by single occupancy vehicles (SOVs) and/or vehicle miles traveled by commuters who use SOVs (Winters, 2000). Alternatives to SOV driving include biking, walking, public transit, carpooling, vanpooling, and telecommuting. Improving infrastructure for commuting by bike and on foot is considered a non-motorized strategy while promoting other tools for transportation are regarded as motorized strategies (Litman, 2010). Regardless of the level of its effectiveness, it is shown that all these strategies can reduce demand for driving alone and miles travelled to work.

Research shows TDM has a positive impact on both the entity that conducts TDM and the entire community, including the local transit agency and citizens (Zali, Abizadeh, & Bagherinia, 2013).

- First, TDM can bring about **economic development** and **fiscal sustainability** (Litman, 2013; Garrett-Peltier, 2011; Weisbrod & Reno, 2009; Cambridge Systematics, 2002;

Cambridge Systematics, 1999; APTA, 2010; Smart Growth America, 2013) by creating jobs, increasing local government tax revenues, increasing business income, and reducing road costs. Fiscal sustainability effects include reducing personal costs for the automobile and its incidental expenses (Litman, 2013; Weisbrod & Reno, 2009; APTA, 2007).

- Second, TDM **decreases fuel usage** as it reduces driving, and in turn, improves air quality. The environment improves due to reduced energy consumption and carbon emissions (Davis & Hale, 2007; Shapiro, Hassett, & Arnold, 2002).

- Third, TDM **reduces traffic congestion** by decreasing the number of automobiles and miles traveled, leading to time and cost savings (Litman, 2013; APTA, 2007; Anderson, 2013).

- Fourth, TDM has **beneficial impacts on health**. Positive healthcare effects include improved physical and mental health, and safety. Given the appropriate infrastructure for walking and biking, non-motorized commuting is safer and healthier than driving (Litman, 2010; Litman, 2012).

- Fifth, better transportation systems, based on TDM, **attract young talent** to a community. Affordable transportation alternatives allow students to move to a community that does not require car ownership. According to the National Household Travel Survey, from 2001 to 2009, the annual number of VMT by young people (16 to 34-year-olds) decreased from 10,300 miles to 7,900 miles per capita—a drop of 23 percent. Simultaneously, from 2001 to 2009, the number of passenger-miles traveled by the same age group on public transit increased by 40 percent. In addition, the number of 14 to 34 years-old who do NOT have driver's license increased from 21 percent to 26 percent (Davis & Dutzik, 2013, p. 2).

- Sixth, TDM directly **reduces demand for**, and thus the cost of, providing **parking** (Stanford, 2013; Litman, 2013; Walker Parking Consultants, 2011).

In sum, the literature shows that the economic benefits of active transportation include:

- Reduction in road construction, repair and maintenance costs
- Reduction in costs due to greenhouse gas emissions
- Reduction in health care costs due to increased physical activity and reduced respiratory and cardiac disease
- Reduction in fuel, repair and maintenance costs to user
- Reduction of costs due to increased road safety
- Reduction in external costs due to traffic congestion
- Reduction in parking subsidies
- Reduction of costs due to reduced air and water pollution
- Increased productivity and a reduction of sick days and injuries at the workplace (Campbell & Wittgens, 2004).

There are also other social benefits difficult to quantify such as increased community bonds and maintaining green space.

Research on the costs of public transit show that for every $1 invested, over $1.5 is saved in transportation costs to *both* highway and transit users. These costs include operating costs, fuel costs, and congestion costs (Cambridge Systematics, 1999, p. E-1). In addition, the extra walking related to transit use has been estimated at a lifetime savings of $5,500 per person in 2007 dollars. When accounting for decreases in quality of life, such as disabilities related to obesity, the estimated savings are even higher (Edwards, 2008 cited in Active Living Research, 2009, p. 2). In addition, public transportation trips result in 190,000 fewer deaths, injuries and accidents annually than trips by car, providing $2 billion to $5 billion in safety benefits nationally, based on 1994 data (APTA, 2003, p. 3). Litman (2013) estimates that thirty car drivers shifting to transit provide savings worth between $0.24 and $2.76 per mile, depending on assumptions, in 2001 U.S. dollars (p. 50).

Data on the costs of biking and walking infrastructure indicate it is significantly less than for building roads or parking infrastructure (Bushell et. al, 2013). Davis (2010) found in a review of the literature that "Almost all of the studies identified (in the UK and beyond) report economic benefits of walking and cycling interventions, which are highly significant, and these average 13:1" (p. 1). A report by Rails to Trails Conservancy (Gotschi & Mills, 2008) notes that "Portland's investments in bicycling infrastructure of $57 million in total have helped city residents drive less than average Americans, resulting in a savings of $2.6 billion in travel and time and redirecting more than $800 million to their local economy every year" (p. 39; see also Gotschi, 2011). The report also estimates that increasing bicycling and walking from the current 9.6 percent to 13 percent in the U. S. could lead to $10.4 billion annually in fuel savings, CO2 reduction, and health care cost reduction; this doesn't include costs for parking. Litman (2010) finds shifting from automobile to non-motorized travel is estimated to provide parking savings of $2.00 per urban-peak trip (a typical commute with $4.00 per day parking costs), $1.00 per urban off-peak trip (p. 10).

The likelihood of walking and biking is inversely related to the number of automobiles owned per household (Trans Link, 2010, p. 8). Car sharing and car/van pooling can enable people to reduce or eliminate car ownership (Katzev, 2003; Millard-Ball et al, 2005). Both car sharing and ride sharing increase mobility choices and air quality, and reduce commuters' costs and parking demand on campuses (Morency et al., 2012). In particular, Lane (2005) finds that car sharing makes people more aware of the costs of trips and as a result, car sharing makes members take fewer trips by cars, leading to cost savings, less demand for parking, and reduced environmental impact (Millard-Ball et al, 2005).

Universities and TDM

A number of universities have successfully implemented TDM programs that include diverse strategies such as shuttle systems, transit programs, bicycle facilities, pre-tax commuter benefits, and preferential carpool parking to encourage students, faculty, and staff members to use sustainable modes of transportation (Balsas, 2003; Van Heeke, Sullivan, & Baxandall, 2014; Sobush, n.d.; Toor & Havlick, 2004; Zhou, 2013). Balsas (2003) found in a survey of eight bicycle-

and pedestrian-friendly campuses[1] that all had multiple TDM strategies in place, including transit pass and rideshare and carpooling programs, guaranteed ride home, intelligent transportation systems, incentives to not drive to campus ("For instance, Stanford pays 2500 employees who do not purchase a parking permit during the year through its 'Clean Air Cash' program" [p. 40]), bicycling and walking programs, and education and promotion related to these strategies. He found that six of the eight campuses have bicycle and pedestrian committees, while the other two have transportation advisory committees. Four of the campuses also had full time bicycle and pedestrian coordinators and three had bicycle/pedestrian plans. According to Balsas, "campuses with bicycle committees and coordinators tend to conduct surveys more often and to attract more funding" (p. 42). He also found that funding came from student fees, bicycle registration fees, fines for traffic and parking violations, and also from foundations, alumni associations, and state and federal sources. He noted that: "The advantages of having a bicycle committee and a bicycle coordinator include the ability to make changes to existing policies more expeditiously. Non-motorized traveling can only be maximized by thoroughly integrating bicycling and walking needs and desirable circulation patterns in all transportation, and housing and environmental policies" (p. 42).

A more recent report by Van Heeke, Sullivan, and Baxandall (2014) shows that "Over the past two decades, colleges and universities have increasingly adopted the goal of reducing driving as part of their long-term plans to develop healthy, sustainable and successful institutions" (p. 4). They are doing this in part because parking consumes land and is expensive, reducing driving helps the environment and improves relations between the campus and town, and younger people increasingly prefer communities that are served by multiple transportation options. Strategies used to reduce driving include: free or discounted access to transit services, programs to promote bicycle use, building new biking and walking paths, ridesharing initiatives, car sharing programs, and expanding distance learning and online resources. (See Appendix A for examples of what some other universities are doing.)

According to their transportation master plan, "**CU-Boulder's** experience shows that TDM costs approximately four times less than providing expensive underground parking" (p. 1-6). **Stanford University** estimates it has avoided more than $100 million in parking construction costs over the past decade due to its efforts to discourage driving (Levin, 2013) and "reducing the share of its faculty and staff that car commute alone from 72 percent to 47 percent" (Schmitt, 2013b, para. 9). TDM at Stanford is a multi-pronged effort and includes everything from free bus passes for faculty and staff to actual cash payments of $300 per year for not driving alone (Schmitt, 2013b). The implementation of **Cornell's** TDM efforts—including comprehensive transit and carpool/rideshare programs—resulted in 10 million fewer commuter miles driven by participants and savings to the university of $4 million by 1994-1995 (Siegel, 2000, p. 57). **UC San Diego** had plans to build 13 parking structures to add 11,500 parking spaces by 2020. However, only three of these parking structures were built because of the implementation of TDM strategies (Corbett, 2008). UCSD's commitment to multimodal

[1] The campuses included in the study were: Cornell University, University of Wisconsin at Madison, University of Colorado at Boulder, University of California at Santa Barbara, Sanford University, University of California at Davis, University of Oregon at Eugene, and University of Washington at Seattle.

transportation reduced drive-alone rates from 66% in 2001 to 49% in 2008, with an estimated savings of $50 million (Corbett, 2008). Jeffrey Tumlin, a transportation consultant with the firm Nelson\Nygaard and former transportation program manager at Stanford, suggests colleges that succeed at reducing costs typically have someone on staff with the technical expertise to rigorously compare investing in capital with investing in programs (Schmitt, 2013a). Also very important is making people aware of the programs and incentives available (Schmitt, 2013b).

TDM Strategies

University TDM strategies include, but are not limited to the following: parking management; transit incentives; enabling and promoting bicycle and walking; encouraging car sharing and ride sharing; expanding campus housing; and telecommuting (Toor & Havlick, 2004). Through these strategies, TDM programs are designed to maximize the benefits of reducing SOVs arriving on campus. Each strategy has its own goal: parking management tries to directly reduce parking demand on campus; transit incentives aim to encourage the use of public transportation; enabling and promoting walking, biking, and car pool/sharing aim to encourage each mode for commuting respectively. However, the impact of each strategy on reducing SOVs on campus is not mutually exclusive. Each strategy has an interdependent relationship. Increases in transit use are also associated with decreases in parking demand and strategies for walking, biking, and carpooling/sharing supplement transit use (Toor & Havlick, 2004). As Siegel (2000) notes, since people can't always commute by the same mode every day, options need to be flexible, varied, and offered on a continual basis.

Parking Management

Parking management is a key element in university TDM plans (Shoup, 2008). Increasing demand for parking puts pressure on universities to use land for parking lots instead of building research or health facilities for students, faculty and staff or maintaining green space. The growing dilemma of parking on campus requires universities to make difficult decisions about constructing parking. Studies suggest easy or low-cost parking availability encourages more SOV use, thus creating a never-ending demand for more parking (Weinberger et. al., 2008).

Parking management mainly tries to decrease parking demand, and thus, saving costs to universities. Universities may adopt one of two approaches to campus parking. One is the political approach that relies on rules and regulations of parking. It regulates time, location, and eligibility for parking. This, arguably, is the approach that has primarily been used at UNO. The other is an economic approach, which depends on market mechanisms, based on price adjustment. It focuses on the economic assumption that flexible prices can balance demand. In particular, Shoup (2008) emphasizes the role of performance-priced parking prices. Performance-priced parking charges higher prices for the more convenient and desired parking spaces (p. 136). Different parking prices on campus allow parking users to calculate their cost of parking and make better decisions, based on their own preferences (Walker, 2011). This strategy is relatively low in cost to implement; however, controlling demand for parking through price-based parking discourages equity of parking opportunity because members of the university who can afford to pay high prices for premium parking are less affected by this

strategy. This is why it is also important to provide other low-cost and efficient options for people to commute to campus.

Transit Incentives

Many universities offer incentives such as free or subsidized public transit access to students, faculty, and staff. The aim of transit incentives is to reduce the demand for parking, but also increase students' affordable access to school, housing, and employment, and has the side effect of improving air quality. Free or subsidized transit also helps universities attract students by reducing the cost of attending college while also increasing transportation equity (Brown, Hess, & Shoup, 2001). It's also valuable for employee recruitment. Universities that provide Unlimited Access (UA) programs have experienced large increases in bus ridership and decreases in solo driving (Meyer & Beimborn, 1998; Williams & Petrait, 1993). For example, Brown, Hess, and Shoup (2003) show that when University of California at Los Angeles implemented BruinGo, the use of transit increased by 56 percent during BruinGo's first year and drive-alone rates fell by 20 percent. Combining UA with performance-priced parking could create even larger reductions in driving alone and miles travelled (Shoup, 2008).

In addition, reduced fares, improved service, mental maps, and residential relocation, could increase transit ridership in terms of travelling together, and in turn, reduce automobile ownership (Brown et al., 2001). Reduced fares can increase students' willingness to buy UA permits and thus, use transit services more frequently. Reduced or free fares in some universities are provided through subsidies from parking revenues and mandatory student fees. Mandatory purchasing in particular allows transit agencies to offer discounted fares to universities because it avoids the problem of adverse selection. The University of Colorado employs the mandatory policy to reduce fares of UA, and it is evaluated positively (Brown et al., 2001). People who conceive that public transit service works for them, use the service more. Residential relocation by students seeking easier transit access could also increase transit ridership.

Research shows that providing real-time information at transit stops and stations has the potential to increase ridership (Trans Link, 2010, p. 6). The quality of transit facilities at stations, such as signage, travel information, and amenities, can also attract new riders (Trans Link, 2010, p. 6). The most important determinant of user satisfaction with a transit stop or station is frequent, reliable service in an environment of personal safety, and only indirectly, the physical characteristics of that stop or station (Taylor, Iseki, Miller, & Smart, 2009, p. v). A generally accepted threshold level of service for transit-oriented developments is frequencies of 15 minutes or better during most of the day (Trans Link, 2010, p. 8). Higher densities generally support greater levels of transit service. One thing to note is that UA may decrease the demand for ridesharing or car sharing (Brown et al., 2001). Although UA could have a negative impact on other alternatives, the diversity of alternatives and its benefits should not be underestimated.

Bicycling and Walking

Increased walking and biking can reduce parking demand and lead to cost savings for universities, as well as improve financial sustainability for individuals, health, safety, campus

aesthetic appeal, and students' engagement on campus (Brown et al., 2003; Litman, 2012; Litman, 2013). Infrastructure for non-motorized transportation can also improve a campus' aesthetic appeal. Increased spaces for people encourage more face-to-face meeting of people on campuses. As urban design affect citizens' behavior, this could motivate students' engagement on campus (Zali, Abizadeh, & Bagherinia, 2013).

To promote walking and biking, it is necessary to provide access and infrastructure. Pucher, Dill, and Handy (2010) found that various strategies can improve the level of bicycling, including the availability of a bicycle in the household (the single strongest predictor of bicycling for transportation), bike lanes, secure and sheltered bike parking, shower facilities, and programs such as bike-to-work days. They conclude as well that overall "a *comprehensive approach* produces a much greater impact on bicycling than individual measures that are not coordinated" (p. S122, emphasis added). Issues important for walking include personal safety, whether the streetscape is attractive and interesting with diverse views, and the presence of destinations (Pikora et al., 2002). It is also not sufficient to construct bicycling or pedestrian infrastructure only on university campuses. To provide sustainable modes of non-motorized transportation, municipalities also need to improve infrastructure. Given the variance in urban infrastructures, the costs for and benefits of promoting walking and biking on campuses cannot be easily generalized.

Carpooling and Ride Sharing

Car sharing refers to sharing "vehicles owned by a separate organization and shared among a number of different users, who may use them at different times" (Millard-Ball et al., 2005, p. 2-1). Ride sharing, also called carpooling, occurs when "privately owned vehicles are shared for a particular trip" (Millard-Ball et al., 2005, p. 2-1). Fewer trips by single occupants decreases parking demand and negative environmental impacts (Millard-Ball et al, 2005).

Factors for successful car sharing and ride sharing include having positive community attitudes toward car/ride sharing, active partners, and previous experiences. First, Millard-Ball et al. (2005) suggest "persons with high regards for environmental values are likely to be attracted to car-sharing, as are persons who have a strong focus on travel costs" (p. 4-35). Community attitudes toward environmental values are positively associated with successful implementation of car sharing. One barrier of car sharing is "a lack of understanding about how and where it works, and skepticism over the extent to which it can help partner organizations reach their goals" (p. 7-20). In this case, communications could be effective for influencing attitudes. Second, support from partner organizations, engaged in car sharing helps promote its long-term success (Millard-Ball et al., 2005). Partner organizations are composed of any entity that helps with car sharing, including local governments and business sectors. The level of support by partner organizations can be critical to the success or failure of car sharing and ride sharing. For instance, students who do not live on campus need to share ride information with other residents. Collaboration between universities and cities could promote the use of sharing. Third, the previous experience of members in car sharing is positively linked to current participation (Zhou, 2013). Although the influence of previous experience weakens over time, it is important for participants to have a positive car sharing/ride sharing experience.

Effectiveness of TDM

Cost-benefit analysis can be utilized to measure the effectiveness of TDM strategies. Quantifying the costs and benefits of each strategy is critical to conducting a cost-benefit analysis. However, it is difficult to exactly measure strategies in quantitative and monetary terms. Also, it is difficult to generalize because measuring costs and benefits depend on different environments. One cost-effective scenario is a combination of transportation alternatives, drawing on TDM strategies. Toor and Havlick (2004) suggest possible TDM strategies that could be applied to campuses and the tools for implementing the strategy with its effectiveness (see Table 1). Each tool is not limited to only one strategy, and also, its effectiveness is not limited to only one level. Depending on the type of strategy, the effectiveness of the tools can change. Also, a change of environment can change the effectiveness and costs to implement. Thus, this table can be employed as a kind of general checklist for establishing effective TDM.

Table 1. TDM Strategies and Their Level of Effectiveness

Strategies	Tools	Effectiveness at Reducing Vehicles, Vehicle Miles Driven or Vehicle Trips	Cost to Implement
Transit-oriented	Transportation allowance	High	Low/High
	Parking cash out	Medium	Low/High
	Tax incentives	Medium	Neutral
	Discounted transit passes	Medium	Neutral
	Pre-tax benefit for faculty/staff	Medium	Neutral
	Student transit pass	Medium	Neutral
	Parking permit rate increase	High	Neutral
	Unlimited access	High	High
	Employee transit pass	High	High
Bicycle-oriented	Bicycle accessories (e.g., free helmets)	Marginal	Low
	Commuter club	Marginal	Low
	Transportation allowances	Marginal	Low
	Parking cash out	Medium	Low/High
	Parking permit rate increase	High	Neutral
	Tax incentives	Medium	Neutral
	Bike loan program	Low	Medium
Walking-oriented	Discounts at retailers	Medium	Low/High
	Commuter club	Medium	Low/High
	Transportation allowances	Medium	Low/High
	Parking cash out	Medium	Low/High
	Tax incentives	Medium	Neutral
Ridesharing-oriented	Preferential parking rates	Low	Low
	Empty seat subsidy for vanpools	Low/Medium	Low
	Pre-tax payments	Low/Medium	Low
	First time ride incentive	Low/Medium	Low
	Prize and promotional events	Low/Medium	Low
	Transportation allowances	High	Low/High
	Van and car loan program	High	Low/High
	For-profit vanpools	High	Low/High

Strategies	Tools	Effectiveness at Reducing Vehicles, Vehicle Miles Driven or Vehicle Trips	Cost to Implement
Ridesharing-oriented	Parking cash out	Medium	Low/High
	Parking permit rate increase	High	Neutral
	Vanpool subsidy	Low/Medium	Medium
	Commuter club	Medium	Medium

Opportunities and Barriers of TDM

There are some factors in terms of opportunities or barriers that facilitate the success or failure of TDM implementation. Opportunities include funding resources, leadership, partnership, and political acceptability (Gärling & Schuitema, 2007; Jaffe, 2013; Litman, 2013; Taylor, 2007; Zali et al., 2013). Barriers are the flip sides of opportunities. In other words, fewer opportunities can be barriers to implement TDM strategies. First, funding resources are critical to TDM strategies in universities. Funding can be collected from student fees, parking revenues, grants, or other resources. Second, facilitative leadership matters to better implementation of TDM strategies. Leadership is also associated with local partnership. Local partnership among colleges, towns, and transit agencies makes a better quality transportation system. Finally, the adoption and implementation of certain strategies depends on political acceptability. Political acceptability is affected by political culture and public attitudes (Gärling & Schuitema, 2007).

From these perspectives, it is expected that coercive tools for implementing TDM strategies, such as prohibiting car use, are difficult to implement because of public opposition and political infeasibility. Tools that are non-coercive and encourage voluntary participation are more acceptable (Taylor, 2007, p. 183). Coercive combined with non-coercive measures are likely to become most effective (Gärling & Schuitema, 2007). The higher the effectiveness of TDM strategies, the larger the population that will use the services. This means that the effective and acceptable TDM strategies affect the behavior of citizens, and in turn, increase the opportunities of implementing those strategies (Zali et al., 2013).

Framework for TDM

A framework for TDM is derived from a review of the literature (see Figure 1). TDM strategies that can be applied to a campus are categorized into four parts: parking management, transit service, enabling and promoting walking and biking, and car sharing and ride sharing. Each strategy has the same goal of reducing cars on campus. There are a number of tools for implementing strategies, such as financial incentives, price adjustments, and communication campaigns. Although there is no rule of thumb in selecting strategies and tools, it is important to consider factors that make TDM in universities successful or not. Funding resources, political acceptability, collaborative partnerships, and leadership promoting the success of TDM all are important factors. Finally, well-designed combinations of TDM strategies reinforce opportunities for improving TDM.

Figure 1. Framework of TDM

Strategies	Costs	Benefits
• Parking Management • Transit Service • Walking and Biking • Car and Ride Sharing	• Infrastructure costs • Transaction costs • Operating costs • Monitoring costs • Evaluation costs • Incentives or Subsidy	• College's cost savings of constructing parking surface • Air quality • Safety • Health • Aesthetic appeal • Students' engagement • Attract more students • Economic development • Individuals' cost savings of buying and maintaining autos

Building on the literature review above, our focus in this research is to examine the costs, benefits, and challenges of enabling and supporting sustainable modes of transportation—public transit, biking, walking, carpool/ride share—compared to parking for single-occupancy vehicles at UNO. Previous research has focused primarily on the direct fiscal cost savings from building parking on campus (Brown et al., 2003). Brown, Hess, and Shoup (2003) only measure the return on investment of unlimited passes to students. Although the findings show that costs of building automobile parking are more than spending on unlimited passes, they do not measure the other costs for TDM comprehensively. Other existing research has paid attention to only one side in terms of costs or benefits (Litman, 2013; Bushell et al., 2013). We include this but also add to it by estimating the indirect costs and savings from implementing TDM—related to health, the environment, community and other indirect costs/benefits. This comprehensive evaluation to TDM would make a contribution to deciding on investments in TDM at UNO.

Methodology

This study used multiple data sources to address the research questions:

1. What has UNO done in relation to TDM and how does it compare to peer and aspirational universities?
    - What strategies have been implemented and why?
    - How is TDM administered and financed?
    - What has been successful and what are the challenges?
2. What are the direct and indirect costs of supporting various modes of transportation at UNO? What is the return on investment of each mode?
3. What strategies and priorities should UNO consider in supporting sustainable transportation options?

Interviews

We contacted 19 universities designated as University of Nebraska Board of Regents peers, Coalition of Urban and Metropolitan Universities (CUMU) members, aspirational peers, and/or local peer institutions. We were able to interview contacts at 11 institutions about their TDM efforts; the other universities did not respond to our request for an interview. Contacts included staff at Parking Services, Public Safety, Transportation, or similar departments (8) as well as sustainability coordinators (3). Interviews were held in-person (2) or via telephone (9), conducted by three of the study's researchers. They took place between June 16 and August 4, 2014 and lasted on average 37 minutes; all were recorded. We also interviewed together two administrators who manage parking and transportation at UNO. This interview lasted a little more than one hour and was not audio recorded. See Appendix B for interview protocols.

Secondary Data

Secondary or existing data were also gathered, including already-completed studies on parking at UNO, a study on the costs and benefits of parking/shuttle vs. transit done by Verdis Group (2013), wellness data, student government student surveys, and a Parking and Traffic Master Plan. We also obtained data from UNO Parking, Metro Transit, and the Office of Institutional Effectiveness related to transportation, enrollment and staffing, and so on. In addition, as part of the sustainability master planning (SMP) process, students, faculty, and staff were surveyed regarding their behaviors, knowledge and attitudes related to sustainability, including transportation mode use. For the mode use question, 481 faculty/staff/administrators and 540 students responded. The survey was administered via Survey Monkey in April 2014. Group discussions, as part of the SMP process were conducted with dozens of key administrators, faculty, staff and students across campus. Data from these group discussions helped to gather ideas related to sustainability and transportation, and identify perceived opportunities and barriers to supporting various modes of transportation at UNO. Finally, we analyzed published TDM plans from other universities.

Analysis and Ensuring Trustworthiness/Validity of the Data

For analysis of the qualitative data, Microsoft Excel and Word were used to systematically organize and analyze the data from interview notes and documents. After writing up notes from each interview, and reviewing documents such as TDM plans, following Miles and Huberman (1994), data were then organized around key concepts and themes using spreadsheets and tables, and in relation to the research questions. To improve trustworthiness of the findings, several steps were taken. First, we tried to be as transparent as possible in reporting the research process of the study. In addition, all interviews but one were audiotaped to ensure accuracy in data analysis (Rubin & Rubin, 2005). Third, triangulation of the data was pursued by multiple researchers participating in conducting the interviews, regularly discussing results, and drawing on data from multiple sources during data analysis. Finally, participants were asked to review findings and conclusions and provide feedback (Maxwell, 2005).

Findings

This findings from data collection methods are presented below, addressing each research question: What UNO has done in relation to TDM and how it compares to peer and other universities, examining the direct and indirect costs of supporting various modes of transportation at UNO, and recommendations for strategies and priorities UNO might consider in supporting sustainable transportation.

Transportation Demand Management at UNO, Peer, and Other Universities

In this first section, we address the following research questions: What has UNO done in relation to TDM and how does it compare to peer and other universities? What strategies have been implemented and why? How is TDM administered and financed? And what has been successful and what are the challenges?

University of Nebraska at Omaha

Data on the current transportation conditions at UNO are based on secondary data such as existing reports and studies, findings from the recently-administered survey for the sustainability master planning process, and interviews with UNO administrators and others.

While UNO students and employees use several modes in getting to campus, the majority arrive driving alone via single occupancy vehicles (SOVs). A survey of student mode choice done in the fall 2007 semester found that 77.7 percent of respondents (N=243) drove alone to campus (Grant, 2008). A survey done by the student government in 2010 found 84.6 percent of student respondents (N = 641) drove a personal automobile/motorcycle to campus. Finally, a more recent survey completed in April of 2014 as part of the Sustainability Master Planning (SMP) process, analyzed the mode choice for the total number of trips respondents completed in one business week, including telecommuting or not traveling to campus (see Table 2). Of the 783 student respondents, the survey found students drive alone for 54.6 percent of trips to campus. Among the 490 employees completing the survey, 78.5 percent indicated they drove alone daily. It is important to note that 18.5 percent of student trips and 6.5 percent of employee trips to campus were avoided due to studying or working remotely or having the day off (Verdis, 2014). If percent of trips includes only those who come to campus, 67 percent of student trips and 83.9 percent of employee trips are drive alone.

Between campus sites (NOT commuting), the 2014 SMP survey found that 7 out of 10 students walk and/or take the shuttle, 2 out of 10 drive alone in vehicles to other locations/ between campuses, and 1 percent bike. Also according to the SMP survey, there was high awareness of transportation-sharing and transit programs on campus. Among faculty and staff who answered when asked if they have seen or are aware of the following, they answered for: B-cycle = 85%, Zipcar = 71%, and MavRide = 68%; among students: B-cycle = 79%, Zipcar = 66%, and MavRide = 70%. However, some also commented that information on these programs can be difficult to find online and elsewhere.

Table 2: UNO Mode Share, Average Percent of Trips on Weekday, Including Trips Not Taken To Campus (SMP Survey, April 2014)

Mode	Student % of Trips Taken	Employee % of Trips Taken	Total % Trips Taken[2]
Drive Alone SOV	54.6	78.5	57.27
Not Travel to Campus	18.5	6.5	17.16
Walk	9.3	3.7	8.67
Carpool	6.0	5.9	5.99
Transit	8.2	2.0	7.51
Bike	2.4	2.8	2.44
Motorcycle, Moped, or Scooter	0.5	0.3	0.48
Other Non-motorized	0.4	0.2	0.38

Finally, it is worthy to note that according to the UNO Office of Institutional Effectiveness, 14 percent of students lived on campus during the fall 2013 term, so could more easily walk or bike since they have no need to commute long distances to campus. In addition, the 2013 Wellstream Personal Health Assessment for UNO showed that 74% of respondents (641 participants) do not get adequate recommended exercise and BMI is too high for 60% of respondents (N = 525), suggesting many employees could benefit from using more active modes of transportation.

Walking

The second most common form of transportation for students and employees at UNO is walking. The survey done by the student government in 2010 found 14.8 percent of respondents walked to campus. The 2014 SMP survey showed that students walk to campus for 9.3 percent of trips while walking comprises 3.7 percent of employee trips (among all trips, including not travelling to campus). If stay at home trips are omitted, then 11.5 percent and 4 percent of student and employee trips to campus were walking. Besides efforts to encourage people to walk around campus for exercise through the Wellness committee, and relatively good side paths within and between campus locations, there are little to no programs in place to encourage walking to commute to campus. Comments made during the SMP information meetings with key groups across campus indicated the desire for a more pedestrian-friendly campus, including safer connectivity across Pacific and Center Streets, wider sidewalks in some areas (such as between Pacific and Pine), and improved sidewalk-scapes such as the incorporation of nature next to side paths.

Carpooling/Ride Share

Data from a 2007 UNO student survey showed 11.6 percent of students carpooled to campus weekly (Grant, 2008). The survey done by the UNO student government in 2010 found

[2] The total population was calculated by taking student and employee mode share respectively, multiplying it by the populations for each of students (15,448) and faculty/staff (1,943) to get a count for each, then adding these together to get total count divided by total population (17,391) to get mode share percentages.

9.2 percent of respondents carpooled to campus. The 2014 SMP survey showed 6.0 percent of student trips and 5.9 percent of employee trips were completed in a carpool (among all trips, including not travelling to campus). This changes to 7.4% for students and 6.3% of trips if just examining percent of trips taken to campus, omitting stay-at-home trips.

The university recently implemented two initiatives that allow individuals to share a parking pass, for surface lots and garages, with the intent of reducing the number of cars driven to campus. These programs are currently in place but are not well advertised. Administrators noted there is reluctance to designate a special lot or stalls for carpooling as it would require monitoring, which is difficult. There is also some concern that UNO parking is so cheap, there is little incentive to share rides. The University is also considering contracting with Zimride, a rideshare service that utilizes social media to match people interested in carpooling. The 2014 SMP survey found that 74 percent of faculty and staff and 73 percent of students said they support UNO sponsoring carpooling and ridesharing programs (Zimride, MetrO!,). A few comments made during the SMP information meetings with key groups across campus indicated an interest in encouraging more carpooling, including creating designated carpooling spots and more ridesharing options.

Public Transit

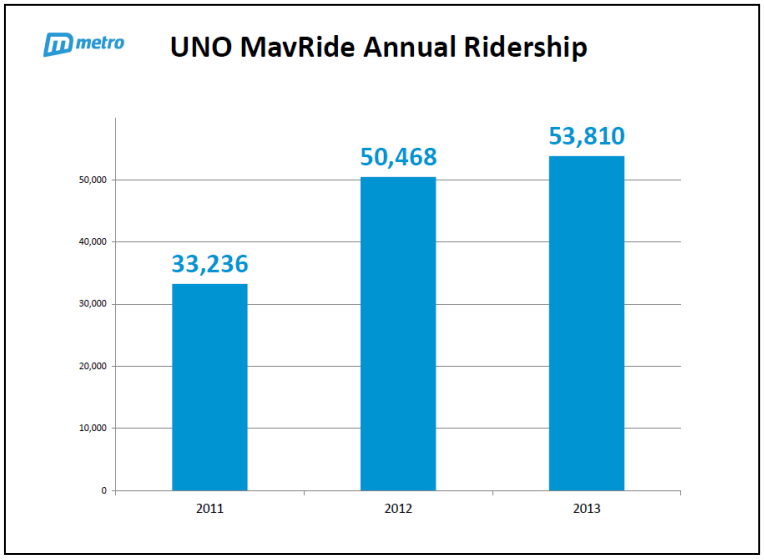
In 2007, a study by Grant (2008) showed that 86.4 percent of UNO students had never taken public transit while commuting to UNO and 5 percent indicated they utilized public transit at least weekly during their commute to UNO. The survey done by UNO student government in 2010 found that 8.9 percent of student respondents travelled to campus by bus. The 2014 SMP survey showed that 8.2 percent of student trips (and 2 percent of employee trips) are taken to campus using transit. When the data for trips not taken is omitted, this increases to 10.1 percent for students and 3.7 percent for employees.

MavRide, a partnership between UNO student government and Metro Transit, began in the fall 2011 semester. This program provides bus passes for students to use the bus at no cost (to the student) per trip. The program started by distributing 400 passes a semester and has now expanded to 800 passes each fall and spring and 200 passes in summer semesters. The total number of MavRide trips increased from 33,236 in 2011 to 53,810 trips in 2013 (see Table 3 and Figure 2).

Table 3: UNO MavRide Annual Ridership

Year	Number of Trips
2011 (Feb-Dec)	33,236
2012	50,468
2013	53,810
2014 (Spring only)	25,977
Total	**159,584**

Figure 2: MavRide Annual Ridership



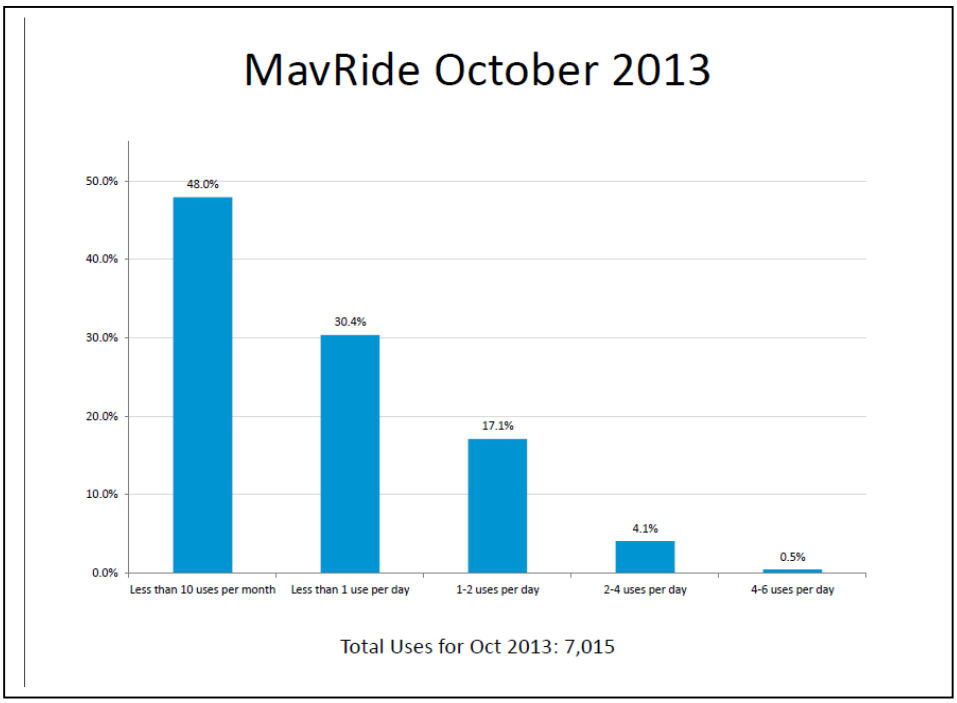
Trip data show that 90 percent of students use the pass two or fewer times per day on average (see Figure 3). One thing to note is that the number of uses includes transfers, so 4 buses per day could actually be one person taking two buses to reach campus, and two buses to return home. Worry about the overuse of passes, as expressed by some administrators, appears to be a non-issue; the greater concern being the high number of people who use the pass less than 10 times a month.

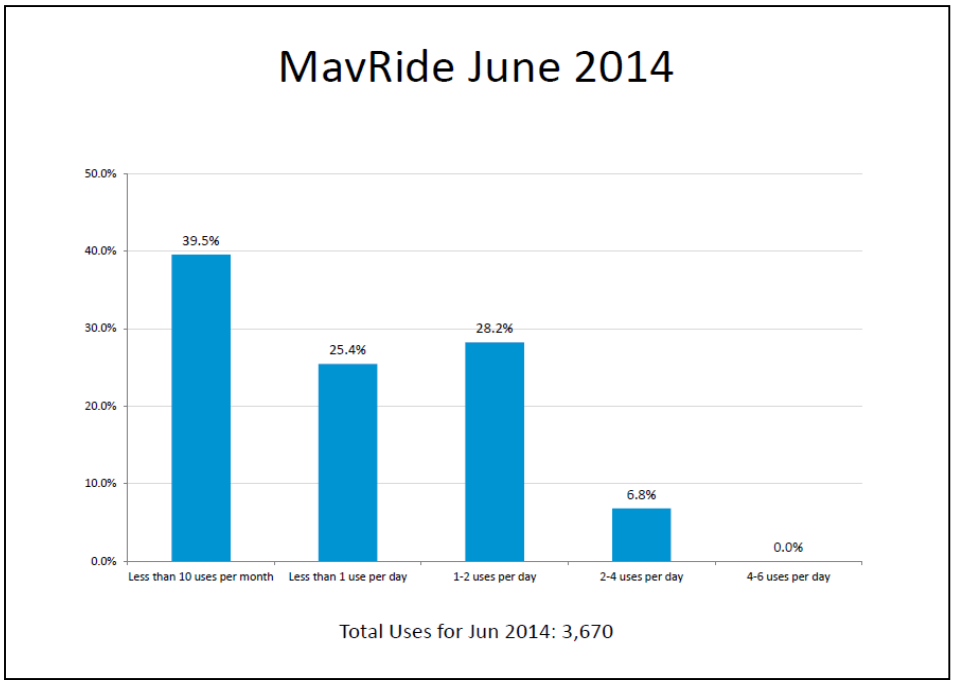
A survey conducted by the UNO student government the semester after MavRide began in spring 2011 showed 96% of MavRiders who took the survey (N = 81) described their experience as either "extremely positive" or "mostly positive." In addition, 57% indicated that driving alone was their primary mode choice prior to receiving the MavRide card and of those, 93% indicated they *decreased* the number of times they drove to campus. It was estimated that the 400 MavRiders collectively used ***129 fewer* parking** spots per day and experienced a 52% reduction in SOV trips to campus.

A more recent and extensive study done by Verdis (2013) shows that the MavRide program reduced demand for parking *by* ***130 spaces per day***. They estimate that if the MavRide program is expanded further, public transit use will continue to increase and for every ***100 additional users*,** parking demand will be ***reduced by 16.25 spaces***. The planned Metro improvements along Dodge Street will also encourage more use.[3] It is noteworthy to add that the MavRide program is not currently promoted on the University's web site, nor is it available to employees. According to administrators, UNO is currently looking into providing free or reduced-rate bus passes for faculty and staff. The Parking Manager has also met with Metro Transit to assist, supplement, or provide help with the campus shuttle service. The challenge with collaborating has to do with timing and volume. Parking has also worked with student government on eliminating some shuttle stops to make shuttles more efficient.

[3] See Metro's plans for improvements here: http://www.ometro.com/announcements/proposed-transit-improvements.

Figure 3: MavRide per Person Use for October 2013 and June 2014





A large number of comments made during the SMP information meetings with key groups across campus were about transit. These included a desire to see improvements with the transit system in general to make it easier and more convenient for people to use. Along with this, several people brought up the need to make the shuttle system on campus better

connected to the transit system and more efficient in energy use. Several people also brought up the desire for a light rail system along the Dodge Street Corridor or a monorail connecting campuses. According to administrators, there has been some discussion of a "people mover" to connect north-south campuses but there would need to be significant investment from outside for this to happen.

Bicycling

The survey done by UNO student government in 2010 found that 6.2 percent of student respondents travelled to campus by bike. The 2014 SMP survey showed that bicycling constitutes 2.4 percent of student trips and 2.8 percent of employee trips. Bike counts on campus have also been conducted since September of 2010, although not at regular intervals (see Table 4). These counts show between 147 and 366 bikes parked on campus at residence halls and in academic areas.

Table 4: UNO Bike Count

Location	9/9/10	10/6/10	5/4/11	6/3/11	6/14/11	8/29/11
Total Academic	89	69	47	40	39	121
Total Residence	170	155	125	109	108	163
Grand Total	**259**	**224**	**172**	**149**	**147**	**284**
Location	9/13/11	9/28/11	10/24/11	9/11/12	9/4/13	4/28/14
Total Academic	128	72	89	115	111	52
Total Residence	190	208	202	251	219	194
Grand Total	**318**	**280**	**291**	**366**	**330**	**246**

Bicycling initiatives on campus include: bicycle racks throughout campus, one of which is covered; a campus bike share/bike library program; two on-campus B-cycle stations (see Table 5 for usage);[4] two bike fixit stations on campus; employee participation in the Cycling Commuter Challenge, which runs from May to September each year (see Table 6); an annual Trek to Campus event; and a dedicated webpage about bicycling at UNO, maintained by professor emeritus David Corbin. UNO Parking and a grant through CDC's Communities Putting Prevention to Work, administered by Live Well Omaha, funded new bike racks and the bike fixit stations in recent years; student government helped fund the B-cycle stations, funding part of the cost of two stations for $25,000,[5] as well as subsidizing half the cost of 100 passes for students at $2,750; and Human Resources has helped fund participation in the annual Corporate Cycling Challenge. A volunteer bicycling committee has been active for a couple of years and held workshops, attended fairs on campus, and applied for League of American Bicyclists' bicycle friendly status. In the spring of 2012, the League awarded UNO honorable mention as a Bicycle Friendly University.

[4] The cost of B-cycle membership for university members is $40/year.
[5] Costs for additional stations would be ~$35,000-37,000 per station; no additional on-going costs.

Table 5: B-Cycle Usage for UNO Kiosks

Location	Number of Bikes Checked Out				
	2011 (start 6/11)	2012	2013	2014 (thru 5/14)	Total
62 & Dodge	119	89	140	60	408
67 & Pine	82	101	243	32	458
Total	**201**	**190**	**383**	**92**	**866**

Table 6: UNO Commuter Challenge Participation

Year	Trips	Miles
2008	701	7,684
2009	673	5,603
2010	804	5,961
2011	1,485	11,586
2012	2,942	12,692
2013	2,032	12,334

Administrators note that there have been some complaints about people bicycling in the main corridor on the Dodge Street campus and consideration of adding dismount signs in the main corridor. Support Services would also like to get money to put together a bicycle barn (or lockers). Technically, bikes are not supposed to be in buildings but there is no secure storage option available currently. A few comments made during the SMP information meetings with key groups across campus about bicycling included the desire for better and safer paths for cyclists that connect campuses, including separated bike paths and better signage (such as for sharing the road) across campus.

Car Share

In April of 2013, the ability to rent a car for short-term use became available to UNO students and employees (and community members) through the addition of two Zipcars on campus. Use of the Zipcars has steadily increased since its initiation—in number of reservations, hours reserved, miles driven, and number of members. During the first six months of operation, Zipcar averaged 17 reservations per month but then between October of 2013 and May of 2014, the average number of reservations increased to 36.75 reservations per month. See Table 7. The only costs of having Zipcar on campus are providing permits and enforcement. It should be noted that Zipcar has not yet been made available as an option for department car rentals (in lieu of renting from Enterprise), but there is anticipation of making this option available soon.

Table 7: UNO Zipcar Use April 2013-May 2014

	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sept 2013	Oct 2013
Reservations	15	14	18	21	17	17	22
Hours Reserved	109	65	222	242	129	67	86
Miles Driven	911	586	2,288	2,135	1,100	554	804
New Members	5	7	3	1	2	1	1
Total Members	**21**	**28**	**31**	**32**	**41**	**42**	**43**
	Nov 2013	Dec 2013	Jan 2014	Feb 2014	Mar 2014	Apr 2014	May 2014*
Reservations	36	27	20	37	38	48	49
Hours Reserved	114	129	50	228	299	162	204
Miles Driven	1,223	562	437	1,347	2,165	1,417	1,171
New Members	6	1	2	2	2	4	6
Total Members	49	**50**	**52**	**54**	**56**	**60**	**66**

*87% of month Reporting

Other Initiatives/Items

In fall 2014, Parking is implementing a $5 day pass in Lot T. This is geared for people who only need to drive to campus on occasion and can be used without having to buy a semester or annual permit. UNO has lost several stalls due to construction in recent years, so parking has become more congested on surface lots. Some people seem to have found alternatives as one administrator noted there has been a drop in parking permit purchases. It is difficult to tell from the permit data the degree of the drop; however, as an example, data on Day/Night Surface Lot parking permits purchased show that from Academic Year (AY) 2012-2013 to AY 2013-2014, faculty/staff permits purchased dropped from 1,133 to 911 while student permits stayed about the same increasing slightly from 4,379 to 4,408.

According to administrators, parking fees are based on the budget needed to keep roads and sidewalks in good maintenance and enforcing parking regulations. An administrator noted that UNO spends a lot of money on enforcement that is never met with income from fines. They forecast what the budget requires plus X amount to cover the cost of the next parking structure (PS3). If PS3 comes in, it will require a significant increase in parking fees. But increasing rates is politically unwelcome. It is also difficult to do if other UN campuses are not increasing rates, as is currently the case. Administrators also want to keep student costs down. There has been some effort made to keep parking garage rates flat (that is parking on the periphery) and slowly increase the cost of prime surface lot parking. Administrators also noted that it is possible to use the "parking structure pot of money" for investing in other modes—there is no policy keeping UNO from doing this.

Administrators noted that parking is often the thing people say they dislike the most on campus but there seems to be little willingness to do something different. A large number of comments made during the SMP information meetings with key groups across campus were about campus planning and transportation in general. Many were about the desire to shift the culture on campus away from complaining about parking to a campus with fewer cars, more green space, and multiple options for getting to campus. Administrators noted that beyond changing culture, the biggest challenge is finding funding.

Peer Universities

Findings in this section are based on data from interviews with contacts at 11 designated, aspirational, and/or local peer universities, and documentation from websites for 19 peer universities, including the 11 in the interview sample. See Table 8.

Table 8: Peer Universities Included in Study Sample

	NU Regents	CUMU	No. of Students	TDM Plan
Institutional Peers				
Cleveland State University	Yes	Yes	17,229	
Indiana Univ-Purdue/Univ-Indianapolis	No	Yes	30,451	
Northern Illinois University	Yes	No	22,990	
Oakland University	No	Yes	19,379	
Portland State University*	Yes	Yes	29,524	No
University of Arkansas at Little Rock	Yes	Yes	12,872	
University of Colorado-Denver*	Yes	No	29,000	Yes
University of Missouri-Kansas City	No	Yes	15,754	
University of Missouri-St. Louis*	Yes	Yes	16,809	No
University of North Carolina at Charlotte*	Yes	Yes	25,277	No
University of Northern Iowa*	Yes	No	13,168	No
University of Texas at San Antonio	Yes	Yes	30,968	
Wichita State University	Yes	Yes	14,909	
Sustainability Aspirational Peers				
University of Colorado-Boulder*	No	No	32,558	Yes
University of Iowa*	No	No	29,810	Yes
Local Peers				
Creighton University*	No	No	6,226	No
MCC*	No	No	(credit) 32,765	No
University of Nebraska-Lincoln*	No	No	24,593	No
UNMC*	No	No	3,681	No
UNO	NA	NA	15,448	No

*Contact person interviewed

Mode Split

Only three of the peer universities we examined had a TDM plan (that we could find or were told about) and only a few knew their mode split; that is, the transportation modes by which students, faculty and staff get to campus. Among the universities that did know their mode split (Portland State, UNCC, University of Colorado-Denver, University of Iowa, University of Colorado-Boulder, Creighton, and UNMC), UNO is on the high end for drive-alone rates, with only UNMC being higher. UNO is about in the middle compared to others for rate of carpooling and doing better than local peers for non-drive alone modes of transportation; however, institutional and sustainability aspiration peers are doing much better for walking, biking, and transit. It should be noted that some of these universities (Portland State, University of Iowa, and UC-Boulder) have been using TDM strategies for several years. See Table 9.

Table 9: Mode Split for Universities with Most Recent Available Data[6]

	Students % Mode Split (when come to campus)					Faculty/Staff % Mode Split (when come to campus)				
	Drive alone	**Car/van pool**	**Walk**	**Bike**	**Transit**	**Drive alone**	**Car/van pool**	**Walk**	**Bike**	**Transit**
Institutional Peers										
Portland State University	21	4	18	8	45	28	7	7	15	40
University of Colorado-Denver (estimates only)[7]	60		15		25	60		15		25
Sustainability Aspirational Peers										
University of Iowa	12	1	58	4	6	57	14	7	6	13
University of Colorado-Boulder	18.9	3.5	25.3	15.9	27.6	47	7.4	6	9.4	20.8
Local Peers										
Creighton University	48.6	14.5	32.2		5.71	81.6	14.1	2.9		1.4
UNMC[6]	87.3	12.7				87.3	12.7			
UNO[8]	67	7.4	11.5	2.9	10.1	83.9	6.3	4	3	2.2

TDM Strategies

Table 10 shows that peers use a variety of TDM strategies and only two (University of Arkansas at Little Rock and Wichita State) appear to use no or almost no TDM strategies, according to their websites. A couple more appear to only use relatively few strategies (Oakland University and UNMC). The rest seem to use a multi-pronged approach to TDM.[9]

Regarding bicycling, among those that implement several TDM strategies, nearly all provide bicycle parking, at least five with covered, indoor or secure parking, including bike lockers at three universities. Several peer universities also offer bike share (5), bike rentals (3) and have bike shops (4),[10] a mobile mechanic (1), and/or fix-it stations (4). Three universities offer classes. Two universities (10.5%) are designated bike friendly universities (Portland and UNL). We were not able to gather sufficient data about bicycle infrastructure such as number, length and quality of bike lanes.

Related to walking, very few universities in the sample appeared to have any kind of featured or organized activities. The exceptions were Indiana University-Purdue/University-

[6] Reporting only for five transportation categories listed (i.e. does not include "other") so rows do not necessarily add up to 100%.

[7] Data not available to be broken down by students, faculty/staff.

[8] Data based only on trips taken to campus from the SMP 2014 survey.

[9] Note that because some of this data were gathered only via website analysis, it may be that more is being done then is conveyed on university websites.

[10] Portland State offers memberships to its bike shop and raises about $35,000 per year in memberships. This gives students and staff access to the tools and repair stands and also to any instruction or help that they need with their repairs. Members receive a 20% discount on all parts, accessories and paid service.

Indianapolis with its focus on walkways, Northern Illinois University's walking guide, and University of Colorado-Boulder's Pedestrian Safety Committee.

Twelve of the nineteen universities (63%) in the sample offered a free or discounted bus pass to students: Five universities provided free bus passes or access and seven provided discounted or subsidized passes to students. Six universities also offered discounted and/or payroll-deducted, pre-tax passes for employees.

At least eight universities (42%) provided special permits for car or van pooling and three offered special or priority parking for car/van pools. Four universities offered car/van pooling matching services, including two that used Zimride (University of Colorado-Denver and Boulder). Others (9; 47.4%) provided links to or promoted through their website local or regional carpool matching services (such as Metro Ride Share). Eleven (58%) universities had Zipcar or a similar car share service on campus.

Table 10: Peer University TDM Strategies/Programs Implemented

	Bike	Walk	Transit	Car/Van Pool	Car Share	Other
Institutional Peers						
Cleveland State University	Bike parking		Free for students; payroll deduct for staff		Zipcar	Daily scratch off permit; zoned parking
Indiana Univ-Purdue/Univ-Indianapolis	Bike parking	Walk-ways	Discount pass for students	Permit; link to Commuter Connect	Zipcar	
Oakland University	Bike share			Link to free platforms		Shuttle
Portland State University[11]	Bike shop, indoor & outdoor bike parking; bike share, classes		Discount pass for students & staff	Permit & priority parking; Drive Less Connect platform	Zipcar & Car2go	Promotion
University of Texas at San Antonio	Bike share		Discount pass for students	Permit; link to free online platforms		Shuttle
University of Arkansas at Little Rock						
University of Missouri-KC	Bike rental, shop & map; bike parking		Discount passes for students	Link to Metro Rideshare	Zipcar	Shuttle
University of Missouri-St. Louis				Permit for students	Similar to Zipcar	Shuttle
University of North Carolina at Charlotte	Bike parking; bike lockers			Permit; link to ShareTheRideNC; encourage vanpool	Hertz on Demand	Shuttle; zoned parking

[11] Designated bicycle friendly universities by the League of American Bicyclists.

	Bike	Walk	Transit	Car/Van Pool	Car Share	Other
Wichita State						Shuttle
Northern Illinois University	Borrow a bike program, fix-it station	Walking guide	Free transit for students.	NIU Carpool Connections	Zipcar	Shuttle
University of Colorado-Denver	Bike parking, bike lockers, 5 fix-it stations		Discounted pass for students; discounted, pre-tax pass for staff	Permit; Zimride		Shower; promotion; daily fee lots
University of Northern Iowa	Bike parking & lockers		Discount passes for students			Shuttle; multi-modal trans center
Sustainability Aspirational Peers						
University of Iowa	Covered bike parking; 2 fixit stations; bike map; rentals; classes & trips		Discount passes for students & staff	Permit, matching service; employee vanpool	Zipcar	Emergency ride home for staff
University of Colorado-Boulder	Bike parking; 2 bike shops & mobile mechanic; bike share	Pedestrian Safety Committee	Free pass for students; discount pass for staff	Zimride; priority parking	eGo CarShare	Comprehensive promo; Guaranteed Ride Home program
Local Peers						
UNL[10]	Bike parking; bike shop		Free pass for students	Permit	Zipcar	Scratch off permits
Creighton University	Bike nest, bike parking			Promo Metro Ride Share	Zipcar	Shuttle; taxi service
MCC	Bike share; fixit stations; sharrows; secure bike parking; classes		Free pass for students; pre-tax payroll deduct for staff	Promo Metro Ride Share; priority parking		Promotion
UNMC	Bike parking			Promo Metro Ride Share		Gym showers for .50 cents.
UNO	Bike parking; bike share; 2 fix-it stations		Free pass for students	Permit	Zipcar	Shuttle; day parking passes

Other strategies used by several universities included: daily scratch off parking permits or daily fee lots, zoned parking, shuttle, free or low-cost use of showers, and late night taxi service. The more comprehensive TDM programs also provided staff emergency ride home programs and focused on promoting multi-modal transportation options.

Administration, Funding, and Impact

Peer universities administered TDM programs through a variety of departments, most commonly through parking and/or transportation services or a similar-named department (14), public safety (4), and/or by or in conjunction with a sustainability office (3). Five universities' TDM efforts also involved student organizations. Parking (only) and public safety departments appeared to be least likely to implement a variety of TDM strategies. In addition, the most comprehensive programs seemed to take a collaborative approach to administration of TDM programs and had good support from the top university administration. See Table 11.

Table11: Peer University TDM Administration, Funding, and Impact

	Administration	Funding	Impact
Institutional Peers			
Cleveland State University	Parking & Transportation Services Department		
Indiana Univ-Purdue/Univ-Indianapolis	Transportation and Project Management		
Northern Illinois University	Parking Services; bus system student-run	Student fees for bus.	
Oakland University	Center for Student Activities & Leadership Dev; University Police		
Portland State University	Transportation & Parking Services; good support from top admin; collaborative	Transportation & parking fees; some grant funding; memberships for bike shop	Staff drive alone rates: 50% to 26%; student drive alone rates: 41% to 19-20%. Decade of growth without building any new parking.
University of North Carolina at Charlotte	Parking Services; support from Chancellor & Student Government	Parking permit fees.	Noticeable effect.
University of Arkansas at Little Rock	Public Safety		
University of Colorado-Denver	Sustainability office works closely with Parking and Transportation Office. Support from top admin	Parking fees except student fee for transit pass & sustainability office budget for promo	% of drive alone has decreased
University of Missouri-Kansas City	Parking Operations		
University of Missouri-St. Louis	Parking and Transportation; sustainability coordinator	Parking fees included in tuition.	No change.
University of Northern Iowa	Public Safety & Student Government	Parking funded by parking fees; other transportation by student fees	
University of Texas at San Antonio	Transportation Division		
Wichita State University	Parking		

	Administration	Funding	Impact
Sustainability Aspirational Peers			
University of Colorado-Boulder	Transportation Services; Student Environmental Center; several staff; supper from top; collaborate w/ City.	Transit funded by: housing, general funds, transit agency, City	Increase of 62% in bicycle use on the Main Campus and 23% in pedestrians entering campus from 1998 to 2010.
University of Iowa	Parking & Transportation; support from admin	Parking & Transportation funds, including parking fees	Able to not build as many commuter lots.
Local Peers			
Creighton University	Volunteer committee; sustainability manager; public safety	General fund	Too little done to see change.
MCC	Campus Sustainability Program; transportation committee; support from top admin	Student services & general fund	
University of Nebraska-Lincoln	Parking & Transit Services; no resistance but not lot of support from top admin	Parking & Transit Services budget (parking fees)	Plateau in no of students bringing cars to campus even though lot of new building
UNMC	Parking; sustainability manager; little "buy-in" from top	Energy savings; no dedicated funding source.	Too little done to see change.

We were not able to do a detailed analysis of funding sources for TDM, but based on interviews and website analysis, we found that funding for TDM programs came from a variety of sources, including: transportation and parking fees (8), student fees (3), general funds (4), tuition (1), grants (1), energy savings (1), and memberships (1).

Only a few universities had information on the impact of their TDM efforts. The programs with TDM plans and that have been doing TDM for some time, with more comprehensive programs, were able to provide the best data on impact. Portland State, for example, indicated that staff drive-alone rates dropped from 50% to 26% and student drive alone rates from 41% to 19-20% since they've started TDM. They've had a decade of growth without building any new parking. University of Colorado-Boulder had an increase of 62% in bicycle use on the Main Campus and 23% in pedestrians entering campus from 1998 to 2010. Other campuses that have implemented a variety of TDM strategies have found some degree of impact, even if anecdotal, including plateauing of drive-alone rates and no need to build new parking. Only one university (UMSL) suggested they have seen no impact; however, it also appears they have not done a great deal to implement TDM strategies. Some others said it has been too early to tell if there has been impact or not enough has been done to see change.

Reasons for TDM, Challenges, and Need for Success

Table 12 provides a summary of what interviewees said about the reasons motivating them to implement TDM strategies, challenges, and things needed for success in implementing TDM. The most common reasons for implementing TDM strategies, according to interviewees, were related to sustainability and reducing environmental impact (9); for financial reasons such as avoiding the high cost of building new parking (7); and to accommodate growth with limited or no additional space to add parking (2). At least one campus also noted the desire to improve students' accessibility to educational opportunities.

Table 12: Peer University Interview Sample—Reasons for Implementing TDM, Challenges, and Needed for Success

Reason for TDM	Challenges	Needed for Success

• Sustainability & environmental impact (9[12])
• Avoid high cost of building new parking (7)
• Growth & limited space (2)
• Other groups in city support
• Lack of convenient parking
• Tax credits for sustainability
• Not want to add parking
• Reduce need to build parking
• Access for students
• Get fewer students to bring cars to campus
• Health
	• Funding/resources (9)
	  ○ Department silos & cost center fragmentation
	  ○ Not having student fee
	  ○ Funding not clearly identified
	• Context/external environment (5)
	  ○ City car-centric design
	  ○ Lack control over infrastructure-operated by City
	  ○ Connectivity between public transit & campus
	  ○ Location of campus
	• Student & others involvement (2)
	• Several people in key positions road blocks (3)
	• Lack of incentives & support from top admin
	• Properly valuing parking
	• Building design
	• Lack of convenient parking
	• Main campus nearing build out
	• Growth
	• Costs
	• Technical issues
	• Lack of understanding about urban design
	• Mentality that we can build our way out of our parking problem
	• Promotion
	• Parking highly political
		• Support from top administration (3)
		• Get students involved early (3)
		• Give people options & tell them about it/promote early (2)
		• Emphasize cost of parking
		• Communicate benefits
		• Provide incentives
		• Collaborate with partners
		• Have knowledgeable about transportation design

[12] Number of times noted by interviewees.

According to interviewees, the most cited challenge for implementing TDM strategies was having adequate funding or resources, brought up in some form by 9 out of the 11 universities interviewed. Related to this is the challenge of fragmented, or funding and administration silos—for example, parking is managed and funded in one department, design and building in another, sometimes working at cross-purposes, as noted by one interviewee. This interviewee noted the problem of facilities automatically planning for more parking when a new building is built as opposed to considering a design that would better accommodate bicycling, walking, and transit. As a result, the university lacked a comprehensive, multi-modal approach to design and transportation planning and implementation. In several cases, interviewees noted that one or two people in key positions were "road-blocks" to shifting to a TDM approach and with that there was a lack of strong support from top administrators to create a mode shift.

At least five interviewees also brought up the context or design of the surrounding area of the university, making it difficult to create connectivity and safe options to get to campus. Other challenges noted included: getting students or others involved, properly valuing parking and lack of convenient parking, growth and limited space, lack of understanding about urban design or the continuing mentality that we can build more parking to address parking problems, and some technical issues of implementation (such as in administering and use free bus passes). One person also noted that parking was a highly political issue due to the hierarchy of people working or served on the campus.

Finally, what interviewees said was needed for successful implementation of TDM strategies included: support from top administrators/leadership, contacting students and staff early about transportation options, providing incentives, collaborating with partners, and continually promoting and communicating the costs and benefits of transportation options. One interviewee suggested providing TDM strategies and incentives first before increasing the costs or limiting parking; that is, use the carrot before the stick.

TDM Plans at Other Universities

To gain a broader understanding of the existing TDM programs, the TDM plans available for the following universities were analyzed: University of Hawaii at Manoa, George Mason University, Indiana University Bloomington, University of Texas at Austin and San Francisco State University. The analysis focused on the following components: the university department or departments responsible for implementing the TDM plan, the motivation behind adopting TDM, how TDM programs are financially supported, and the metrics with which effectiveness is measured.

In general, a parking and transportation department carried out the TDM programs. San Francisco State University, Indiana University Bloomington and George Mason University involve a transportation committee with stakeholders representing different departments. At the University of Texas at Austin, proposed TDM improvements would be implemented by Campus Planning, Campus Safety & Security and University Operations. Cooperation amongst a variety of stakeholders rather than an isolated "parking department" is a common theme seen throughout the TDM plans.

The universities were motivated to implement a TDM program for a variety of reasons but the most common appeared to be financial sustainability. Additionally, environmental sustainability and the minimization of conflicts between the demand for parking and other aspects of the university were motivational factors. The University of Hawaii Manoa is unique in that access to education by people of all incomes and cultures is the primary factor cited for adopting a TDM program.

TDM programs are funded primarily by revenue generated by parking fees. In the past, George Mason incorporated transportation improvements into the budget of capital building projects and the TDM plan suggests the establishment of a transportation improvement fund supported by user fees. San Francisco State University suggested the use of a student fee to fund the universal transit access program.

Monitoring the effect of TDM programs is a vital part of the process. Several metrics are suggested and they include campus mode share, parking lot occupancy, parking permit sales, peak transit use, and bike counts. The use of campus surveys and parking lot data were the most common monitoring strategies utilized.

Estimating Current and Future Transportation Costs at UNO

The following analysis is based largely on UNO's Parking/Traffic Master Plan (Felsburg Holt & Ullevig, 2011) and Verdis' (2013) study, "Parking Problems? Transit Programs as a Cost-Effective Solution." UNO's Parking/Traffic Master Plan (Master Plan going forward) is focused mostly on parking demand; however, it also includes some suggested strategies for other modes of transportation. According to the report, its focus was to… "…identify best management practices for parking supply… evaluate the effect parking supply decisions have on traffic operations … develop construction cost estimates associated with providing additional parking capacity" (p. 1). The Master Plan identified current parking demand and followed with a forecast of demand into 2020-21.

The plan notes the ***current*** peak supply of parking was greater than peak demand: "peak parking rates at UNO were 0.38 stalls occupied/student and 0.66 stalls occupied/faculty and staff" (p. 11) and parking occupancy does not reach 100%; peak = 78% occupancy with 1,868 stall space surplus (p. 18). It also noted that UNO's parking ratio of 2.1 (persons per space) was lower than the national college campus average of 2.8 (persons per space).

The Master Plan identified a number of parking challenges over the next seven years, including student enrollment growth and loss of parking spaces. Those noted were:

Dodge Campus Parking Lots
D&E for Community Engagement Center (76 and 73 stalls)
G, future building or parking structure (215 stalls)
K, addition to Weber Building (65 stalls)
R, green space
Y&Z, no longer open to UNO use
Crossroads parking (1,350 stalls) to be replaced by 1,000 stalls at Center Campus

Pacific Campus Parking Lots

5 and 14 (255 and 215 stalls) to be replaced by future building
Scott Court to add 248 – resident only stalls and 105 proposed on street

All told, the Master Plan projects that by 2020-21, UNO will be faced with a ***shortage*** of ***1,607 spaces*** if no other efforts are made to shift drive-alone rates to other modes (p. 21).[13] In the following analysis, we estimate the cost of increasing parking at UNO by 1,607 spaces, compared to expanding and encouraging other modes of sustainable transportation: transit, walking, bicycling, and car/van pooling that will "free up" or eliminate the need for building this additional number of parking spaces.

Parking

Construction Estimates of Parking Structures

In order to meet parking demand without attempting to reduce drive-alone rates, the Master Plan identifies the following locations for possible parking lot construction, along with their associated costs:

Site 1, Lot F. Net gain of 358 spaces at $6.5 million for an estimated construction cost of $18,156 per additional stall.

Site 2, Lots H&X. Net gain of 723 spaces at $11.25 million for an estimated cost of $15,560 per additional stall.

Site 3, Lot G. Net gain of 574 spaces at $10 million for an estimated cost of $17,422 per additional stall.

Site 4, Hillside Parking Structure. Estimated cost of $10.6 million or $14,702 per additional stall. This could also be surface parking at a lower cost of $5,250 per space with a net gain of 400 spaces.

Site 5, Lot 6. Estimated cost is $10.6 million or $16,085 per net gained stall (659 spaces)

Site 6, University Life Parking Lots. Estimated cost $3.4 million; surface parking of 1,000 stalls to replace the Crossroads spaces, cost per space of $3,400.

In an effort to estimate monthly costs associated with the construction of parking structures, the costs for sites 1-5 were averaged, adjusted for inflation to get to real 2014 dollars, then amortized over 35 years at a fixed rate of 4 percent (see Verdis, 2013). The five structures had an average cost of $9,810,000 in 2011 dollars. Using the average annual rates of inflation for 2012 (1.7 percent), 2013 (1.5 percent) and 2014 (2.0 percent), the average cost for a parking structure at UNO is estimated at $10,328,950. Assuming a 35 year life of the structure at a fixed rate of 4 percent, the monthly principal and interest (if spread out equally over the 35

[13] Interestingly, the same report finds that UNO's parking ratio projected to 2020-21 is 2.6, which is still slightly lower than the national average for college campuses of 2.8.

years) cost would be $45,734, or $84.22 per stall per month (based on the average number of new stalls projected for the five structures).

Using the same methodology for Site 6 (above) – a surface lot – the estimated construction cost in 2011 was $3.5 million. In real 2014 dollars, the same lot would cost $3,579,860. Assuming a 20 year life, a fixed 4 percent interest rate, and interest expenses spread over the life of the project, the total paid would be $5,206,379, or $21,693 per month. The lots are estimated to provide 1,000 stalls, so the monthly cost stall would be $21.69 per stall per month. The cost estimates are very similar to those provided by Verdis: parking garage estimates $64 – $93 per space per month; surface parking estimates: $15 – $22 per space per month (p. 40). The above amounts are only construction estimates and say nothing about maintenance or opportunity costs (such as lost opportunity to use the space for other purposes, e.g., buildings).

Operating Cost Estimates

While the Master Plan only identified costs associated with the construction of parking structures, estimates of operating costs were identified in Verdis' (2013) study. These include monthly operating and maintenance costs per parking space for UNO: $13.42 per stall per month (p. 37). [14]

Opportunity Costs/Land Costs

Often ignored or discounted are the opportunity costs associated with parking, particularly in urban campus where space is limited and demand is high (Dober, 2000). If UNO decides to build parking on campus, given the fixed amount of space available, there is a cost associated with the lost opportunity to use the space for something else such as a building or green space. According to UNO's Facility Development Plan (2013), for example, future plans include:

- Expansion of Strauss Performing Arts Center,
- Development of competitive soccer field and shared recreational amenities,
- Enhancing the pep bowl as open space and encouraging housing adjacent to the pep bowl,
- Development of a new Science Building,
- A future Science and Arts building, expansion of Weber Fine Arts,
- Redevelopment of a mixed use residential and academic neighborhood at University Village,
- Enhancing connections to Elmwood park, and
- Improving internal neighborhood vehicular, pedestrian and transportation circulation.

Costs to consider in this regard include land acquisition, the lost ability to pursue public-private partnerships for the construction of new buildings, enrollment effects, etc. To estimate

[14] The Verdis estimates are low as they do not include costs for insurance, lighting, and administration.

opportunity costs, we rely on efforts by Verdis (2013) to capture land costs associated with parking in Omaha. Assuming 35 years at 4 percent interest, land costs for Omaha are $36 to $89 per space per month for parking garage and $50 to $122 per space per month for surface lots.

Shuttle Costs

UNO offers a shuttle service for students, faculty and staff; primarily for moving people from parking areas to the center of Dodge and Pacific Street campuses. Verdis (2013) estimates that shuttle costs for UNO are $42 per stall per month.

Total Parking Costs

Table 13 estimate total monthly costs associated with each parking stall at UNO. The estimates are similar to the construction costs identified in UNO's Parking/Traffic Master Plan plus adding costs incurred by UNO for operations, land acquisition opportunity costs, and shuttle service per Verdis' (2013) work. Projecting these costs out to estimate the costs associated with UNO's anticipated parking demand in 2020-21 of 1,607 stalls, the average monthly cost, in current dollars, for UNO would be $282,253 to $367,424 (or $175.64 to $228.64 per space per month) for parking garages and $204,266 to $319,970 (or $127.11 to $199.11 per space per month) for surface lots.

Table 13: Monthly Parking Costs per Space at UNO[15]

Parking Garage, Costs per Space Per Month	
Category	
Direct Costs	$84.22
Operating Costs	$13.42
Shuttle	$42.00
Land Costs	$36 to $89
Total Costs	$175.64 to $228.64
Surface Parking, Costs per Space Per Month	
Direct Costs	$21.69
Operating Costs	$13.42
Shuttle	$42.00
Land Costs	$50 to $122
Total Costs	$127.11 to $199.11

Cost-Benefit Analysis of Sustainable Transportation Modes

This section analyzes the costs and benefits of sustainable modes of transportation, largely using existing UNO data. Sustainable modes of transportation—public transit, biking,

[15] These estimates are based largely on work done by Verdis (2013) and UNO's Parking/Transportation Master Plan (2011)

walking, and car/van pooling—generally entail costs for infrastructure, maintenance, and administration. There are also opportunity costs where if UNO invests in TDM, it may lose opportunity to earn revenues from parking. Drawing on the literature, costs and benefits of sustainable modes of transportation are categorized into four sections: fiscal, health, environment, and community. See Figure 5.

It is difficult to accurately conduct such a cost-benefit analysis because some costs and benefits are not easily quantifiable. In particular, it is difficult to calculate some benefits, such as the beautification of campus; thus, it is notable that we do not include all the benefits of sustainable modes of transportation. Also, we do not exactly know the degree to which the improvement of sidewalks, for example, correlates with an increase in walking or biking mode share at UNO without conducting a pre- and post-survey or count. To help solve this problem, we rely on other data provided from other studies that measure the general costs for infrastructure for walking and biking in addition to UNO data.

As noted above, to measure costs and benefits of sustainable modes of transportation at UNO, we set a benchmark against which we will measure returns on investment of these modes. We focus on the previously-noted estimate in the UNO Parking/Traffic Master Plan that in 2020-21, UNO is expected to face a shortage of 1,607 spaces given that no other increases in parking supply or travel demand management strategies are initiated. Given the need for 1,607 spaces, we measure how much investment in TDM could reduce the need for parking spaces and make adequate returns on that investment. Every cost and benefit is calculated into the monthly value.

Costs of Sustainable Transportation Strategies

First, we examine the costs for conducting various sustainable transportation strategies, including: public transit (MavRide), car sharing (Zimride), walking and bicycling, and a guaranteed ride home program. Our best estimates are that the following associated costs will reduce anticipated monthly demand per stall by 1,607 spaces in the initial year of investment: 1,547 by MavRide and 60 by Zimride, plus likely additional spaces by investing in walking and bicycling.

MavRide allows pass holders to use public transit at no cost per trip. The monthly cost for the existing transit program in UNO is approximately $1.39 per participant (pass holder) per month according to data provided by Metro and UNO.[16] In addition, the Verdis (2013) study found that, "… for every 100 additional participants in the MavRide program it can be estimated that an additional 16.25 spaces parking spaces will not be required per day" (p. 17). Another way of saying this is that for every Mavride participant, 0.1625 parking spaces are opened per day. This estimate suggests that we would need to provide approximately 9,520 passes to reduce the daily demand for 1,547 parking spaces. As a result, UNO would need spend $13,233 monthly (9,520 * $1.39 per month) to offset anticipated future demands on parking. This equals $8.55 per space per month.

[16] Costs are based on past data on actual use of MavRide. There is a possibility that use will increase as the program is promoted, and thus costs for the program may also go up. This amount also assumes that Metro will continue to offset the actual costs of the MavRide program at the current rate.

In addition to MavRide, UNO can promote car sharing through Zimride. Zimride estimates that UNO could reduce the demand for 60 parking spaces the first year, with expected growth to continue.[17] According to a draft service contract, the costs for Zimride include an annual fee of $12,000, an initial setup fee ($2,500), and possibly a marketing fee ($2,500) the first year. Given that Zimride was willing to waive a one-time setup fee in the past, we only consider here annual fees and marketing costs as the total cost of Zimride. Thus, the annual costs for Zimride is estimated to be $14,500, or $1,208 per month; which equals about $241.67 per parking space opened or avoided the first year.[18]

Beyond Mavride and Zimride, a multi-pronged approach to TDM should include improved infrastructure for walking and bicycling. Thus, we add a monthly budget for bicycling and walking infrastructure to complement transit and carpooling. Based on the literature review and the recommendations in feedback from the League of American Bicyclists on UNO's Bicycle Friendly Application and in UNO's Parking/Traffic Master Plan, the following improvements were included in cost projections:

- Part-time bicycle/pedestrian (or multimodal) program coordinator—$22,000 (annual)[19]
- Infrastructure items:[20]
    - Bike lockers--$2,090 x 5 = $10,450 (not annual)
    - Construction of new ramps and paths in various locations:
        - Ramps $810 x 5 = $4,050 (not annual)
        - Curb extensions/bulb outs $13,000 x 2 = $26,000 (not annual)
    - Expand shared used paths on Pacific campus (400 foot gap)--$36,567 (not annual)
    - Add sharrows in road near PS2— Shared Lane/Bicycle Marking average $180 each x 10 = $1,800
    - Paint to improve crosswalks & side paths
        - Pedestrian crossings $360 x 7 = $2,520
        - Advance stop/yield line, $320 x 3 = $960
        - Painted curb/sidewalk, $3.06/linear foot x .5 mile = $8,078
    - Add bike dismount signs in main spine on Dodge campus. Add additional signage for improved bike/walking way finding—average $300/sign x 8 signs = $1,800 (one time cost, not annual)

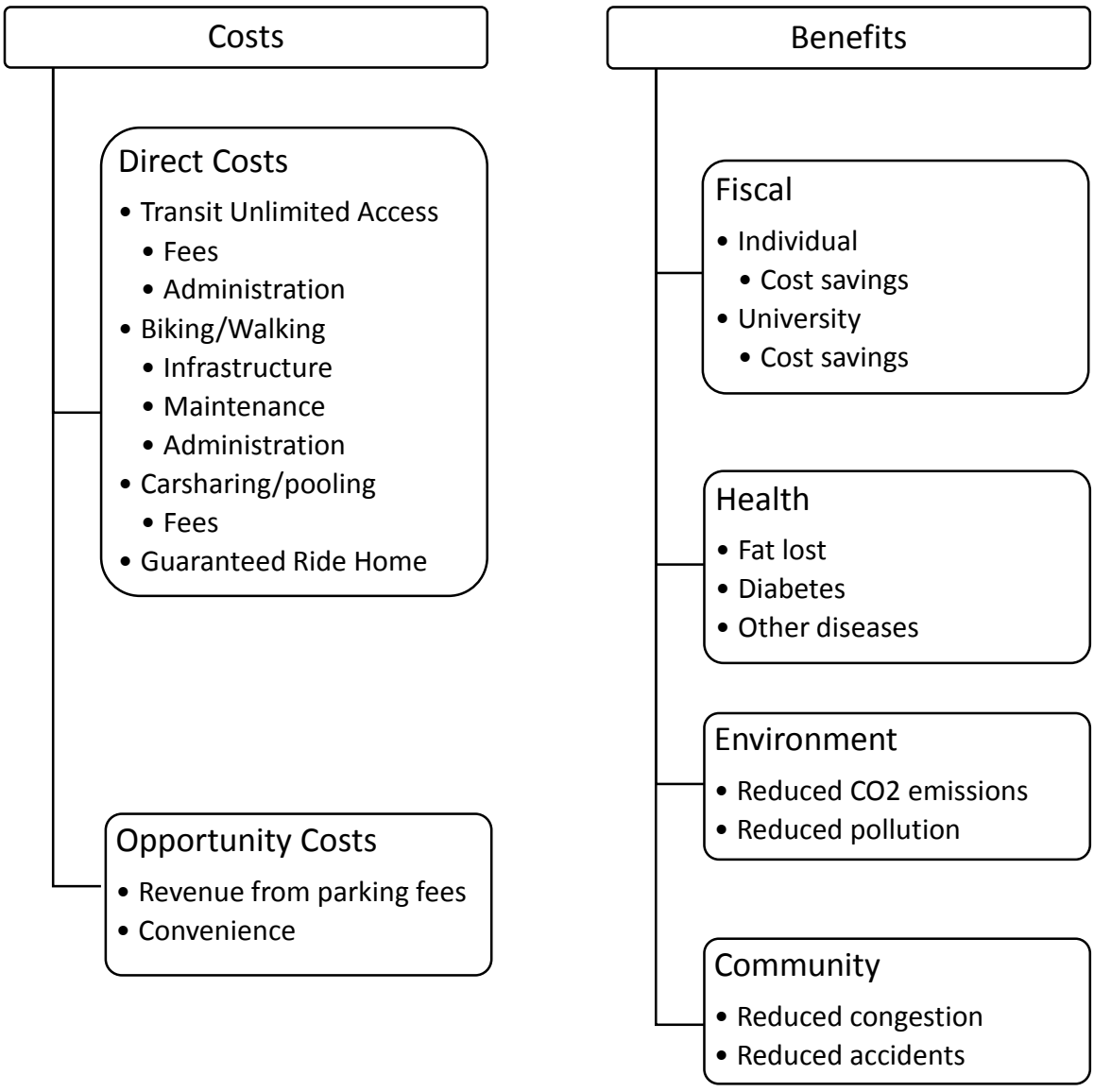
[17] Zimride suggests an average campus partner of our size typically experiences between 1,000-3,000 users who engage in Zimride in the first year. To be conservative, they assume 1,000 students create a profile in the first year and then 40% of those who sign up post rides (1,000*.4=400) and 30% of the rides posted result in a carpool formed (400*.3=120). They also assume a conservative 2 people per car.

[18] Note that we do not include here incentives from Enterprise that could reduce the cost of Zimride by as much as $6,000/year (or 50% off).

[19] The average salary for bicycle pedestrian coordinator jobs is $44,000 according to: http://www.simplyhired.com/salaries-k-bicycle-pedestrian-coordinator-jobs.html.

[20] Costs are based on Bushell et al., 2013, except where otherwise noted. Number of items needed are rough estimates only.

Figure 5: The Costs and Benefits of Sustainable Transportation Options



Promotion of all modes of transportation should also be integrated into current operations but are not included in cost projections here. The anticipated UNO costs for walking and bicycling upgrades then are estimated to be $114,225 per year, or $9,519 per month.[21] For bicyclists, we estimate average cost of bike ownership and maintenance at $350 annually or $29.16/month.[22]

It is assumed that investing in walking and bicycling infrastructure and amenities will open up or eliminate the need for additional parking spaces. It is difficult to project the number of spaces that may be opened up or diverted from being built; however, research shows that

[21] While the annual costs are really $48,708 ($4,059/mo), the rest is one-time or at least not annual cost but we keep in the costs to ensure proper maintenance/upkeep and upgrades over time.

[22] http://www.theurbancountry.com/2011/05/americans-work-384-minutes-each-day-to.html

adding such infrastructure and amenities does increase bicycling and walking (see for example Pucher, Dill, & Handy, 2009). According to a FHWA study of four cities on non-motorized transportation (Lyons et al., 2014), a $147.5 million investment yielded a 15.8% percent increase in walking mode share and a 44 percent increase in bicycling mode share. If we extrapolate these findings to the proposed investment in walking/bicycling at UNO, an annual investment of $114,225 (or about $6.50 per capita) should see the current proportion of students, faculty and staff walking and biking to campus increase from 8.67 percent and 2.44 percent, to 8.93 percent and 2.65 percent, respectively. Estimating the effect of this mode shift to demand for parking is beyond the scope of this study and in need of future work.

In addition, successful TDM programs often include a Guaranteed Ride Home Program. The makeup of the program, from whom is covered (faculty, staff and/or students), the extent to which the rider covers a portion of the costs, and the extent to which there are caps on the program's use per year, vary greatly. All of these variables affect the program's costs. According to a study in 2006 (Office of Budget and Management, Federal Transit Administration) average costs per trip in Minneapolis, Oklahoma City and Cleveland ranged from $25-$35, respectively. Participation in the Guaranteed Ride Home Programs had a median participation rate of 1.29 percent. So, if we use our estimate of 1,547 MavRide pass participants coming to campus on any given day of the week, as well as an increase in people who walk or bike to campus by 82 persons a day (see calculations below), we can project an estimated monthly cost of $630.42 (1,629 x 0.0129 x $30).

Finally, we include opportunity costs. Investments in sustainable transportation modes that keep UNO from constructing 1,607 parking spaces means UNO will lose parking revenues, estimated as $33,340 to $41,575 based on the study by Verdis (2013). As stated above, the monthly rate for parking at UNO on average is $20 for surface parking and $24.94 for garage parking per user per month and ratio of users to parking spaces is 2.1 according to the Parking/Traffic Master Plan. Thus, UNO is expected to lose between $67,494 per month ($20 x 2.1 x 1,607) and $84,165 per month ($24.94 x 2.1 x 1,607) in revenue if it does not construct additional parking spaces. This equates to $42 to $52.38 per month per space.

To summarize, details of calculating costs of sustainable transportation modes are as follows:

1) Direct costs
    i) Individual
        a. Bicycling: $29.16/month
    ii) University
        a. MavRide: $13,233/month
        b. ZimRide: $1,208/month
        c. Bicycling/Walking: $9,519/month
        d. Guaranteed Ride Home Program: $630.42/month

2) Opportunity costs
    i) University

a. Lost parking revenue: $67,494 ~ $84,165/month

Total Costs = $92,113 ~ $108,784/month

Benefits

The benefits of sustainable transportation modes are divided into four sections: fiscal, health, environment, and community.[23] Each benefit is derived from the premise that the anticipated 1,607 parking spaces would not need to be built. First, people could save money: 1,607 students or faculty/staff would not need to operate their own car for commuting because they could use MavRide, carpool, walk or bike as alternatives. According to National Center for Transit Research (2014), vehicle ownership and operation costs for an average U.S. driver are estimated as $0.65 per mile. Assuming that UNO members' average commute round trip is 20 miles for 4 days a week (FHWA, 2010; U.S Census, 2011; Emerging Terrain, 2011), we calculated that 1,607 persons could save $334,256 per month ($0.65 x 20 miles x 16 days per month x 1,607) in terms of car ownership and maintenance.[24] In addition, individuals can save rates on parking permits, which are $20.00 or $24.49 per month. 1,607 persons could save between $32,140 and $39,355 per month.

University administration would also not need to construct the expected shortage of 1,607 parking stalls as a return on TDM investment. Cost savings will be different, depending on the style of parking lots, such as parking garage or surface lot. Regardless of the style of parking lot, the basic costs for parking includes construction costs, operation and maintenance costs, land costs, interest costs, and shuttle service costs. As indicated above, we added those costs up and calculated final saving costs of reduced parking demand for 1,607 parking spaces. Integrated costs for garage parking could be estimated between $175.64 and $228.64 per space per month while costs for surface lot parking would be somewhere between $127.11 and $199.11. Thus, the total cost savings for university could be between $282,253 ~ $367,424 per month ($175.64 to $228.64 x 1,607) per garage space or $204,265 ~ $319,969 per month ($127.11 to $199.11 x 1,607) for surface lot spaces.

Next, individuals are expected to save on costs related to fitness and health. Litman (2014) estimated that individuals who ride a bike or walk could save $0.20 or $0.50 per mile on

[23] At the outside to our analysis, we also planned to try to include calculations for the benefit of sustainable transportation for recruitment and retention. We were not able to find reliable estimates for this so we left it out of the calculations. It is worth noting that four-year public universities spend on average $457 per student to recruit new students (Noel Levitz, 2013). The literature suggests that young adults are driving less and increasingly reliant on transit, biking and walking (Davis & Dutzik, 2013). We can also assume that some students (especially low-income and minority students) are better able to stay in school if they have affordable transportation to get to school. Providing a supportive environment through transportation options also provides a signal that the university supports students in their learning. According to The College Board's *Trends in College Pricing*, in 2013, on-campus students at 4-year public universities spent on average $1,123 on transportation; 4.9% of their total budget (est. ave budget $22,826). The cost is higher for commuting students.

[24] The Federal Highway Administration (2010) shows that the average commute distance is 12.6 miles in the U.S while Emerging Terrain (2011) shows that average Omaha commuting distance is 13.3. Also, U.S Census data show the distance from work census block to home census block for 1,293 of 1,629 workers was less than 10 miles in the Omaha area. As we combine these data, we roughly estimates that workers in Omaha commute 10 miles one way on average.

average, respectively.[25] Thus, with an annual of investment of $114,225, we estimate a projected mode share increase of 8.5 percent for bicycling (37 people) and 3.05 percent for walking (45 people). To be conservative in our calculations, we assume that most people will bicycle or walk for 7 months out of the year. Data from the University of Colorado-Boulder suggests that an average estimate for bicycling is 4.0 miles round trip (2.0 miles one way) and walking 1.4 roundtrip (0.7 miles one way). So, for bicycling we calculate 37 x $0.20/mile x 4.0 miles x 16 days per month = $473.6 per month and for walking 45 x $0.50/mile x 1.4 miles x 16 days per month = $504 per month. Individuals who use MavRide as a transit service also have better health because they walk or bike to access to transit service. We assume that 1,547 individuals would use MavRide on a given day during the week. Data from a recent on-board survey of Metro Transit riders found that people who ride the bus walk 0.26 miles one way on average or bicycle on average .9 miles (Metro, 2012). We do not know what the percent of walkers or cyclists might be so assume the majority of MavRide users are walking to transit so calculate benefits: 1,547 x $0.50/mile x 0.52 miles round trip x 20 days per month = $8,044.40.

Third, the environment could be enhanced. Litman (2013, 2014) estimates the community would accrue benefits of $0.04/mile and $0.03/mile for reduced pollution and energy conservation (total $0.07/mile) when residents walk or ride a bike. Thus, we calculate 37 people for bicycling x $0.07/mile x 16 days per month x 4.0 miles = $165.76 and 45 for walking x $0.07/mile x 16 days per month x 1.4 miles = $70.56. Also, given that individuals who ride MavRide walk 0.52 miles round trip in average, we calculate the additional benefits from transit users, 1,547 x $0.07/mile x 0.52 miles x 20 days per month = $1,126.22.

Fourth, the community is expected to save on costs of congestion and accidents due to increased commuting by walking, biking, or transit. Litman and Lovegrove (1999) estimated that $0.15/kilometer ($0.09/mile) could be saved from reduced congestion and $0.04/kilometer ($0.02/mile) from reduced accidents (total $0.11/mile). Thus, 37 for biking x $0.11/mile x 4.0 miles * 16 days per month = $260.48 and 45 for walking x $0.11/mile x 16 days per month x 1.4 miles = $110.88. Again, we need to include the benefits from persons who ride MavRide with walking: 1,547 x $0.11/mile x 0.52 miles x 20 days per month = $1,769.77.

To summarize, details of calculating benefits of sustainable transportation modes are as follows:

1) Fiscal Benefits
   - i) Individual
     a. Average cost car ownership and use: $334,256/month
     b. Average cost of parking permits: $32,140 ~ 39,355/month
   - ii) University
     a. Parking garage costs diverted: $282,253 ~ $367,424/month
     b. Surface parking costs diverted: $204,265 ~ $319,969/month

[25] The total value of health benefits include a reduction in government, business and consumer healthcare costs; reduced worker disability costs and improved productivity; users' willingness-to-pay for reduced illness and longevity; minus any increase in medical costs associated with walking and cycling (Litman, 2014, p. 15).

2) Health
   i) Walking: $504/month
   ii) Biking: $473.60/month
   iii) Transit: $8,044.40/month

3) Environment
   i) Walking: $70.56/month
   ii) Biking: $165.76/month
   iii) Transit: $1,126.22/month

4) Community
   i) Walking: $110.88/month
   ii) Biking: $260.48/month
   iii) Transit: $1,769.77/month

Total Benefits =

Parking Garage = $661,175 to $753,561/month

Surface Parking = $583,187 to $706,106/month

Benefit to Cost Ratios

The benefits to cost analysis confirms what we see in the literature and interview findings: the cost of meeting transportation demand by focusing on the construction of parking structures far exceeds the benefits. Our analysis finds that the monthly benefits of **investing in multi-modal strategies to meet transportation needs exceeds the costs by a ratio of 6.08 to 7.67**.

Table 14: Sustainable Transportation Monthly Benefit to Cost Ratios

Total Costs of Investing in Sustainable Transportation

Surface	$92,113
Garage	108,784

Total Benefits of Investing in Sustainable Transportation

	Low Estimate	High Estimate
Surface	$583,187	$706,106
Garage	$661,175	$753,561

Ratios of Benefits to Costs of Investing in Sustainable Transportation

	Low Estimate	High Estimate
Surface	6.33	7.67
Garage	6.08	6.93

Summary and Recommendations

Finally, in this section we address the question: What strategies and priorities should UNO consider in supporting sustainable transportation options?

Based on a review of the literature:

- Many universities are adopting TDM and the benefits of enabling and promoting multi-modal transportation appear to outweigh the costs.
- The most effective programs take a multi-modal perspective and multi-pronged approach to TDM. It is integrated across modes and holistic in approach.
- Important factors of success include: Funding resources, collaborative partnerships, leadership, and political acceptability.
- It's important to emphasize non-coercive strategies, but some coercive strategies are also needed.
- Context is important—the surrounding city or town also needs to improve multi-modal options for them to be more successful on campus.
- Related specifically to transit: free and reduced-cost bus passes lead to greater transit use. Transit-orientated design/development and encouraging people to live in transit-accessible corridors can help to increase use.
- Related to carpooling, factors for successful car sharing and ride sharing include having positive community attitudes toward car/ride sharing, active partners, and previous positive experiences.
- Regarding bicycling and walking: Strategies that can improve the level of bicycling should take a comprehensive approach and include the availability of a bicycle in the household (the single strongest predictor of bicycling for transportation), bike lanes, secure and sheltered bike parking, shower facilities, and programs such as bike-to-school/work days. Issues important for walking include personal safety, whether the streetscape was attractive and interesting with diverse views, and the presence of destinations to walk to. Bike-and pedestrian-friendly campuses frequently have bike/pedestrian program coordinators and advisory committees and bike/pedestrian plans.

Based on data from the study findings:

- Investing in sustainable transportation options is cost effective compared to investing in SOV parking. Our benefit-to-cost ratios range from a low of 6.08 to 7.67. This means that at a minimum, benefits of multi-modal options relative to its costs are more than 6 to 1.
- A multi-pronged approach to TDM is being pursued by most of university peers. The more advanced peers do so in a planned and holistic manner and in partnership across campus and with partners outside of campus.
- Approaches that silo parking and transportation make it difficult or impossible to take a more comprehensive approach to TDM.

- Leadership from the top can make all the difference in implementing TDM. One person in a key position can also be a major roadblock to implementing TDM.
- Addressing design issues that encourage or impede sustainable transportation options is needed on and off campus.
- Coercive measures such as raising parking fees can be challenging politically and for other reasons. Non-coercive strategies to provide alternatives to driving-alone can help to reduce or avoid costs and the need to significantly raise parking fees; or make raising fees more palatable.
- Start early (at orientation or before) to educate students, faculty and staff about transportation options and issues.

Based on the "lessons learned" from the literature and findings, we recommend the following for UNO:

1. Consider shifting funds from the "parking structure 3 savings" fund or obtain dedicated funding from other sources to invest in transit, carpooling, bicycling and walking. The largest return on investment appears to be to greatest for the MavRide program. That said, based on research, the most effective strategy is a multi-pronged approach to transportation demand management.

    a. Pilot-test expanding MavRide to UNO staff and faculty and expanding MavRide to more students. Include education about how to ride the bus and use the passes.
    b. Contract with Zimride or a similar service to promote and expand carpooling. Consider providing incentives to get people to try carpooling for the first time.
    c. Follow recommendations from the Parking/Traffic Master Plan and the League of American Bicyclists to include:
        i. Hiring a part-time bicycle/pedestrian (or multimodal) program coordinator, who can then:
            - Help create a campus bike/pedestrian plan
            - Plan and promote events such as organized campus rides, car-free days and campus bike tours
            - Apply for funding, evaluate programs, etc.
        ii. Adding infrastructure and other items:
            - Bike lockers
            - Construction of new ramps and paths in various locations
            - Expand shared used paths on Pacific campus (400 foot gap)
            - Sharrows in road near PS2
            - Bike dismount signs in main spine on Dodge campus
            - Give away bicycles or provide at low cost instead of giving away free parking permits.
            - Provide free or low-cost shower facilities.

d. Implement an “emergency ride home” program in cases of emergencies for those that utilize transit, bike or walk to campus.

2. Get clear support for a multi-modal/TDM approach from the UNO Chancellor and key administrators, which will enhance the success of TDM efforts on campus.

3. Change the focus of the Parking Department and Parking Advisory Committee to a (Multimodal) Transportation Department and Advisory Committee.

4. Consider modifying the parking fee model to better capture UNO’s associated costs. The current monthly parking lot fee is $24.99, whereas the actual cost is between $176 and $229 per month. Similarly, the monthly parking surface pass at UNO is $20, whereas the associated cost is between $127 and $199/month.

5. Integrate the promotion of multi-modal transportation into all UNO communications (including changing the Parking Department website to a Transportation-focused website). Flyers promoting multi-modal transportation should be posted throughout campus. Orientations should provide transportation information to help educate students, faculty and staff.

6. Work collaboratively with the City of Omaha and Douglas County to promote TDM and a complete streets policy regionally.

References

Active Living Research. (2009). *Active transportation: Making the link from transportation to physical activity and obesity: Building Evidence to prevent childhood obesity and support active communities*. Retrieved from http://puff.lbl.gov/transportation/transportation/pdf/alr-brief-active-trans.pdf.

Anderson, M. L. (2013). *Subways, strikes, and slowdowns: The impacts of public transit on traffic congestion*. Paper presented at the NBER Working Paper.

APTA. (2003). *The benefits of public transportation: The route to better personal health*. American Public Transportation Association. Retrieved from http://www.apta.com/resources/reportsandpublications/Documents/better_health.pdf

APTA. (2007). *Public transportation: Benefits for the 21st century*. American Public Transportation Association. Retrieved from http://www.apta.com/resources/reportsandpublications/Documents/twenty_first_century.pdf

APTA. (2010). *Public Transportation takes us there*. American Public Transportation Association.

Balsas, C. J. L. (2003). Sustainable transportation planning on college campuses. *Transport Policy, 10*, 35–49.

Brown, J., Hess, D. B., & Shoup, D. (2003). Fare-free public transit at universities: An evaluation. *Journal of Planning Education and Research*, *23*, 69-82.

Bushell, M. A., Poole, B. W., Zegeer, C. V., & Rodriguez, D. A. (2013, October). *Costs for pedestrian and bicyclist infrastructure improvements: A resource for researchers, engineers, planners, and the general public*. UNC Highway Safety Research Center. Retrieved from: http://katana.hsrc.unc.edu/cms/downloads/Countermeasure%20Costs_Report_Nov2013.pdf.

Cambridge Systematics. (1999). *Public transportation and the nation's economy: Economic development research group*. Retrieved from http://www.apta.com/resources/reportsandpublications/Documents/vary.pdf

Cambridge Systematics. (2002). *The benefits of public transportation: An overview*. Reichman Frankle Inc. Retrieved from http://www.apta.com/resources/reportsandpublications/Documents/ben_overview.pdf

Campbell, R., & Wittgens, M. (2004). *The business case for active transportation: The economic benefits of walking and cycling*. Prepared for Better Environmentally Sound Transportation.

The College Board. (2013). *Trends in college pricing*. Retrieved from: http://trends.collegeboard.org/sites/default/files/college-pricing-2013-full-report.pdf.

Corbett, S. (2008, August 2). *If you build it – they may not come! How to advance sustainable transportation AND save your campus $50 million*. University of California San Diego. Retrieved from: http://sustainability.universityofcalifornia.edu/documents/sam_corbett.pdf.

CU-Boulder Transportation Master Plan. (2011, September). LSC Transportation Consultants, Inc. and ALTA Planning + Design.

Davis, A. (2010, March). *Value for money: An economic assessment of investment in walking and cycling*. Research Report 5. Bristol City Council & NHS Bristol. Retrieved from: http://www.apho.org.uk/resource/item.aspx?RID=91553.

Davis, B., & Dutzik, T. (2013). *Transportation and the new generation: Why young people are diving less and what it means for transportation policy*. U.S. PIRG Education Funrd Frontier Group. Retrieved from http://www.uspirg.org/sites/pirg/files/reports/Transportation%20%26%20the%20New%20Generation%20vUS_0.pdf.

Davis, T., & Hale, M. (2007). *Public transportation's contribution to U.S. greenhouse gas reduction: From science to solutions*. Retrieved from http://www.apta.com/resources/reportsandpublications/Documents/climate_change.pdf.

Dober, R. P. (2000). *Campus landscape: Functions, forms, features*. John Wiley and Sons, Inc., New York, NY.

Emerging Terrain (2011). A friendly reminder. Retrieved from http://emergingterrain.org/archives/597.

Felsburg Holt & Ullevig. (2011, October). University of Nebraska at Omaha parking/traffic master plan.

Federal Highway Administration (2010). *2010 conditions and performance: Executive summary*. Retrieved from https://www.fhwa.dot.gov/policy/2010cpr/execsum.htm.

Gärling, T., & Schuitema, G. (2007). Travel demand management targeting reduced private car use: Effectiveness, public acceptability and political feasibility. *Journal of Social Issues, 63*(1), 139-153.

Garrett-Peltier, H. (2011, June). *Pedestrian and bicycle infrastructure: A national study of employment impacts.* Political Economy Research Institute, University of Massachusetts, Amherst. Retrieved from http://www.peri.umass.edu/fileadmin/pdf/published_study/PERI_ABikes_October2011.pdf.

Gotschi, T. (2011). Costs and benefits of bicycling investments in Portland, Oregon. *Journal of Physical Activity and Health*, *8*, S49-S58.

Gotschi, T., & Mills, K. (2008). Active transportation for America: The case for increased federal investment in bicycling and walking. Rails-to-Trails Conservancy and Bikes Belong. Retrieved from: http://www.railstotrails.org/resources/documents/whatwedo/atfa/atfa_20081020.pdf.

Grant, F. L. (2008). *The journey to campus: Commute mode choice for University of Nebraska at Omaha students*. Master's Thesis. University of Nebraska at Omaha.

Jaffe, E. (Producer). (2013). *Why people choose cars, even when mass transit would serve them better*. Retrieved from http://www.theatlanticcities.com/commute/2013/02/why-people-chose-cars-even-when-metro-would-be-faster/4566/.

Katzev, R. (2003). Car sharing: A new approach to urban transport problems. *Analyses of Social Issues and Public Policy,* 3(1): 87-109.

Lane, C. (2005). PhillyCarShare: First-year social and mobility impacts of car sharing in Philadelphia. Paper presented at Transportation Research Board 84th Annual Meeting, Washington, DC, January 9-13, 2005. Retrieved from

https://trb.metapress.com/content/b42564504543235x/resource-secured/?target=fulltext.pdf.

Levin, A. (2013, September 2). *Stanford has avoided $100,000,000 in parking structures over the last decade*. Peninsula Transportation Alternatives. Retrieved from: http://peninsulatransportation.org/stanford-has-avoided-100000000-in-parking-structures-over-the-last-decade/.

Litman, T. (2010, March). *Quantifying the benefits of nonmotorized transportation for achieving mobility management objectives*. Victoria Transport Policy Institute. Retrieved from: http://mail.artshenkman.com/cs/groups/content/@webottawa/documents/pdf/mdaw/mdy3/~edisp/con056214.pdf.

Litman, T. (2012). *Evaluating public transportation health benefits*. Victoria Transport Policy Institute Retrieved from http://www.vtpi.org/tran_health.pdf

Litman, T. (2013). *Evaluating public transit benefits and costs: Best practices guidebook* (pp. 1-130). Victoria Transport Policy Institute. Retrieved from http://www.vtpi.org/tranben.pdf.

Litman, T. (2014). *Evaluating active transport benefits and costs: Guide to valuing walking and cycling improvements and encouraging programs*. Victoria Transport Policy Institute. Retrieved from http://www.vtpi.org/nmt-tdm.pdf.

Litman, T., & Lovegrove, G. (1999). *UBC TREK program evaluation: Costs, benefits and equity impacts of a University TDM Program*, Victoria Transport Policy Institute.

Lyons, W., Rasmussen, B., Daddio, D., Fijalkowski, J., & Simmons, E. (2014). *Nonmotorized transportation pilot program: Continued progress in developing walking and bicycling networks – May 2014 report*. U.S. Department of Transportation, Federal Highway Administration. Available at: http://www.fhwa.dot.gov/environment/bicycle_pedestrian/ntpp/.

Maxwell, J. A. 2005. *Qualitative research design: An interactive approach*. Thousand Oaks: Sage.

Metro Transit. (2012). *On-board survey*. Administered as part of the Heartland 2050, Regional Transit Vision.

Meyer, J., & Beimborn, E. A. (1998). Usage, impacts, and benefits of innovative transit pass program. *Transportation Research Record: Journal of the Transportation Research Board, 1618*(1), 131-138.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. Sage.

Millard-Ball, A., Murray, G., Schure, J. T., Fox, C., & Burkhardt, J. (2005). *Car-sharing: Where and how it succeeds*. TCRP Report 108. Transit Cooperative Research Program. Washington, DC: Transportation Research Board.

Morency, C., Habib, K. M. N., Grasset, V., & Islam, M. T. (2012). Understanding members' carsharing (activity) persistency by using econometric model. *Journal of advanced Transportation, 46*(1), 26-38.

National Center for Transit Research (2014). *Cost-Benefit analysis of rural and small urban transit*. Retrieved from http://www.nctr.usf.edu/wp-content/uploads/2014/07/77060-NCTR-NDSU03.pdf.

Noel Levitz. (2013). *2013 cost of recruiting an undergraduate student report*. Retrieved October 30, 2014 from: https://www.noellevitz.com/papers-research-higher-education/2013/2013-cost-of-recruiting-an-undergraduate-student-report.

Office of Policy and Performance Management, Federal Transit Administration. (2006). *Guaranteed ride home programs: A study of program characteristics, utilization and cost*. Retrieved from: http://www.fta.dot.gov/documents/Guaranteed_Ride_Home_Program_final_study_web.pdf.

Pikora, T., Giles-Cortia, B., Bulla, F., Jamrozika, K., & Donovan, R. (2003). Developing a framework for assessment of the environmental determinants of walking and cycling. *Social Science & Medicine*, *56*, 1693–1703.

Pucher, J., Dill, J., & Handy, S. (2010). Infrastructure, programs, and policies to increase bicycling: An international review. *Preventive Medicine*, *50*, S106–S125.

Rubin, H. J., & Rubin, I. S. 2011. *Qualitative interviewing: The art of hearing data*. Thousand Oaks, CA: Sage.

Schmitt, A. (2013a, April 16). *Transport U: Colleges save millions by embracing policies to reduce driving*. Streetsblog USA. Retrieved from: http://usa.streetsblog.org/2013/04/16/transport-u-colleges-embrace-policies-to-reduce-driving/.

Schmitt, A. (2013b, April 17). *Transport U: Stanford turns green commuting into greenbacks*. Streetsblog USA. Retrieved from: http://usa.streetsblog.org/2013/04/17/transport-u-stanford-turns-green-commuting-into-greenbacks/.

Shapiro, R. J., Hassett, K. A., & Arnold, F. S. (2002). *Conserving energy and preserving the environment: The role of public transit*. American Public Transportation Association. Retrieved from http://www.gobrt.org/aptaenergyreport.pdf.

Shoup, D. (2008). The politics and economics of parking on campus. In S. Ison & T. Rye (Eds.), *The implementation and effectiveness of transport demand measures: An international perspective* (pp. 121-149). Aldershot, UK: Ashgate Publishing.

Siegel, J. B. (2000, December). *An evaluation of the carpool program at the University of Florida*. Masters Thesis, University of Florida.

Smart Growth America. (2013). *Building better budgets: A national examination of the fiscal benefits of smart growth development*. Smart Growth America. Retrieved from http://www.smartgrowthamerica.org/documents/building-better-budgets.pdf.

Sobush, H. (n.d). *Designing a preferential carpool parking program to effectively reduce parking demand and traffic congestion on University campuses*. Center for Urban Transportation Research, University of South Florida. Retrieved from http://www.nctr.usf.edu/clearinghouse/html/pref%20parking%20at%20universities.htm.

Stanford University Parking & Transportation Services. (2013, August 17). *Transportation demand management at Stanford University: A brief overview*. Retrieved from: http://www.slideshare.net/slideshow/embed_code/25827750.

Taylor, M. A. P. (2007). Voluntary travel behavior change programs in Australia: The carrot rather than the stick in travel demand management. *International Journal of Sustainable Transportation*, *1*(3), 173-192.

Taylor, B., Iseki, H., Miller, M., & Smart, M. (2009). *Thinking outside the bus: Understanding user perceptions of waiting and transferring in order to increase transit use*. Institute of Transportation Studies. Retrieved from http://www.its.berkeley.edu/publications/UCB/2009/PRR/UCB-ITS-PRR-2009-8.pdf.

Toor, W., & Havlick, S. (2004). *Transportation and sustainable campus communities: Issues, examples, solutions*. Island Press.

Trans Link. (2010). *Transit-oriented communities: A literature review on the relationship between the built environment and transit ridership.* Trans Link. Retrieved from http://www.translink.ca/~/media/documents/plans_and_projects/transit_oriented_communities/transit_oriented_communities_literature_review.ashx.

UNO Student Government. (2010). *Student government transportation survey*.

U.S. Census Bureau (2011). *OnTheMap application and LEHD origin-destination employment statistics*.

Van Heeke, T., Sullivan, E., & Baxandall, P. (2014, February). *A new course: How innovative university programs are reducing driving on campus and creating new models for transportation*. U.S. PIRG & Frontier Group. Retrieved from: http://www.uspirg.org/reports/usp/new-course.

Verdis. (2013). *Parking problems? Transit programs as a cost-effective solution*. Retrieved from: http://verdisgroup.com/wp-content/uploads/2014/02/Metro-Transit-Parking-Study-2014-09-02-compressed.pdf.

Verdis. (2014). *UNO sustainability master plan report*.

Walker Parking Consultants. (2011). *Parking management plan Omaha Downtown Improvement District*. Omaha, Nebraska. Retrieved from: http://www.mapacog.org/images/stories/SSH_Publications/Final_Parking_Management_Plan_MAPA010712_Final.pdf.

Weinberger, R. et. al. (2008, October). *Guaranteed parking – Guaranteed driving*. Retrieved from: http://transalt.org/files/news/reports/guaranteed_parking.pdf.

Weisbrod, G., & Reno, A. (2009). *Economic impact of public transportation investment*. American Public Transportation Association. Retrieved from http://www.apta.com/resources/reportsandpublications/Documents/economic_impact_of_public_transportation_investment.pdf

Williams, M. E., & Petrait, K. L. (1993). U-pass: A model transportation management program that works. *Transportation Research Record* (1404).

Winters, P. L. (2000). Transportation demand management. *Transportation in the New Millennium*. Retrieved from: http://onlinepubs.trb.org/onlinepubs/millennium/00123.pdf.

Zali, N., Abizadeh, S., & Bagherinia, A. (2013). New urbanism and urban design: Tools for changing behavioral patterns of the citizens. *International Journal of Natural & Engineering Sciences*, 7(1), 31-36.

Zhou, J. (2013). Study of employee carsharing on the university campus. *Journal of Urban Planning and Development*, *139*(4), 301-310.

Appendix A: University TDM Strategies Examples

Transit

University of Colorado at Boulder offers a mostly free eco-pass for students for the bus and light rail service. An incentive to purchasing the eco-pass is the Guaranteed Ride Home Program. In the case of emergency or a work schedule change, eco-pass holders can receive a free taxi ride. To ease the burden of offering the service, the University sells interior and exterior advertising on the buses. The advertising spots can be purchased at monthly, semester, or yearly rates. Monthly rates range from $45-$150, semester rates range from $90-$300, and yearly rates range from $225-$750. Rates depend on the type of bus where the advertisement will be placed and if the advertiser is University-affiliated.[26]

The Portland State University campus is served by the Portland Streetcar, MAX Light Rail, and 15 different bus lines. PSU sells the student Flex Pass at a discounted rate and it is valid on all TriMet buses, MAX Light Rail, and Portland Streetcar. Also, if there is a day where a student carrying a Flex Pass needs to drive to campus, the student will receive a $2 discount off parking for that day.[27]

Cleveland State University allows faculty and staff to purchase RTA monthly bus passes via payroll deductions using pre-tax dollars in order to incentivize the use of public transportation.[28]

University of Northern Illinois' Huskie Bus Line is a free service offered to all NIU students. It serves the main campus, local apartments, shopping centers, and food establishments. Also, University of Northern Illinois offers a late night ride service that will pick up a student with no questions asked from 3pm to 6am. There is also a "Walk Safe" service to those who do not wish to walk alone between 6pm and 2am.[29]

Walking

University of Wisconsin-Madison has internal passageways for walkers. The campus posts walking distances between key points on campus. An online web site is also available to track the exact distance of commutes, calories burned, and even elevation. To keep pedestrians safe, the campus has a Lightway Walking Path and also has walking escorts available.[30]

[26] Retrieved from: http://www.colorado.edu/parking/commuting/bus/ecopass.html
[27] Retrieved from http://www.pdx.edu/hr/transportation-parking
[28] Retrieved from http://www.csuohio.edu/services/parking/weeklyupdate/weeklyupdate.pdf
[29] Retrieved from http://www.niu.edu/comnontrad/transportation/index.shtml
[30] Retrieved from http://transportation.wisc.edu/transportation/walk.aspx

Biking

University of Colorado at Boulder offers a biking program and encourages biking to reduce the negative impact on the environment from other means of transportation, as an excellent form of exercise, and to save money that would otherwise be spent on gas and parking. The university has a bike station that is paid for by bicycle registration fees. The bike station staff helps with bicycle repairs and maintenance. Faculty, staff, and students can rent cruiser bikes for 48 hours free of charge. Furthermore, semester bike rentals are available for $30.[31] Portland State University operates an on-campus bike shop called the PSU Bike Hub, where students and staff can repair their own bikes with guided instruction, purchase commuting accessories and repair parts, drop off a bike for professional repair, and take classes in bike commuting and bike repair techniques. Standard bike racks are located outside every building on campus. PSU Transportation and Parking Services operates two bicycle garages, where bikes can be parked inside a secure, covered space that includes electronic card access control and security cameras.[32]

University of Arkansas has a loaner bike program that makes bicycles available to students, alumni, faculty and staff free of charge. Once signed up for the program, a person will be given a pass-code which will unlock any Razorbike on campus for their use. Each bike will be used as transportation on or around campus for short trips and then made available for the next user (Razorbikes Loaner Bike Program, 2011).[33]

Carpooling

University of Colorado at Boulder contracted with Zimride to offer carpool matching for students, faculty and staff. Students, faculty and staff can use their facebook profile or create a Zimride profile to see who is going to campus via the same routes/location.[34]

University of Northern Illinois offers a free carpool service to students, faculty, and staff. It is estimated that commuting costs $330/month for a 50-mile, 3 day/week commute (based on 55 cents/mile). Carpooling helps cut costs and ease parking congestion on campus. NIU's carpool service matches students, faculty, and staff up with other commuters in their area.[35]

Carpooling Program at UC-Davis provides:

- Discounted parking permits (up to 60 percent off regular permit rates for carpoolers);
- Reserved parking spaces for regular carpools;
- Limited free parking permits for days when sharing a ride is not possible;
- Complimentary ride-matching service;
- Pre-tax payroll deduction for the cost of carpool parking permits for staff and faculty,

[31] Retrieved from http://ecenter.colorado.edu/transportation/bike
[32] Retrieved from http://www.pdx.edu/hr/transportation-parking
[33] Retrieved from http://parking.uark.edu/320.php
[34] Retrieved from http://ecenter.colorado.edu/transportation/carpool
[35] Retrieved from http://www.niu.edu/RideShare/

- Emergency ride home service (if a student or employee needs to leave campus suddenly before their scheduled carpool, the university will pay for a taxi);
- One complimentary rental car voucher per quarter;
- Automatic entry into prize drawings for restaurant gift cards, and other discounts and rewards provided by local sponsors.

Appendix B: Interview Questions

Peer Institution Contacts

1. Do you know your campus mode split? If so, what is it?
    a. What percent of faculty, staff and students (and visitors) use: Public Transit, Biking, Walking, Carpool or Car Share, or drive Single-Occupancy Vehicles?
2. What, if any, strategies have you implemented in the past 10 years to reduce demand for Single-Occupancy Vehicles parking on campus (that is, implement transportation demand management)?
    a. Have you used different strategies for faculty, staff and students? If so, how do they differ?
    b. Would you be willing to share your TDM plan with us if one exists?
3. If no strategies have been implemented, why haven't you implemented TDM strategies? What, if any challenges have you faced?
4. If strategies have been implemented, what were the primary reasons or goals for adopting these strategies?
5. Have you seen a measurable impact on the reasons/goals you just stated?
    a. That is, have you been able to adequately address the reasons you've articulated for adopting TDM strategies? Why or why not?
    b. Have you been able to achieve your intended goals?
6. Who was involved in making these strategies a success?
    a. Administration, student or staff champion?
7. Do you measure the effectiveness of TDM strategies in any way? If so how?
    a. Which metric is the most effective? Why?
    b. Do you have a cost-benefit analysis you can share with us? Has there been any update to the analysis following adoption of TDM strategies?
8. Have you seen a mode shift since implementing strategies? What has been the impact on mode use?
9. How is your TDM program funded and managed or structured within the university?
10. What are/were the biggest impediments or barriers to TDM implementation?
11. What advice would you give to a university considering TDM implementation?
    a. With your experience of your existing TDM programs, what would you do differently if you're recommending anything to us?

UNO Transportation Contacts

1. UNO conducted a Parking Study about three years ago. Which of the strategies related to reducing demand for Single-Occupancy Vehicle parking included in the report have been implemented?
2. Have you been able to see any impact from implementation yet? What systems if any do you have in place to measure impact of these strategies?
3. If none have been implemented, why not? What are the impediments to implementation?
4. What other strategies have you or might you consider implementing in addition to those included in the Parking Study?
5. What do you see as the biggest challenges to encouraging great use of Public Transit, Biking, Walking, Carpool or Car Share among faculty, staff and students?
6. What would it take to get UNO to a place where parking is no longer an issue, where most either live on campus or arrive in a sustainable way or virtual meetings and classes eliminate the need for some trips?