SUTP Technical Document:
Mobilizing minds –
Mobility Management at Universities

Executive Summary

Universities possess the means to eradicate our daily traffic and transport problems once and for all. This could be done by providing sustainable mobility options to their employees and students. By adopting mobility management measures they change the ways their employees and students use transport means. In doing so they contribute to establishing sustainable transport modes for a large number of users and change mindsets of young leaders in the long term. Universities also benefit financially from this and improve community relations by doing so. Mobility management (MM) is a demand-orientated approach to passenger and freight transport that involves partnerships between the traffic generator and local authorities, transport operators and mobility providers. MM includes soft, cost-efficient measures such as information, communication, organization, coordination as well as incentives for voluntary, individual mobility behavior changes towards more sustainable modes of transportation. Key MM aspects for universities include:

1. Walk around your campus and identify mobility needs

2. Define a vision how mobility should be – find inspiration

3. Define which tools you need to realize your vision

4. Acknowledge the role that MM can play

5. Recognize that universities are major traffic generators and must act

6. Communication and awareness-raising

Specifically:

1. Learn from Best-Practice around the world (e.g. by reading this technical document), and use the power of networks and partnerships with other universities

2. Develop a plan: measures to promote sustainable transport can be implemented successfully only in the framework of a long-term, overarching concept. Including:

a. Status analysis – you need to know your target group

b. Planning, identification and preparation of priority measures including:

- Parking management (no successful MM without parking management)

- Improvement of walking environment

- Promotion of cycling – parking facilities, bike sharing scheme

- Carpooling, carsharing and e-mobility (increase vehicle efficiency)

- Marketing & information concept – promote what is available

- Monitoring and evaluation concept – to justify the necessary expenses

- Integration of public transport (PT) (tickets, routes etc.)

3. Address capacity: an institutionalized MM plan is required to successfully meet the many challenges in the mobility sector. This includes appropriate staffing and the establishment of cooperation between stakeholders.

4. Planning and implementation of MM requires funding: identify financial and human resources, needs and potential **savings**.

If you have the luxury to plan a new campus: please note that MM needs to be considered already at the planning and construction phase of a campus. The way you plan and build the campus will influence traffic demand over long periods of time. New campuses need to be adequately served by PT, offer facilities for walking and cycling, and provide mixed landuse.

And remember: **use the power of the students for ideas, implementation and financial sources!**

List of Abbreviations

ASI	Avoid-Shift-Improve
DADINA	Darmstadt transport authority
DOTS	Department of Transportation Services at University of Maryland
EV	Electric Vehicle
GNP	Gross National Product
GRH	Guaranteed Ride Home Program
IMT	Individual Motorized Transport
MM	Mobility Management
NMT	Non-Motorized Transport
ODU	Old Dominion University
PT	Public Transport
RUB	Ruhr-Universität Bochum
SRT	Shared-Ride Taxi
TDM	Transportation Demand Management
UMD	University of Maryland
UMN	University of Minnesota
USD	US Dollar

SUTP.

Sustainable Urban Transport Project

SUTP supports decision-makers worldwide to plan and to implement innovative and sustainable mobility solutions. SUTP offers a comprehensive knowledge platform, capacity development, hands-on advice and networking opportunities. Within the past 16 years, more than 5 000 decisionmakers, planners and students have benefited from our training offers. We've produced a rich library of Sourcebook Modules, Technical Documents, Case Studies, Factsheets, Policy Briefs and Reading Lists.

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1 Introduction

Mobility behavior nowadays in both industrialized countries and developing countries is rather unsustainable. Rapid motorization leads to increased emissions of harmful greenhouse gases (GHG) and other hazardous emissions. Especially in cities, the growing number of private vehicles burdens the infrastructure and consequently transport systems become saturated. A paradigm shift in transport policy is necessary to achieve sustainable mobility. One approach to achieve this is with the use of mobility management (MM), which aims to improve the modal share of sustainable modes in passenger traffic with the help of soft measures.

MM of companies and major institutions, such as universities, follows the idea of causative principle where organizations, causing large amounts of traffic are responsible to reduce the various impacts and enable their employees to move more sustainable.

The number of students and universities is growing worldwide and many higher educational institutions are building additional facilities or even completely new locations to accommodate extra research facilities, staff and students. Universities are already facing a variety of traffic problems: i.e. poor public transport (PT) access in suburban locations, congestion on access roads, overcrowded parking spaces and packed buses at peak times. Thousands of students and employees commute daily by motorized vehicles to the university, causing noise, pollution, and intensification of climate change. However, as this document will show, universities can influence transport mode choices significantly.

Over 19 million students (6 % of the total population) are enrolled in colleges or universities in the USA. The transport sector was responsible for 23 % of global CO_2 emission (IEA 2015).

2 Universities, Students and Transport Related Challenges

Universities are more than solely academic places; universities are major employers, investors, purchasers and consumers of goods and services. They have a significant economic impact on both regional and national scale. In addition, universities are breeding grounds for moral ideas etc. and therefore ideal places to explore new tools to reduce car dependence. Universities share many similarities with small cities, characterized by their large size, own communities and own special population with typical daily activities, and sometimes even own infrastructure facilities. Many university-related activities have direct and indirect impacts on the nearby transportation systems and environment.

Campuses can be regarded as special kinds of neighborhoods, consisting of a set of different buildings for research, education, administration, sports, housing, student centers, libraries, child care, and parking. Sometimes campuses even have hospitals, restaurants, stores or cultural space in close proximity and in between streets, squares, and public spaces. Therefore, they influence the quality of life and transportation systems of their surroundings. Universities attract people with different backgrounds, incomes, lifestyles and attitudes, who study, work, and live together in one place for a certain amount of time.

University Population – Students, Staff and Faculty

A university population is made up of students and employees (sometimes further differentiated into staff and faculty). BARLA ET AL. (2012: 1) state that "a university population is relatively homogenous, well educated, easy to contact and, may be, more open to changes." According to the UNESCO Institute for Statistics, global tertiary enrolments reached 170 million in 2009 (as cited in BRITISH COUNCIL 2012). Out of all global enrolments China, India, United States and Russia have a combined share of 45 per cent. Other emerging economies with significant numbers of tertiary enrolments include Brazil, Indonesia, Iran, and Turkey (BRITISH COUNCIL 2012). Forecasts predict global enrolments to increase by 21 million between 2011 and 2020 (BRITISH COUNCIL 2012). Other estimations predict a rise of global enrollment in higher education up to 260 million by 2025. Almost all of the enrolments growth will happen in emerging economies and developing countries. Therefore, the transport issue of

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universities is highly interesting as universities worldwide are significantly expanding.

Not only Universities themselves have great potential to influence traffic behavior. Students have some control over their course schedule and in this way can avoid traffic peak hours. In addition, irregular schedules lead to a constant movement of people during the day at a university campus. Most university students are unmarried and have no children, and thus have less social responsibilities, which influences their housing and transportation choices. The usually lower income and younger age of students leads to a higher share of active modes of travel for commuting. However, students still "represent a cross section of the population" (MIRALLES-GUASCH & DOMENE 2010: 454) as they originate from different socio-economic backgrounds and places, and have different ages and political views. Mobility behavior of students during their time at university has the potential for positive effects even after students have graduated. Alumni will probably have powerful positions in companies, organizations or governmental institutions and have the chance to address society awareness and behavior.

"Universities are beginning to understand that, like it or not, they are in the transportation business"

(DAGGETT & GUTKOWSKI 2003: 42).

Nevertheless, several aspects limit the reach of MM measures at universities. Those factors might be housing costs, income, social responsibilities, the availability of PT, pedestrian and cycling infrastructure or the need for a company vehicle. Universities need to be aware of the external impacts of the Individual Mobilized Transport (IMT) of their students and employees. Surrounding communities want to maintain good relations with the educational institutions, but at the same time are seeking to reduce congestion on city streets, to avoid increase in rents, and to decrease or prevent the parking of the university population in residential neighborhoods.

3   Mobility Management – Manage the Demand

Different approaches and initiatives to reduce private car use and increase the share of alternatives have been developed in recent years. One of these approaches is MM. Generally, MM refers to passenger transport. MM is a demand-driven approach that aims to promote efficient, environmental friendly and social mobility among a specific target group. MM is performed by local actors, who motivate commuters to change their travel behavior. Actions undertaken include informational, communicative, organizational, and structural and operational measures. Alternatives to the car are made specifically attractive and incentives to use a private car might be decreased. MM measures are in particular soft measures, and to a certain extent hard (infrastructure) measures, that can be linked together to ensure or improve employee mobility. The main features of MM are:

- influence mode choice towards environmental friendly transport modes and decrease IMT,

- multimodal and intermodal approach,

- formation of new partnerships and alliances,

- orientation towards special target groups and target trips,

- consideration of subjective components,

- measures are voluntary in the form of service offerings and information.

MM operates at micro level and is aimed at specific target groups with common mobility behavior, rather than at individuals. Main target groups of MM are traffic generators and transport users. MM usually requires intensive cooperation between different actors, public administration, transport companies and providers of mobility services, and associations.

3.1   Types of Mobility Management Measures

MM consists of a collection of different instruments, services and strategies. Most measures are not a novelty, but the synergy of the several services provides new possibilities to influence transport demand. Figure 1 gives an overview of the different areas of activity of MM, and of selected measures.

A mobility plan, which should be a clear, systematic and mainly action-oriented idea of how to introduce corporate mobility concepts, needs to be designed before introducing MM at a company or university. The plan should discuss the status quo, planning including the objectives, schedules, responsibilities, measures, implementation, monitoring, and evaluation. Some major mobility management measures are discussed below.

3.1.1   Parking Management

The large amount of traffic generation by universities results, among other things, in high parking demand. Providing sufficient parking space is therefore one of the biggest transportation problems of universities. Nowadays, the perception of parking to be free is widely spread (especially in the USA): many commuters perceive free and available parking as their right, not as a privilege, and many commuters use their private car because of subsidized or no-cost parking.
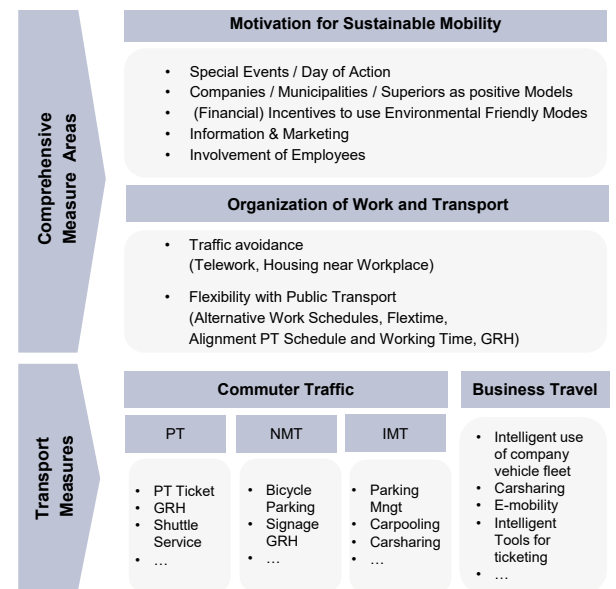

Fig. 1: Areas of activity and selected measures of mobility management (Supplemented after ISB & IVV 2004, GIZ 2004, GOMEZ VILCHEZ 2011)

Availability of Parking

The availability of parking is a central parking management tool as well as an important general mobility management measure. As SHOUP (2005: 123) puts it: "Parking spaces do not create vehicle travel, but they enable it." People's decision to commute by car is directly influenced by parking availability (number and location of parking spaces) and parking costs. The traditional approach to parking space planning has simply been a projection of the parking demand at peak hours. Inadequate parking availability can increase travel time and costs by private vehicle and therefore trigger the use of other modes. Minimized parking space saves costs for investment, management, care and maintenance. Good signage can avoid unnecessary traffic. Modern technology allows live updates on available parking spaces in different garages and direct drivers to alternatives (see figure 4). Examples of good parking management are special parking permits and prices, and/or locations for carpoolers.

Fig. 2: Parking signage at Heidelberg University (KORFFMANN 2016)

Fig. 3: Reserved parking for dean of the medical faculty at Bochum University (KORFFMANN 2016)

Fig. 4 : Parking signage in Heidelberg at the university campus (KORFFMANN 2016)

According to WILLSON (1992: 144) "between 25 and 34 percent fewer cars would be driven to work if commuters had to pay to park."

Charging for Parking

According to TOOR and HAVLICK (2004: 7), "parking pricing is one of the most significant determinants of travel behavior". Although "charging for parking for employees is generally more politically acceptable. In the case of an educational institution students are unlikely to choose their school based upon parking availability" (TOOR & HAVLICK 2004: 84).Universities are indirectly subsidizing car use as often the total parking costs exceed the revenues from parking charges, while sustainable transport modes are not subsidized at all.

Construction and maintenance costs

The cost for building parking space varies because land costs differ, depending on whether the university or company is located in a rural, suburban or urban area. In addition, other factors such as the parking structure (above or below ground, surface parking) determine the construction costs. Estimations range from 1,500 to 30,000 USD per new parking space (SHOUP 1995, COOK 1999, BGW 2007). In addition to construction costs, there are additional operation and maintenance

What can cities gain from proper parking management? Find out in this video from transport policy advisor Paul Barter. It is available on the SUTP YouTube-Channel.

Video: *https://youtu.be/c95mAzIW_JM*

costs, and potential expenses for debt services. The costs of obtaining land often do not play a role as most universities own the land already. Creating new parking spaces (see fig. 5) might result in some revenue through parking permits. However, most of the time, this is not even enough to pay for the loan needed. Even more so, using the land to build new research facilities instead of additional parking, increases the possibilities of obtaining new grants, attract additional students or improve the educational quality.

Fig. 5 : Construction of parking structure in Heidelberg next to Berliner Straße (KORFFMANN 2016)

For the maintenance (cleaning, lighting, winter service, insurance, garden service, energy and staff) of one **parking spot about 50 to 150 EUR** can be expected per month and space (BGW 2007). For underground parking spaces, the cost is **annually 4-12%** of total investments (DENA n.d.).

Stanford University was the first university in the USA who used a cash-out program in the mid-1990s. Nowadays, employees who decide not to buy a parking permit, receive 300 USD per year. (SIEGMAN 1994, STANFORD UNIVERSITY PARKING AND TRANSPORTATION SERVICES 2016).

Parking in University Neighborhoods

The introduction of parking management by universities might result in a displacement of parking to off-campus areas and thus overflow parking in surrounding neighborhoods, which can put stress on the town-university-relationship. To prevent this situation, it is common to install parking meters on streets directly adjacent to universities. This measure is often combined with the implementation of Residential Parking Permit zones in nearby residential neighborhoods. Residents need to purchase a full-time parking permit for a small fee, while non-resident parking is restricted to a limited time and priced with market rates. A good cooperation and communication between the surrounding municipality and the university is of great importance to implement successful parking management with few conflicts.

Flexible Parking Permits

Flexible parking permits offer a number of single day permits for a fixed price to users. If parking costs are paid annually or per semester, car use is (indirectly) promoted, similar to subsidized PT passes. The University of Michigan for example sells parking permits in the form of a scratch card.

Cash-Out Parking

Raising parking prices is not always easy due to resistance in politics, administration or in unions. A way to avoid these discussions is the possibility to pay employees not to drive by private car. In a cash-out parking program employees need to decide if they want a parking permit or gain an equivalent payment instead. "The cost difference between having a parking permit and not having one is

then the sum of the cost of purchasing a parking permit and the cash payment offered to those who do not purchase a permit" (TOOR & Havlick 2004: 8). A cash-out program is reducing single occupant driving and increasing carpooling and PT use. According to TOOR and HAVLICK (2004), parking cash-out schemes work best for universities which offer free parking, or are in the phase of restructuring parking leasing projects.

Freshman Parking Bans

Another parking management instrument could be the reduction or even the ban of parking permits for first year students (freshmen). Freshmen often live on campus or in a near dormitory and are thus less car dependent to reach the university. The mobility habit developed in the first year functions as the basis for the student's mobility behavior during his entire time at university and is thus especially crucial to stimulate. Different methods exist to encourage first year students not to bring a car to university: the easiest way is to simply not create parking permits for freshmen. Other possibilities include a lottery system to gain a permit or a high increase of parking prices for first year students. One should note, that a freshmen parking ban could provoke a debate about equal treatment. Offering good alternatives and having affordable student housing can help to address this concern. In addition, POINSATTE and TOOR (1999) point out that a parking ban is generally not considered to be an obstacle for student enrollment.

BOX 1: Parking Management

Further information on Parking Management can be found in the *SUTP Technical Document #14*. This document provides an overview of the different approaches to on-street parking management and provides advice to policy makers dealing with problems arising from unmanaged on-street parking. For more information on the various operational, planning, institutional and social challenges around parking practices in cities, and how these could be overcome, consult the *SUTP Module 2c*.

Subsidized PT Ticket: 10-30 % reduction of automobile trips and increase of student **ridership of 70-200%** during the first year and in following years from 2-10% annually (BROWN ET AL. 2001).

3.1.2 Subsidized Public Transport Pass

Universal fare programs are partnerships between universities and public transit organizations where universities buy public transit passes. A special fare program is one of the most known and most successful MM measures. Subsidizing public transport use is highly effective to reduce single occupant vehicle driving. The subsidized PT programs often feature free or discounted access to PT within a certain area for students, staff and faculty and sometimes also to residents of the community. The passes have different names like UPass, ClassPass, Eco Pass, Ed Pass, free transit passes, SuperTicket, but are mostly known under the term of Unlimited Access. Unlimited Access is not to be confused with campus shuttle services that move people from dorms to classrooms or different places on campus. According to BROWN ET AL. (2001), three types of Unlimited Access programs can be differentiated: opt-in (nobody enrolled, participants decide themselves), opt-out (everyone enrolled, participants decide to exit), and mandatory (everyone must participate). Depending on the circumstances, one of the three price structures is the most suitable option. The university pre-pays a certain amount of money for a certain period of time to a transit agency based on estimated ridership numbers. This so called "shadow fare" (BROWN ET AL. 2001: 234) is paid by the university for the riders. Since many fares are being purchased at once, the fares are substantially discounted. Unlimited Access programs can be funded from a variety of sources. The most common is a combination of student fees, university funds, parking revenues and government grants or aid. Especially parking revenues seem to be an interesting funding resource as it is not only a significant financial resource but acts as a disincentive to IMT. The university card is used as transit pass, providing (unlimited) free access to PT for students. Some transit organizations use electronic fare payment technology and charge universities on a per-ride basis and no longer on estimated package basis.

A subsidized PT pass provides benefits not only for the university but also for the surrounding city. Typical benefits for towns include for instance a stimulus of economic development, reduction of traffic congestion, a decrease of single-occupant vehicle trips, improvement of air quality, reduction of operating costs per rider, improvements of overall transit services, and reduction of off-campus parking demand. Tackling the issues of traffic management will strengthen the relationship between communities and universities. Among others, benefits for the university are a reduction of demand, a promotion of a greener campus, better transportation equity, reduction of transportation costs for students,

and support to recruit and retain students. Subsidized PT also increases the options for residence locations of students and staff.

The transit agency can benefit trough an increase in total ridership as well as an increased number of riders per vehicle, a decrease in cost per ride, a high steady source of revenue as well as a better image. In a survey of 35 American universities offering Unlimited Access programs, BROWN ET AL. (2001) discovered that automobile trips were reduced by 10 to 30 per cent and student ridership increased by 70 to 200 per cent during the first year and in following years by 2 to 10 per cent annually.

3.1.3   Walking

Walking is often neglected as a mode of transport. In the planning of access paths to a university campus, the needs of pedestrians in many cases receive little consideration. Walking is a fast, free, and direct mode of transport with many health benefits. There are certain infrastructural needs so that walking can be a suitable option. Sidewalks or pedestrian areas should offer a direct way to destinations (no big detours) and ensure the security and safety of pedestrians. Good signage and maintenance at all times are crucial. Lighting and if possible pedestrian priority on street crossings are additional instruments. Special attention is needed for pedestrian with disabilities. At university campuses, for students walking is one of the most frequently used modes to get to class. This applies especially for those who live within walking distance. But, also students who arrive by PT usually need to walk afterwards. Walking is

> **How to make a city more walkable? Find out in this video from Walk21-founder Jim Walker. It is available on the *SUTP YouTube-Channel*.**
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> Video: *https://youtu.be/AHZYxI3lAmM*

> **BOX 2: Transit Alliances**
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> Further information on PT can be found in the *SUTP iNUA implementation guide #5*, which focuses on transit alliances as an umbrella for public transport. The paper outlines the multiple benefits of integrating all public transport services and modes in a city, metropolitan area or wider region into one system. For details on the development of the German public transport alliance system, consult the S*UTP Technical Document #4*. Policy-makers in developing cities find more information in the *SUTP Module 3f* – Public Transport Integration & Transit Alliances.

strongly affected by safety concerns, thus an availability of separate infrastructure for pedestrians should be a top priority for universities. Safety improvements for pedestrians in addition to good infrastructure are campus patrols, night escort services or emergency call boxes *(see figure 6).*

Fig. 6 : Emergency call box at University of Maryland campus (KORFFMANN 2016)

3.1.4 Cycling

The bicycle is an attractive alternative to the car in cities, as it can offer agility, flexibility, medium speed and a rather big action radius. Cycling is an affordable transport mode for everyone without the requirement of having a driver's license. Bikes produce no pollution, occupy only little road space while driving and parking, and are accessible and affordable to many people. In addition to the environment friendliness, cycling also provides many health benefits. The number of people using a bicycle depends on a variety of factors. Typical infrastructural measures include good bike paths and lanes, signage, secure parking facilities for bikes, special street design aimed to improve the safety of cyclists (separation from cars, lighting, intersection design), and provision of bike sharing schemes (see figure 7). Other factors influencing bike use are weather conditions and topography, which can be partly dealt with by promoting e-bikes, or providing showers and change facilities at work to people.

Cyclists have 50 % fewer sickness absences compared to non-cycling commuters (UBA 2010).

Cycling and walking on average are the two most used modes of transport on campuses. Because students usually are more active, have restricted budgets, live close to their educational institution, and most of the time already own a bike, they have much higher cycling rates than the general population. Staff and faculty frequently share some of these characteristics and in addition are an influential part of the community. Their proactive involvement in MM processes and measures can help to have a strong impact on policymakers to invest in better cycling policy and infrastructure.

There are many different ways to promote and encourage students, staff and faculty to commute to work by bike. Cycling action partly overlaps with municipal bicycle planning and therefore requires special communication and coordination. Both, the community and the university need to ensure that commuters have access to safe, easy and direct bicycle connections between their place of residence and the campus. Measures for companies and universities to encourage cyclists are particularly inexpensive and usually unproblematic to develop. The measures can be divided in physical measures, administrative, promotional and economic measures. To increase cycling rates both objective factors (such as the visibility of routes, direct guidance (if possible), safe design, fulfillment of social security needs, adequate cross-sectional width, quality of the path for comfortable ride, prevention of misuse of infrastructure, avoidance of danger to other road users and year-round usability, etc.) and subjective factors (presence of cycling culture, perceptions of people) need to be considered. Protected and safe bicycle parking is another MM incentive to promote cycling commute. The availability of frames for safe locking of bikes should be mandatory. Also, the construction of new parking facilities should provide covered facilities to protect the bikes from bad weather conditions. With respect to bicycle parking, a conversion

Fig. 7 : VRNextbike – Bike sharing station next to the main library and lecture halls in Heidelberg (KORFFMANN 2016)

of parts of the existing car parking garage for bicycles would be conceivable (see figure 8). Another advantage of bicycle parking in garages is, besides avoiding theft and weather protection, the possibility of installing charging infrastructure for pedelecs. Provision of bicycle parking should not only be plentiful but especially close to possible destinations and - in the case of a university – close to dormitories.

Typical administrative measures are the creation of a group of people who continually overview the development of infrastructure and cyclists' needs. The provision of bike safety programs or repair classes, or a bicycle service center can boost the use of bikes as well. Small measures to support bike use quickly show results. Promotional measures can include typical marketing, location-based itineraries for staff, as well as contests or lotteries. Economic measures include a certain financial incentive not to drive or the offering of an interest-free loan to buy a bike as well as company bicycles or company bike leasing schemes.

BOX 4: Sustainable Mobility - Cycling

For further information on Cycling as a solution to mobility challenges and poor environment and health conditions consult the *SUTP iNUA implementation guide #2*. The paper offers concrete and appropriate means to support cycling for policy-makers, planners and interested citizens. Furthermore, the *SUTP Module 1e* identifies key elements of an Awareness and Behaviour Change (ABC) strategy and provides decision-makers, technical staff, consultants and experts as well as individuals with essential tools to implement their sustainable policies by helping them in promoting eco-friendly mobility and getting people on board.

Fig. 8 : Secure, weather protected bike parking in a parking garage at UMD (KORFFMANN 2016)

3.1.5   Shared-Ride Transportation

Shared-ride transportation modes involve several schemes where the sharing of a vehicle is arranged. Users share a vehicle either simultaneously (e.g., ridesharing) or over time (e.g., carsharing). Shared transport systems include transport modes such as carsharing, bike sharing, ridesharing such as carpools and demand responsive transit, which in turn encompasses a range of modes such as paratransit, Dial-A-Ride Transit, and shared-ride taxis.

Ridesharing

Ridesharing programs are considered highly cost-effective alternative transport modes, particularly in areas that do not have easy access to PT. Ridesharing has the goal to put "more people in the same car […] [for] a more efficient use of existing infrastructure" (POINSATTE & TOOR 1999: 37). Ridesharing involves the use of a vehicle by two or more people for the purpose of getting to or from work, school, or other locations. The points of origin and final destination of riders (may) vary. The goal is to share some segment or the entire trip with other people. Ridesharing programs are popular ways to reduce energy demand, congestion, and air pollution. Ridesharing applications range from private cars (carpools) and privately-owned and -operated vans to publicly-owned and -operated vans (vanpools) and buses (buspools).

Carpools

Carpools can be described as the use of a private vehicle by two or more passengers, who share expenses and/or may rotate vehicles. The main benefit is a reduction in transportation costs, especially for parking. Carpool arrangements develop from informal agreements among co-workers or through more organized efforts. Employers can take on a variety of measures to support ridesharing. Promotional efforts can be a simple provision of advertisement and communication ways for staff to find other carpoolers. Provision of ridesharing incentives by the employer, such as special parking or flexible work schedules, is possible as well.

Vanpools

Vanpools consist of up to 15 people who commute together in larger vehicles. Vanpool programs are more strictly arranged and thus less flexible than carpools. In a typical program, the university or transit provider owns and maintains the vehicles and charges a fee to the users. Usually, one person, the driver, is responsible for picking up passengers at a designated time and place. In exchange for this responsibility, van drivers are allowed to use the van privately or receive compensation.

Buspools

The biggest, but also the most rarely used version of ridesharing programs is buspools. They consist of 16 or more passengers, who share a ride between fixed origin and destination points. Customers need to book or reserve a seat. This type is mainly organized by a company administration, as the amount of work in order to drive is higher than with car- and vanpools.

The organization of ridesharing is important to increase the occupancy rate, especially during rush hours and is one of the measures with a relatively high user acceptance. Ridesharing exchanges may be organized by the municipality, a university, company or externally. Frequently, existing networks are used and if possible own company's sub-pages are established. Providing a communication platform, which considers social aspects, motivations and incentives for the employees, supports ridesharing programs. A high user number can increase the probability for successful carpool matches. SCHÄFER-BREEDE (2000: 271) states that the critical mass is for a 20 per cent probability of matching at 6,000 employees respectively 600 carpool prospects. This can often just be achieved by a cross-company cooperation. Providing software might not be enough, rather support ridesharing with an accompanying marketing and contact staff.

Demand responsive transit – Shared-Ride Taxi

Demand responsive transit has been implemented in different areas worldwide, especially in low demand areas or in small areas. In order to respond to travelers' requests, these systems operate based on routes and timetables that may be fixed or flexible. Another form of shared transport is the concept of shared-ride taxi (SRT). A SRT is a door-to-door vehicle (taxi, minivan, etc.) operated by a private operator that enables two or more individuals to be served simultaneously, and share the costs, based on spatial and temporal matching. Some SRT are organization-based, which means that the operator needs approval by the organization (company or university) and the customers need to be staff or students of that organization. SRTs share the comfort of a private car with the advantages of PT. With the help of technology, scheduling, reservations and exact live location are offered.

Paratransit

Paratransit has become a very big challenge in recent years for more and more universities. As universities are looking to be more inclusive, transportation services have to meet that demand. Especially challenging is the fact, that paratransit can be very expensive per passenger (BIDWELL, 11.04.16). Mobility impairments, in form of permanent or short-term disabilities (e.g., need of a wheelchair) request special attention from transport providers (CANTOR, 12.04.16).

Carsharing

Carsharing is another important transport service in MM. It offers the possibility to use a car at any time without owning one. Carsharing can reduce the need for vehicle ownership, which in time will also reduce vehicle use in general. Different estimations suggest that one shared vehicle replaces between four to ten cars. Carsharing combines car availability while saving parking space. MM can help to boost carsharing through assistance in finding parking spaces and include carsharing in the local mobility marketing. A university has ideal conditions for carsharing, because of the high residential density of students, scarce land resources, low income of students as well as the high parking demand and costs. Carsharing would also increase mobility options for university staff and faculty as they have more options to travel as well as a vehicle at work if needed.

3.1.6   Guaranteed Ride Home Program

The guaranteed ride home program (GRH) offers people who can't get home by carpooling or PT, to reach out for an emergency ride. The services can include the use of free or subsidized taxi rides home, short-term car rental, carsharing or the use of a company car. Employees who fall ill, need to get somewhere quickly, or are left due to canceled carpool, can rely on this backup option. Many people fear to be stranded at work without transportation in unforeseen situations. The GRH can decrease people's fear to leave their car at home and be more open-minded towards PT or ridesharing. This incentive has shown in practice that its services are not abused, seldom used and the costs are usually low.

3.1.7   e-mobility

The use of electric vehicles (EVs) or alternative fuel vehicles (e.g., hydrogen, biodiesel, natural gas) for

> ### BOX 5: Carsharing in Emerging Economies
>
> Further information on Carsharing is available in the *SUTP Technical Document #12*. This report aims to evaluate the potential and the necessary political support structure for the implementation of carsharing services in emerging economies.

university fleets or the support of staff and students to use those vehicles is a strategy, applied by more and more universities. E-mobility has several advantages in comparison to gasoline or diesel propulsion. EVs are locally emission-free, pure EVs emit no pollutants while driving, and noise levels are significantly reduced. This is especially advantageous in densely populated areas, which suffer from air pollution. From the power source to the wheel (well-to-wheel) EV's emit significantly fewer total emissions than most conventional cars. If renewable energy sources are the exclusive source for electricity production, the emissions are reduced to approximately 5 g CO_2 per kilometer (BMUB 2016). Universities promoting or switching to e-mobility can benefit from the good image of electric and hybrid vehicles.

> ### BOX 6: E-Mobility
>
> For more information on Electromobility consult the *SUTP Technical Document #15*. The paper shows the diverse range of E-mobility applications and provides a snapshot of the various support schemes and pilot projects that have been carried out. More information focusing on E-Mobility in China can be found in the *Benchmark Report – Climate and Environmental Impact Assessment of Electro Mobility in China*.

3.1.8   Mobility Marketing

Equally important to creating and implementing MM measures is the promotion and marketing of the available mobility options to the wider public. Especially at universities, where the target group is changing every year, it is necessary to continuously inform people about their options.

A variety of possible marketing instruments exists in the context of mobility information. Typical approaches for universities and companies include transportation fairs, special events at the beginning of the semester, vouchers, bike-to-work days, contests, brochures, displays, websites and apps, as well as specific emails. One of the most

expensive but simultaneously most successful measure is face-to-face communication. In the end, a good mix of different marketing and information tools is advisable. Different studies showed that due to marketing efforts automobile driving can be reduced by 6 to 14 per cent and increase in effectiveness of other TDM measures by an added three per cent shift in mode of transport.

3.1.9   Telecommuting / Distance Learning

Telecommuting is defined as a situation where the employee can work away from the physical office work place, on one or more days a week, and communicate via technology. The employee works at home (which is the most common version) or at a work center, sometimes also called satellite work center. By teleworking, commuting trips are avoided, resulting in lower traffic demand and time spent by the employee on commuting. Furthermore, increased concentration, free choice of most productive hours of the day and greater flexibility to other responsibilities are given. Employees might fear a lack of opportunity for advancement as well as a missing interaction with colleagues. Employers on the other side gain potential benefits such as increased employee productivity, reduced absent days, better time management, reduced office space and costs as well as reduced employee turnover. But not only employees are able to benefit from telecommuting. When it comes to an educational setting, telecommuting can be adapted and is called distance learning or distance education. Teachers and students can use technology to substitute lectures or seminars. Some institutions of higher education even offer whole classes via distance learning. Distance learning could be an "interactive, real-time, online exchange between an instructor and students in their respective places of residence. Or special video conferencing studios on campus enable the students to see and hear the

instructor at a distant location" (TOOR & HAVLICK 2004: 57). It may thus also impact the campus environment and reduce congestion.

3.1.10   Flextime

Flextime, or alternative work hours, describes a situation that differs from the normal 8 a.m. to 5 p.m., Monday until Friday, work schedule. As a MM measure, it allows employees more flexibility in their time plan. Employees can change their start, stop and pause times, usually within limits (core hours, a time were employees must be present) set by the administration. Figure 9 exemplifies a standard workday schedule compared to a possible flextime workday schedule. Flextime, sometimes combined with telecommuting, allows staff to deal with personal obligations and be more flexible with their commute.

Distance learning in the UK compared to full-time courses on campus required **87 % less energy** and **85 % fewer CO_2 emissions** were generated (ROY ET AL. 2008).

Regarding a university setting, most of the students and faculty usually automatically use some sort of flextime as they do not commute at rush hours every day and normally do not have an 8-to-5 schedule. Still, there remains more potential to explore. For example through different class-time hours which would disperse parking demand. The same accounts for flexible employee work schedules. At the same time, those developments can achieve the opposite effects regarding carpooling and ridesharing which have less stability in their schedules then.

Standard Workday												
7:00 AM	8	9	10	11	12	1	2	3	4	5	6	7:00 PM
	Work					Work						

Flextime Workday												
7:00 AM	8	9	10	11	12	1	2	3	4	5	6	7:00 PM
Flexible Start			Core Hours		Flexible Lunch		Core Hours		Flexible Stop			

Fig. 9 : Standard workday schedule compared to a flextime workday schedule (MACHEMEHL ET AL. 2013: 12)

3.1.11 Student Housing

Providing on campus student housing can remove the need for trips. Or, as ALLEN (11.04.16) puts it, "universities that have an all resident community campus, they do not need TDM." Student housing (dormitories) are accommodations just for students. Normally, students live for a low price in single rooms, studio apartments or in shared apartments with other students. In the United States and the United Kingdom, the accommodation of students is often organized in an integrated administrative organization belonging to the campus. In Germany, there are numerous different institutions that offer students living spaces. Living on or near campus in student housing is proven by research to be associated with better social adjustment and improved educational achievements.

The place of living in relation to the place of studying determines student transportation. Even though student housing is not a typical MM instrument, it is of high importance in relation to university transport. Living near the university enables students to walk or bike to campus. Nevertheless, there is certain maxima in walking duration. As GHARAIBEH ET AL. (2014) showed, the average time for student one-way walking duration is 17 minutes. Student houses, further away than what students tolerate as acceptable walking distance, are automatically having limited shares of people walking to university. As a result, those students are not encouraged to walk but rather to use other modes of travel. In general, student housing which is not part of the actual campus should have a good PT connection. The old ideas of a mixed land use of course remain, but many universities are already too large to accommodate every student on campus.

Fig. 10 : South Campus Commons student housing at University of Maryland with bicycle racks in front (KORFFMANN 2016)

3.1.12 Campus Planning

Although planning is not a typical MM measure, it is worth mentioning that a well thought campus master plan significantly influences travel patterns of students, staff and visitors. Elaborate university planning with special attention to mixed use development, high development density as well as transit, pedestrian and bicycle friendly design can mitigate negative impacts of IMT or make car use completely redundant. Once the spatial planning is done and environment is built, it is hard to reverse and adapt the situation.

3.2   Actors – "It's the people, stupid!" / Involving the right people is the key to success

MM relies on the cooperation of key actors in the field of transport planning and urban development. The importance of including the right people and decision-makers for the success of any MM concept cannot be emphasized enough. Actor constellations regarding MM at universities normally start with the challenge that no dedicated transportation department exists so far. This challenge, with no division or staff feeling responsible to implement or propose MM, can be the first obstacle. A number of responsibilities should be defined if the according measures are to be implemented. A typical transportation office at a large university, whatever structure it has within the university administration, employs for instance a transit pass administrator, bicycle/pedestrian coordinator, parking management coordinator, and marketing staff. Existing student organizations and (sometimes) also a student government should be included early in the process of planning and implementation. They have better insight in the student needs, can have a significant impact on public opinion and help with further financial resources. A further key factor for successful MM is good cooperation with actors in the surrounding community.

To allow for the inclusion of various actors, usually a coordinating body is established with a special mobility manager. Typical tasks include the preparation of budgets, being the contact point for internal and external partners, strategic development, coordination of operational activities in MM, incorporation of the concerns of MM in municipal processes and tasks, marketing and public relations, as well as monitoring and evaluation of MM. Mobility managers or mobility consultants can convince different stakeholders of the direct benefits of MM measures and provide mobility advice at schools, universities, societies and associations, trade unions etc. At the same time, their task is to find cost-effective alternatives for the infrastructure supply. An important tool to coordinate MM activities is the creation of networks. They serve as a framework for regular exchange for actors. Table 1 gives an overview of relevant actors for MM, based on a selection by REUTTER and KEMMING (2012).

Source: www.unsplash.com

Actor	Main characteristic and possible way of influence
Traffic Generators	• all major institutions such as businesses, hospitals, shopping centers, universities and schools • can independently initiate and implement MM • both actors and target groups for MM
Mobility Service Providers	• typically transport associations and companies • act as key players in the implementation of MM measures • economic interests • offer alternatives to the private car
Administration	• works at different levels in the field of MM • federal level, regions, counties, cities and towns • important role in shaping and implementing MM measures
Politics	• supports introduction of MM through incentives • goal: environmentally friendly transportation, optimal use of scarce financial resources • define the legal framework • role models
Multipliers	• associations, trade unions, cooperatives, student unions in a university context • heterogeneous group • different motives to support MM
Traffic Participants	• target group of MM • can be segmented into different groups with reference to different characteristics

Table 1: Overview of relevant actors for mobility management

3.3 Financing Mobility Management

Financing a MM program or single measures can be challenging for companies and universities. An overview of available funding sources as well as different savings, helps to spend money more effectively. Funding sources can be either public, private or both. TOOR and HAVLICK (2004) provide an overview of the typical variety of sources:

• Student fees

• Parking revenues

• Parking fines

• Transportation impact fee (new building projects must pay for transportation infrastructure to serve demand generated by the building)

• General university fund

• Auxiliary departments may be taxed

• User fees

• Federal, regional, local funds

• Local and regional partnerships

• Public Private Partnerships

• Research projects

• Land value capture financing

Expenditures on MM can be offset by different (measurable) savings and might even save money in the end. MÜLLER (2001) gives a good overview of potential benefits:

Parking space: Building and maintenance costs for parking are not negligible. These are almost never covered by parking fees.

Shortages in staff: Each day of illness costs the company money. Reducing sickness absence and the reduction of commuting accidents can both be achieved if employees switch to safer transport modes such as PT, or stimulate their health by cycling and walking.

Productivity: Relaxed employees are naturally more productive. Commuters who use their own car, often suffer from concentration deficiencies and nervousness. Sensitivities and motivation to work suffer therefrom.

Transportation costs: Supporting staff in financing their PT passes can have tax advantages for employers.

Fleet costs: The provision of underutilized fleets for business is a deficit. Increasing the utilization and conservation of fleets through better organization can pay off in a short time.

Administrative costs: In some cases, MM can lead to a more efficient organization of business through the use of special software for instance.

Recruiting staff: Especially in large urban areas, cost and time for commuting have a negative effect on the attractiveness of the workplace. MM extends the options to get to work and hence the attractiveness of the company in the recruitment of qualified staff.

Employee motivation: MM can have a positive impact on employee motivation in various ways. Health promotion is currently highly significant for companies to foster the relationship with its workforce. Equality needs to be a higher concern.

Image gain: In addition to the above mentioned benefits, MM can result in significant image gain which can be used for marketing goals.

Source: www.unsplash.com

Educational institutions are often struggling with financial limitations. In comparison with other enterprises, companies and institutions, universities have less policy and financial options. However, necessary funding is usually not the central argument against MM measures, but rather it is the lack of political or administrative motivation.

4 Good-Practice – Case studies of Mobility Management in Germany and the USA

Several universities in Germany and the USA, which are already using MM will be discussed in this section. The gained positive and negative experiences from these universities can help to identify the specific local conditions of action easier and to estimate the transferability of examples into their own space. Map 1 & 2 show the distribution of the case studies in the USA and Germany.

**Map 1:** Distribution of Case studies in Germany (A -Aachen, B – Bonn, D – Darmstadt, H – Heidelberg) Source: *https://www.openstreetmap.org*

Map 2: Distribution of Case studies in the USA (C – Maryland, M – Minnessota, N – Norfolk) Source: *https://www.openstreetmap.org*

4.1   Technical University Darmstadt

Darmstadt is a city with 157,000 inhabitants, located in the south of the federal state Hesse. Darmstadt is home to a number of educational institutions and research institutes. The biggest one, in terms of number of students (26,500 students and about 4,500 employees), is the Technical University Darmstadt (TU Darmstadt). The TU does not have one central campus, but is spread out over the city *(see map 3)*.

transport authority can adopt their schedules to the university schedules. The most important MM measures so far were the introduction of a comprehensive parking management plan and the introduction of a mobility card for all employees (about 2200 have been sold) which combines a subsidized transport ticket and a parking pass. The same electronic card (see figure 11) serves both as PT card and parking ticket. The card, which has been received very well, can be purchased by each employee starting at 265 Euro per year. The combination of a mobility card and parking management plan is a strong instrument which enabled the university to reduce the number of parking spaces.
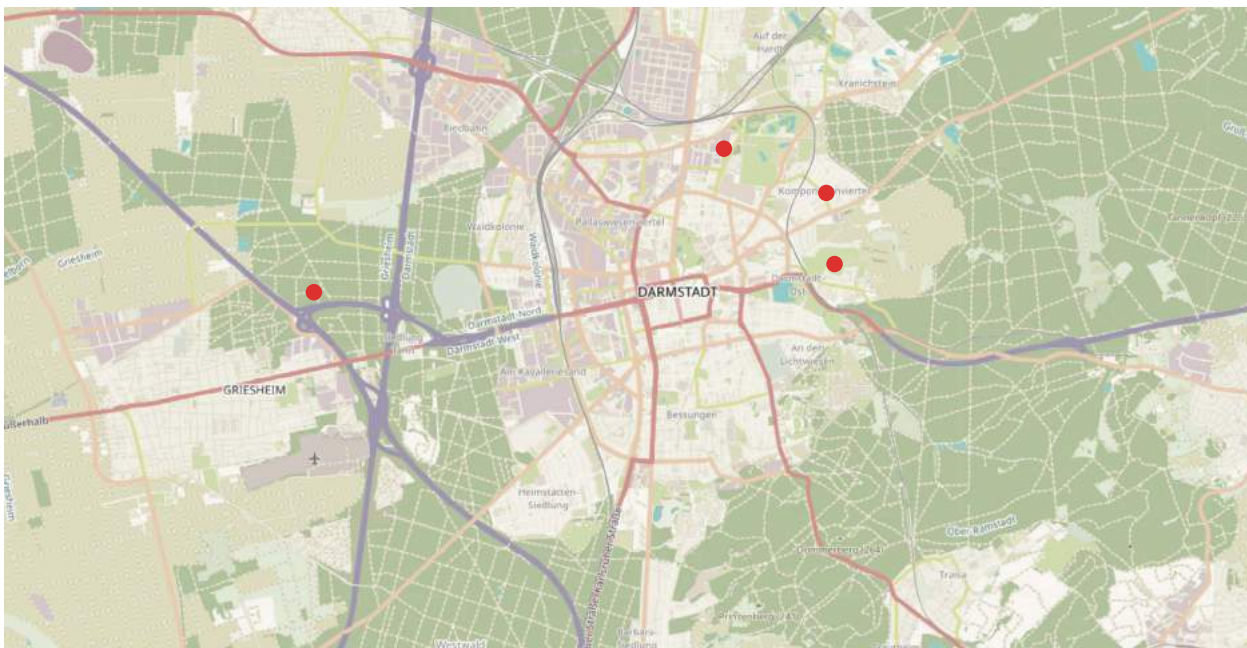
Map 3 : Locations of the university in Darmstadt Source: *https://www.openstreetmap.org*

In 2010, the chair of TU Darmstadt made the decision to establish integrated MM at the university in order to reduce parking pressure and prevent other traffic problems caused by the rising number of students and staff (STASCHECK 2014). In cooperation with the local transport authority, concrete targets for MM have been established. Since 2012 an administrative department takes care of the MM at the university. In 2016, however, the role of the mobility manager changed as more and more measures have been implemented and successfully institutionalized by the normal administration. Therefore, the current mobility manager focuses more on the general strategic transport planning and is assigned to the construction department.

Two different groups were established to improve easy and direct communication − a group for the implementation of MM and a group for the organization of traffic flows. One is an internal, so-called steering committee, where involved university actors, such as different departments, location representatives, staff, and students take part. The second group includes high-ranking representatives of the university, the city, the Darmstadt transport authority (DADINA), the University Institute for Integrated Traffic and Transport Systems, and the Rhine-Main Regional Transport Association, who address different subjects and directly try to solve them. Department 2 of TU Darmstadt, which is responsible for the class schedules and auditorium layouts, exchanges data with DADINA before each semester so that the

A bike-sharing system is offered to students for 2.5 Euro per semester. The cooperation between the student council and Call a Bike (the bike sharing scheme of the German Railways) currently resulted in 350 bikes and more than 30 stations in the city. Students can use the bikes for free for one hour. A do-it-yourself (DYI) bicycle repair shop (available to everyone in Darmstadt) is offered by the student council and mainly financed through donations. Students can repair and maintain their bikes themselves with the provided tools under the assistance of experts. Special maintenance workshops are offered as well. As part of a national competition, 86 pedelecs were bought, 20 of which are for the university fleet and can be borrowed by everyone. The other 66 pedelecs have been acquired directly for departments and for business trips of professors.

MM at the TU Darmstadt is completely financed through the sale of the mobility card. The fee from carsharing stations or revenues from special events are additional sources of funding MM. New parking management measures have been financed through a special loan by the chancellor, which has to be repaid in 15 years. The PT ticket for students is financed separately by special student fees through the student council.

First results of a significant change in modal split confirmed the success of implemented MM measures. Car use on campus Lichtwiese decreased by 35 per cent from 2012 to 2013, and at the same time the use of PT increased by 50 per cent.

4.2   RWTH Aachen University

Aachen, located in the west of Germany, has about 250,000 inhabitants. The RWTH Aachen University, with 9,300 staff and faculty members and about 43,500 students, is one of the largest employers and traffic generators in the region. The RWTH in recent years has been, and still is structurally expanding. As of now, the university has three campuses: Campus Mitte, Campus Hörn and Campus Melaten. Campus West is still in the planning stage, but will be built in the coming years. In addition, there are several individual, smaller locations throughout the city (see map 4).

TU Darmstadt: **Car use** on campus Lichtwiese **fell** from 2012 to 2013 **by 35 %** and **PT use increased by 50 %** (STASCHECK 2014)
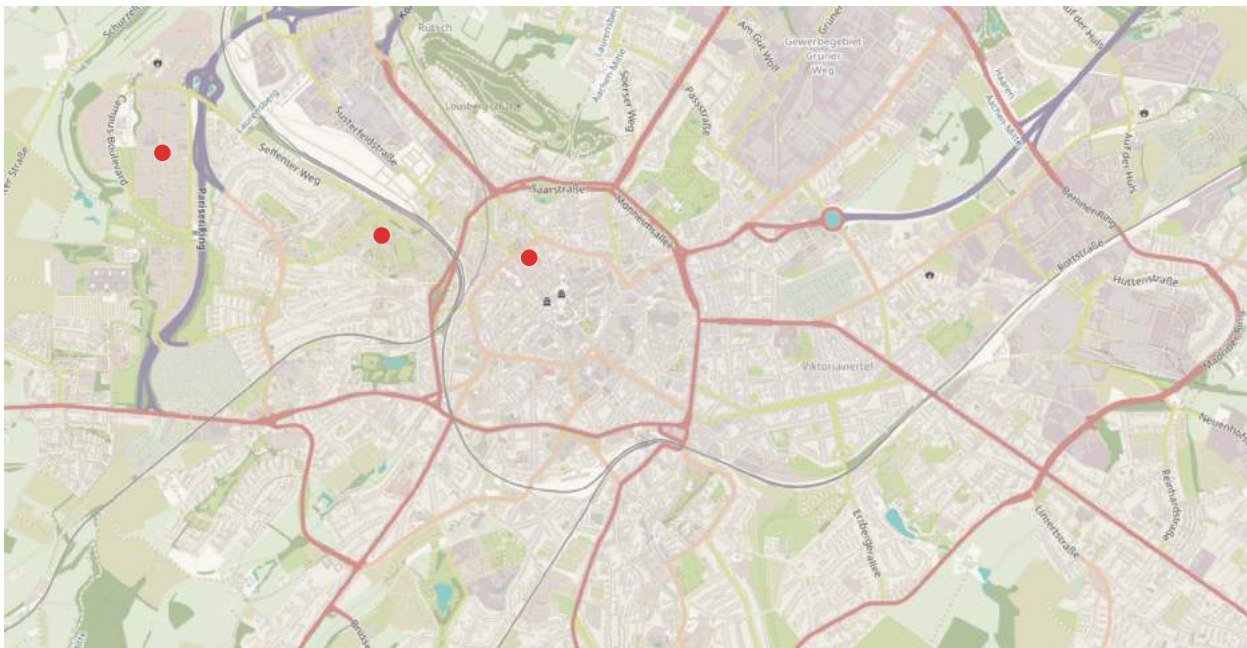

Fig. 11: Mobility card at TU Darmstadt combines PT ticket and parking pass (STASCHECK 2015)

Fig. 12: Parking gate at Lichtwiese, traffic light and special signage (KORFFMANN 2016)

Fig. 13: Parking gate at Lichtwiese, which is only accessible with the personalized mobility card (KORFFMANN 2016)

Map 4 : Different campuses in Aachen Source: *https://www.openstreetmap.org*

The planned construction of buildings at existing parking areas, and the already precarious parking situation for both cars and bicycles have led to the rector's decision in 2008 to create a mobility master plan - a blueprint for integrated transport and MM at the RWTH. Objectives of the MM plan include cost savings for building owners, investors and operators, improved connections within the RWTH and incentives to change the personal mobility behavior.

The RWTH offers its employees a job ticket. The price is based on the destination and the corresponding fare zone of the local transport authority (23-71 Euro per month). RWTH students receive a PT ticket, which allows them to use buses, trams, light rail and commuter trains in the federal state of North Rhine-Westphalia. For this card, students pay about 160 Euro per semester.

The university has implemented a parking management plan in 2011. Anyone who wants to use the university parking areas requires a parking permit. There are various parking zones; the assignment of parking spots is based on the official work location of each employee. Everyone who buys a job ticket optionally obtains a parking card without extra charges. All other beneficiaries who apply for a parking permit have to pay six Euros per month, starting next year seven Euros.

The RWTH has created a separate group on the ridesharing platform "Pendlerportal", where staff and students can sign up. Suitable ridesharing offers and requests are transmitted in real time on phones or computers, which makes spontaneous carpools possible. The available link to the timetable information of PT also shows alternatives if a carpool is canceled. Overall, the RWTH Aachen is easily accessible by PT. The nearest railway station is the train station Aachen West. From here, both the central

campus and campus Hörn are accessible by foot and bus. A carsharing service is used as an addition to the available business fleet but can also be used privately (with a separate user card). Rental and charging stations for an e-carsharing are built as part of an EU project on campus (see figure 14).

Almost all institutes have bicycle racks to ensure safe bike parking. In cooperation with the university, the city is successively improving the cycling infrastructure in the university area. In Aachen, several vendors offer bicycle sharing at various locations. In the coming years also a pedelec rental system with approximately 1,000 pedelecs and many stations close to each other will be established. The electrical support allows rapid movements, despite the challenging topography.

RWTH Aachen: The **share of PT has risen** from 2010 to 2013 **by 14 %**, the proportion of **IMT decreased by 9 %** (WITTE 2014, BOßHAMMER 2015).

This project, called Velocity, is a student initiative that has been supported by EU funds and financial aid of the city. Currently the project is in the test phase, after the realization of ten stations (see figure 15). A special brochure regarding mobility at RWTH, with an overview of all mobility options at RWTH has been developed. It has been distributed to all employees of the university in Spring 2016 and is handed to new employees. As part of the EU project CIVITAS, MM at RWTH was not only accompanied scientifically, but certain measures were also funded and implemented, and the website of the university was renewed. The website provides mobility information both to internal and external people. In addition, the transport authority has published

Fig. 14 : Carsharing station by Cambio with charging infrastructure and special signage next to the Velocity-Station at Westbahnhof Aachen (KORFFMANN 2016)

information regarding multimodal transport, with the help of the university.

Every two years, the Institute of Urban and Transportation Planning at RWTH Aachen, examines the changes in the mobility behavior of the employees with the help of surveys. Thus, in addition to the numerous MM measures there is a regular monitoring and evaluation process established at RWTH. The success of the implemented measures is reflected in the modal split of the staff. The PT share increased from 19 per cent in 2010 to 33 per cent in 2013, and the proportion of IMT has fallen over the same period from 53 per cent to 44 per cent. The implementation of an integrated MM plan has led to reduced target figures of parking spaces for new building projects resulting in a significant cost saving at the RWTH.


Fig. 15 : Velocity-Station at Westbahnhof Aachen VELOCITY AACHEN 2016

4.3   Ruhr-Universität Bochum

The city of Bochum has 370,000 inhabitants and is located in the center of the Ruhr area in North Rhine-Westphalia. The Ruhr-Universität Bochum (RUB) with 41,000 students and 5,500 employees is one of the largest universities in Germany. The dense university campus is located in the south of the city center (see map 5).

A bikesharing system, called metropolradruhr, is provided by nextbike. About 760 bikes are available in Bochum, divided among 75 stations, of which 17 are located on campus. Every student can ride up to 60 minutes for free, as a result of an agreement between the student council and nextbike. Students pay a fee of 1.5 Euro per semester.
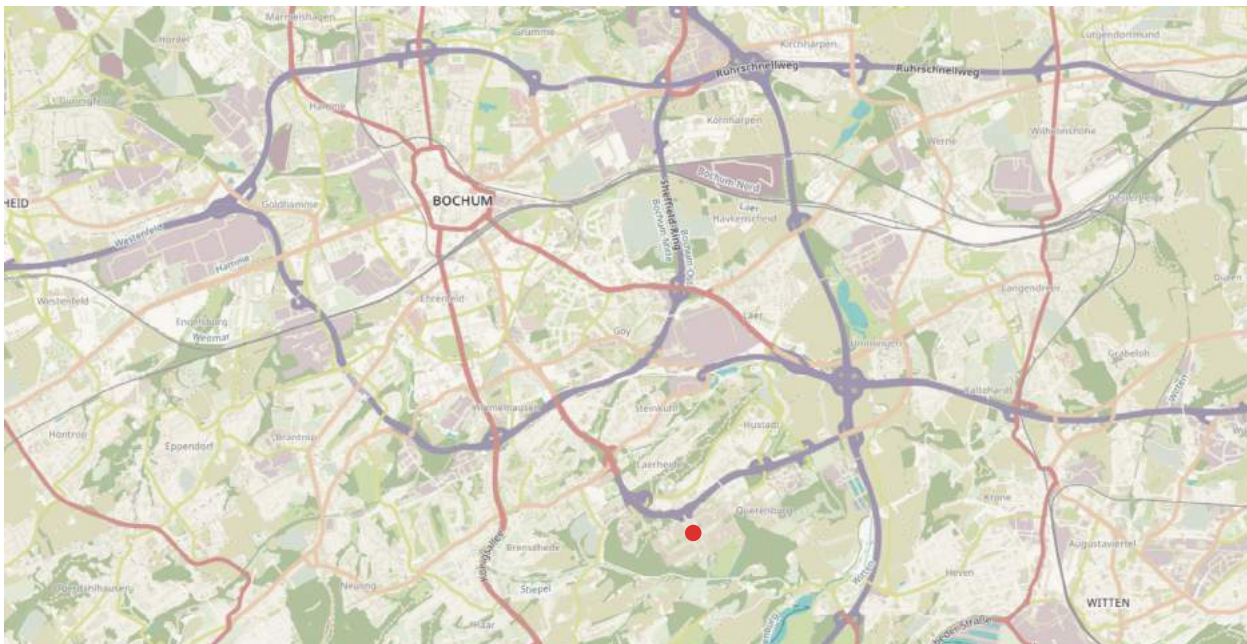
Map 5 : RUB campus southeast of the city centre Source: *https://www.openstreetmap.org*

At the RUB, a team consisting of two employees and two student employees is working on strategic planning in the field of transport infrastructure and MM. In addition to that, the team also takes care of the everyday operation of individual mobility projects. In 2011 a mobility and transport strategy called MOVE 2013 has been launched. The focus of the strategy is to strengthen environmentally friendly modes of transport and to set a new course for sustainable transport within the campus redevelopment. The objectives of the strategy were based on the results of an online survey with data from all students and employees of RUB regarding their commuting behavior. In 2014 the strategy plan has been updated and maintained for the period up to 2020. Communication is the main focus in Bochum. A weekly meeting with the participation of relevant actors (such as transport authority, city administration, local cyclist's association, student council, technical departments) helps to directly clarify problems and to enable decisions on a short path.

Fig. 16: Metropolradruhr station at RUB campus (KORFFMANN 2016)

Furthermore, ten lockable bicycle boxes with space for 20 up to 30 bicycles per box are available on campus *(see figure 17 & 18)*. Students and employees can rent a space and key card for three euros per month. In case of an increase in demand, charging infrastructure for pedelecs can easily be retrofitted. The motor pool of the university also contains EVs, which are used for rides on campus or short trips to the neighborhood.

Bochum: From 2012 to 2014, **student use of PT increased by 13 %, bicycle use increased by 114 %**, while **IMT decreased by 37 %**. Use of cars by employees decreased by 10 % (FRAUENDIENST 2014, RUB 2016).

Implemented measures are communicated firstly via the newly created website (which provides different information depending on the transport mode)

as well as via the "RUB-App". Students receive related mobility information upon enrollment. Furthermore, campus posters for individual offers, newsletters, and the Facebook page of the university, inform about current affairs also in the mobility sector.

A second online survey in 2014 showed that the many measures changed the modal split of the students and staff members significantly. From 2012 to 2014, the use of PT by students increased by 13 per cent, bicycle use increased by 114 per cent, while IMT decreased by 37 per cent. Furthermore, the modal split of employees changed between 2012 and 2014; the use of environmentally friendly transportation increased, and the use of cars decreased by approximately ten per cent.

4.4   Heidelberg University

Heidelberg is a small, bicycle-friendly city with 150,000 inhabitants, located in the north of the federal state Baden-Wuerttemberg. Heidelberg accommodates different universities and educational institutions with a total of about 38,000 students. The most important and internationally recognized is the Heidelberg University. Founded in 1386, it is the oldest university of Germany; the 31,000 students and 14,000 faculty and staff are divided among three different sites in Heidelberg – Campus Altstadt, Campus Bergheim, and Campus Im Neuenheimer Feld *(see map 6)*.

Fig. 17: Bicycle box signage on RUB campus (FRAUENDIENST & GEMMEKE 2015)

Fig. 18: Open bicycle box on RUB campus (FRAUENDIENST & GEMMEKE 2015)

Map 6 : The different campuses in Heidelberg Source: *https://www.openstreetmap.org*

The university does not have institutionalized MM, but still tries to improve sustainable transportation for its employees and students. The compact city stimulates walking and cycling, in particular the Campus "Im Neuenheimer Feld" which is characterized by a high building density. The cycling connections between the campuses are good, and in addition there are two bus lines that continuously operate between the campuses. A special university campus bike route has been planned and is used for marketing both from city and university. The map in figure 19 shows the different routes between campuses and other important bike infrastructure in Heidelberg. Special signage was added to the standard bike signage of the city along the bike routes *(see figure 20)*.

URRmEL is a DYI repair shop for all students in Heidelberg. It is financed with financial support from the student council, the university and the student union, as well as financed through donations. Cooperation of the university with the city administration and the local police has led to actions such as a special coding for bikes, which aims to decrease bike theft as it is easier to track the owner. A campaign, called Aktion 5 – five more minutes for your way – was initiated to reduce the number of reckless cyclists at crossings or driving in the wrong direction, as well as to improve cyclists' awareness of car drivers. In addition to pedestrian friendly infrastructure, such as wide sidewalks and good lightning at night the university, the transport agency and the university hospital provide the program "walk safe" in cooperation with the city. The program combines different measures to improve walking
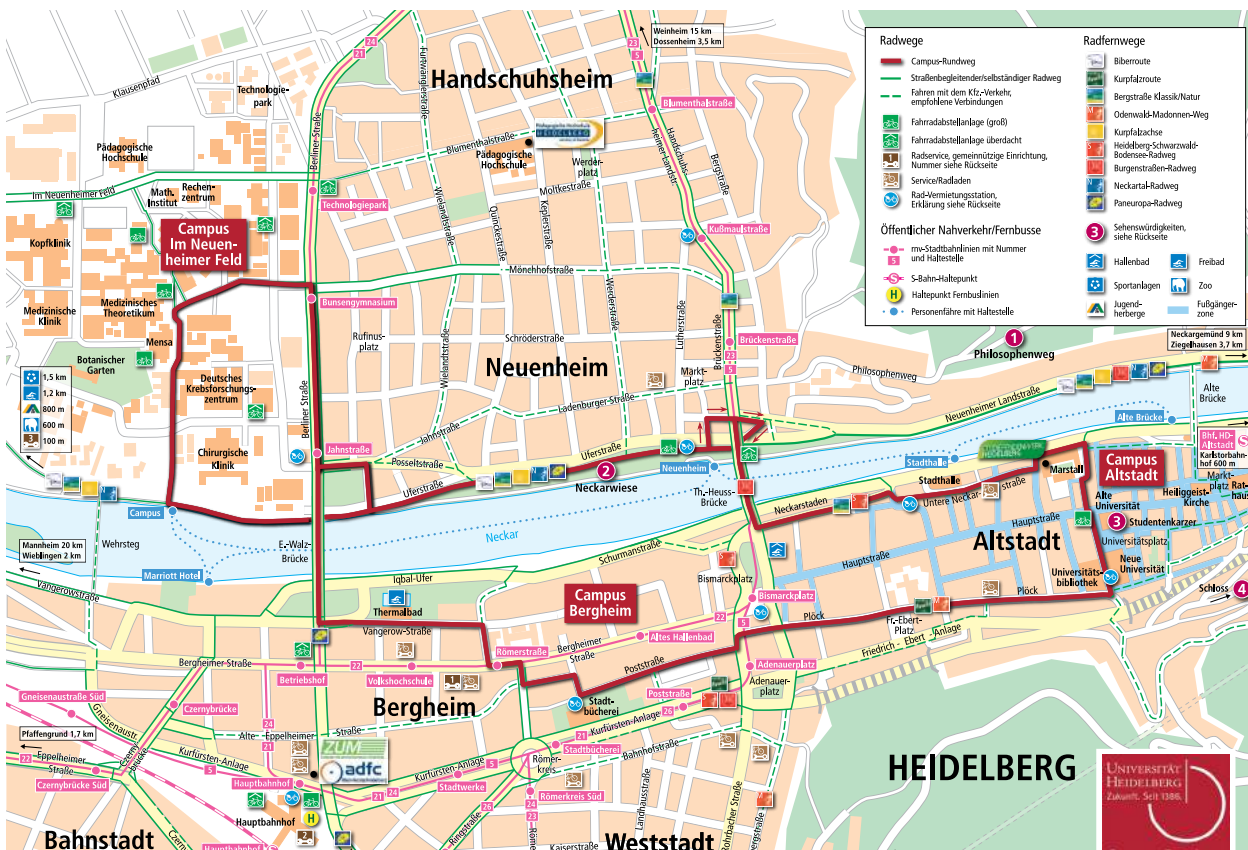

Fig. 19: Map of cycling routes between campuses and other relevant bike infrastructure in Heidelberg (STADT HEIDELBERG 2014)

safety for women for the campus "Im Neuenheimer Feld", especially at night. Part of it is an escort service, which can be requested personally or via phone. Women are accompanied by security staff members to their parking spot or to bus and tram stops. At night, buses also stop upon request between regular bus stops to

reduce walking distance for female passengers. The sports department offers special self-defense courses for women. In addition, the city and the taxi union offer a special women-night-taxi, which can be called at night at a cheaper price. A flyer including a map and summary of all relevant program information is offered *(see figure 21)*.

UniversitätsKlinikum Heidelberg

UNIVERSITÄT
HEIDELBERG
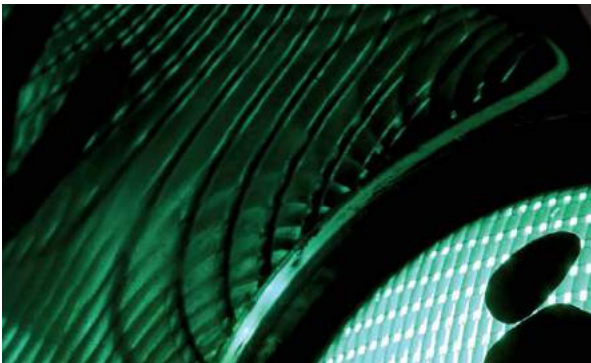ZUKUNFT
SEIT 1386

WALK SAFE –
MEHR SICHERHEIT
IM NEUENHEIMER FELD

Fig. 20: Special university route signage (in red) below the standard city bike route signage of the city (KORFFMANN 2016)
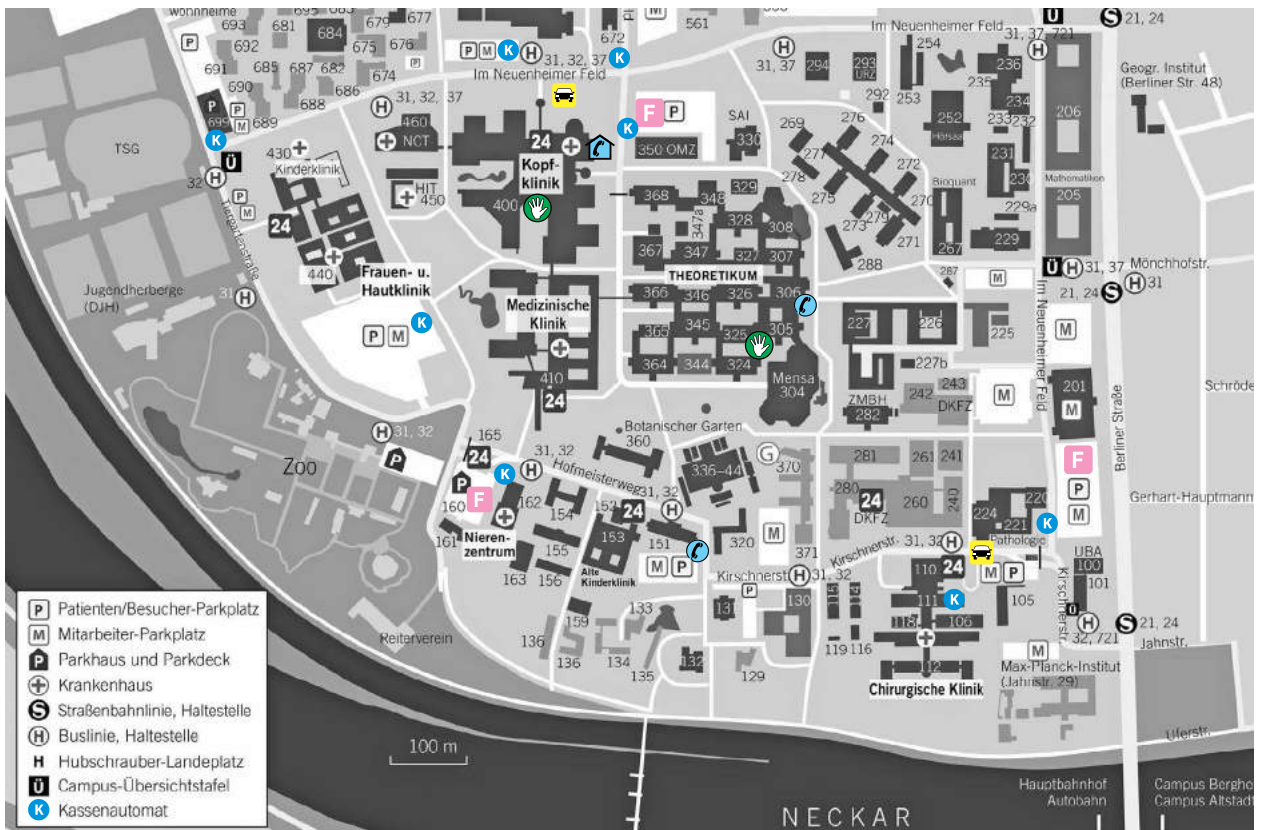

P Patienten/Besucher-Parkplatz
M Mitarbeiter-Parkplatz
P Parkhaus und Parkdeck
+ Krankenhaus
S Straßenbahnlinie, Haltestelle
H Buslinie, Haltestelle
H Hubschrauber-Landeplatz
Ü Campus-Übersichtstafel
K Kassenautomat

Fig. 21: Walk Safe Flyer (UNIVERSITÄT HEIDELBERG 2015)

4.5   University of Maryland

The University of Maryland (UMD) is a public university located between Baltimore and Washington, D.C. in the suburban College Park area *(map 7)*.

The university has about 37,000 students, and 9,000 faculty-and staff members. Approximately 40 per cent of the undergraduate students live on campus. The other students as well as most of the staff members live in the Washington–Baltimore metropolitan area. The target of UMD's ambitious Climate Action Plan is a 50 per cent emission reduction by 2020 (Base 2005) as well as to become a carbon free campus. Consequently, the main aim of its MM plan is to reduce the number of single occupancy vehicles that drive to campus. The Department of Transportation Services at University of Maryland (DOTS) is responsible for mobility related planning, education and enforcement as well as the handling of daily activities such as transit services. The shuttle services consist of a fleet of 75 vehicles (including hybrids) *(see figure 22 & 23)* with more than 3.3 million riders annually. Many students work as bus drivers or as student employees in the DOTS. This program allows students to gain skills and experiences as drivers, dispatchers, or technicians.

UMD: Vehicles used for carpooling or vanpooling receive a **discount of 50% for parking** (ALLEN 2016). Until 2018 the total number of parking spaces will be reduced by 3,000 spaces (MCLAUGHLIN 2016).
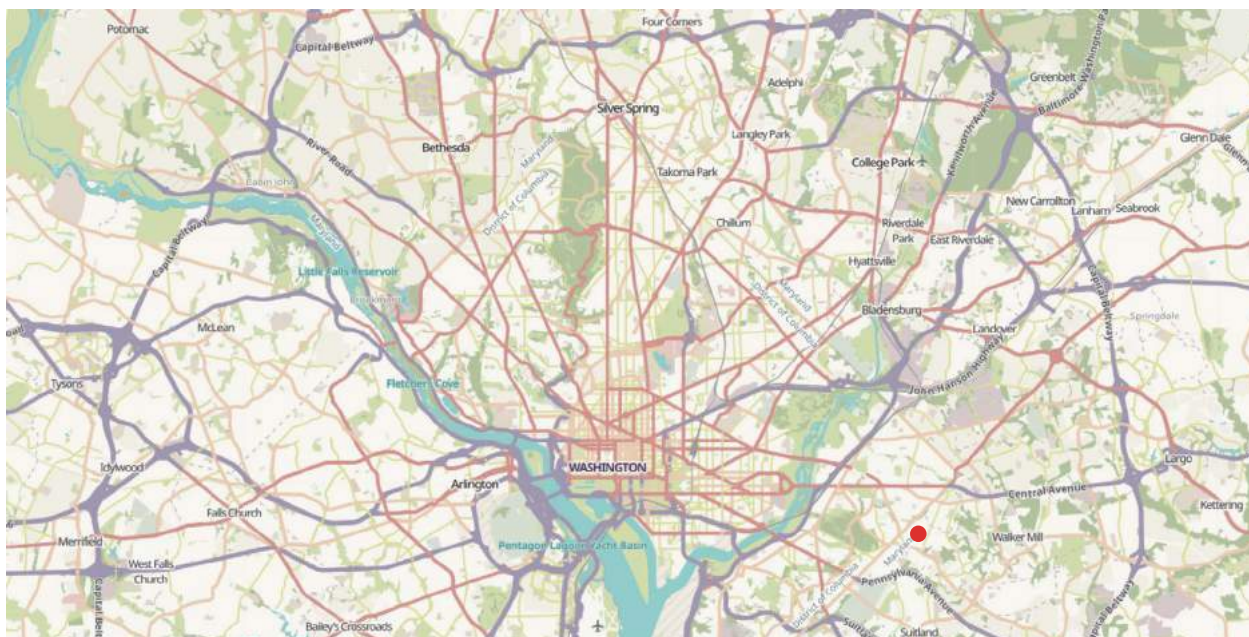

Fig. 22: Big shuttle bus at the UMD campus with bike racks on the front (KORFFMANN 2016)

Fig. 23: Small shuttle bus at the University of Maryland campus which is also used for paratransit (KORFFMANN 2016)

Map 7 : Location of UMD in College Park northwest of Washington, D.C. Source: *https://www.openstreetmap.org*

The university has parking garages and surface parking lots, providing in total 18,000 parking spaces (see figure 24 & 25). This number will be reduced by 3,000 spaces, partly to provide space for the construction of new academic facilities. Most of the spaces are controlled via License Plate Recognition. UMD does not allow freshmen who live on campus to park a car at the campus. Bundle packs of ten parking passes for a price of six USD per day enable commuters who seldom use their private car to pay less for parking. E-mobility at UMD is encouraged via the availability of charging stations in garages and parking discounts for EVs. Carsharing at UMD is provided by Zipcar with 18 vehicles at seven locations on or adjacent to campus. A GRH Program enables employees who commute by modes other than private car, to receive a free ride home when unexpected circumstances arise. A demand response service is available at night with a curb to curb service called NITE Ride as well as direct immediate paratransit transport.

Fig. 24: Parking garage at University of Maryland (KORFFMANN 2016)

Fig. 25: Surface parking lot at University of Maryland (KORFFMANN 2016)

More information on sustainable mobility at the University of Maryland is provided here by the UMD Dept. of Transportation Services.

The BikeUMD program consists of several different measures to improve cycling at UMD. Since 2016, DOTS also has a bicycle coordinator to promote cycling and focus on special projects. Around campus seven bike repair stations offer material to repair a bike free of charge *(see figure 26)*. At the bike shops, people can learn how to maintain and repair bikes themselves. About 4,600 bike parking spaces as well as many spaces at the metro station including special boxes and a bike garage are available. In addition, many buildings across campus offer shower facilities for cyclists. Neglected and abandoned bikes receive a note, and they will be confiscated after two weeks. A bike sharing system (mBike) was launched in May 2016 in cooperation with Zagster. mBike has 125 bikes and 14 stations between the City of College Park and the University of Maryland campus. The system allows users with different levels of physical ability, to use the bike share system too, as the bikes can be adapted to meet personal needs *(see figure 27)*.

All services provided by DOTS are mainly financed through a 200 dollar mandatory annually transportation fee for students, which pays the lion share. Revenues through parking account for about four million USD. Communication with users as well as marketing is done via different channels. In addition to classic analog advertisements, special events, and fairs are used, as well as different social media channels such as Twitter, Facebook YouTube, emails, and SMS.

4.6　University of Minnesota

The University of Minnesota (UMN), has two campuses (three miles apart) located in the urban areas of the twin cities Minneapolis and St. Paul (see map 8). About 51,000 students and 16,000 staff and faculty members study and work at UMN.

The UMN faces challenges to ensure safe and efficient movement of people in the limited available space and tries to provide good accessibility for the large amounts of pedestrians and cyclists. The main goal of the university's MM efforts is to decrease the number of people who are driving alone to campus respectively to keep this number as low as possible.

A local non-profit organization is running a bikesharing scheme in the twin cities as well as at the university. In total, 23 of the 200 stations are located on campus. UMN is offering discount memberships for staff and faculty members. Currently Parking and Transportation Service of UMN is figuring out how to enable discounted memberships also for undergraduate students, which would create a new financial burden of about 250,000 dollar a year. Other amenities for cyclists are special street markings *(see figure 28)* as well as secure bike parking

Fig. 26: Bike repair station at University of Maryland campus (KORFFMANN 2016)

Fig. 27: Bike sharing station by Zagster including recumbent tricycle at University of Maryland campus (ZAGSTER 2016)

facilities or bike lockers, which both can be rented for about 85 USD a year. In addition, a GRH program is not only available to users of PT or carpooling but also to people who normally travel by bike or walk to university.

Fig. 28 : Special bike markings on the street at University of Minnesota (SANDERS 2016)

The University of Minnesota offers several parking options. Public parking is available to anyone at any time, mostly paid via a parking meter. Contract parking involves a commitment with a guaranteed parking space. For disabled people special parking programs exist. Charging stations for EVs are available with different charging speed levels with complementary electricity. A local nonprofit organization, called HOURCAR provides a station based carsharing scheme in the twin cities and on campus, where people pay per hour. In addition, car2go is present in the twin cities with its free-floating system, which charges people per minute. Students can buy a U-Pass metro-area transit pass for 100 USD a semester, which is sold about 20,000 times a semester. All MM measures, including a transit system that carries about 3.5 million passengers a year, bike programs and pedestrian programs – are mainly financed through parking fees (cheapest parking permit is 70 Dollar a month) and a small amount also through a student transportation fee, which is 24 USD a semester. The high amount of funding through parking fees is somehow unusual in the USA, as most universities do not gain enough revenue to finance their MM measures completely through parking.
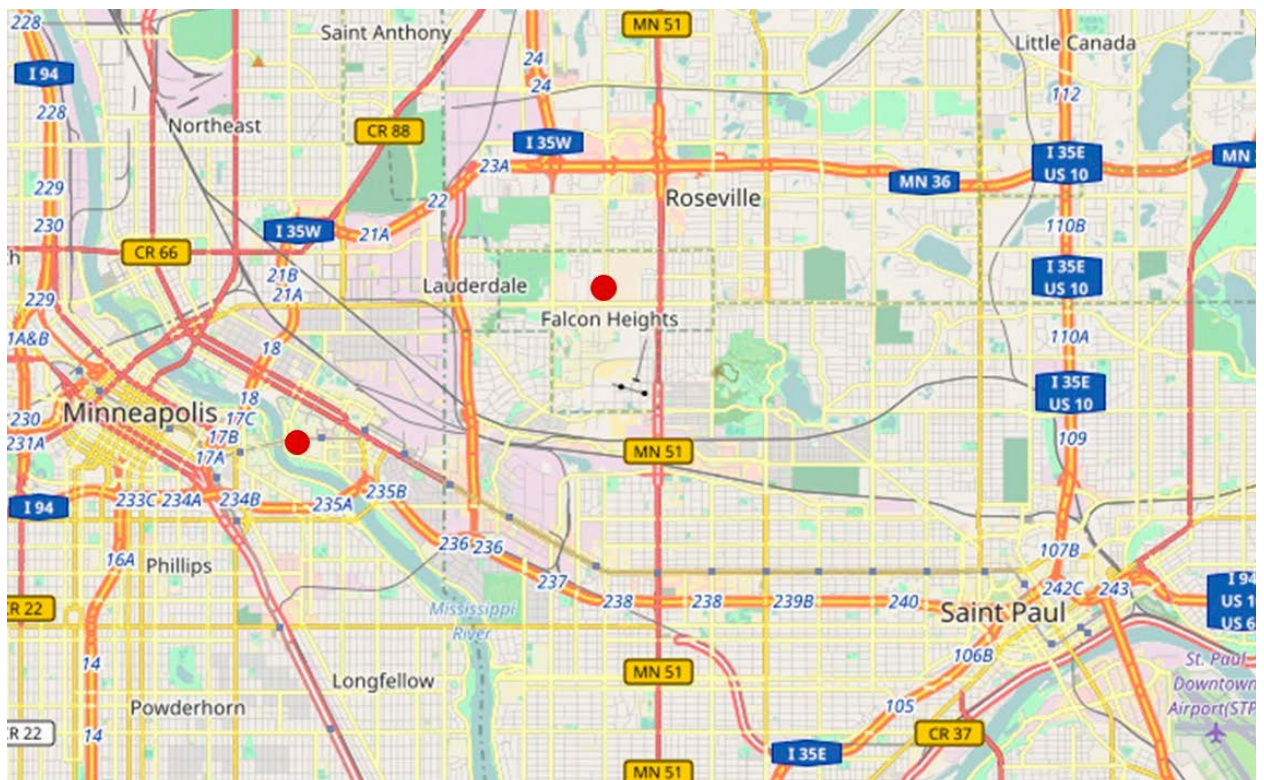

Map 8 : UMN locations in the twin cities *Source: https://www.openstreetmap.org*

4.7   Old Dominion University

The Old Dominion University (ODU) has almost 25,000 enrolled students and employs about 2,500 faculty and staff members. The subsidized regional transit pass, a transit system of 20-passenger busses, and the nighttime safe ride transportation service encourage students and employees to use PT. The main aim of the MM measures is to reduce the number of cars on campus. The parking policy includes 7,500 parking spaces and five garages, the prohibition for freshmen to bring cars to campus, and a parking price structure for employees which is based on income level divided into four groups. The City of Norfolk, has a citywide residential parking permit program to discourage non-residents to park there. Each parking location is served by a shuttle bus.

Carsharing services are offered via Zipcar, which has different locations at ODU. The map of the campus shows *(see figure 29)* the parking locations for different target groups. In addition, other transportation options as transit services, carsharing, bike facilities are shown as well. Especially attractive is the use of different circles to show the walking distance. MM measures are financed through parking permit sales and meter revenues, as well as a mandatory transportation fee (57 USD) for all students. Nevertheless, old parking debts still consume a high volume of financial resources. ODU has a website and several social media accounts (Facebook, Instagram and Twitter) for digital communication. Flyers, postcards and other printed material are distributed throughout the year. Presentations at orientation sessions for new students as well as participation at fairs are common marketing instruments.
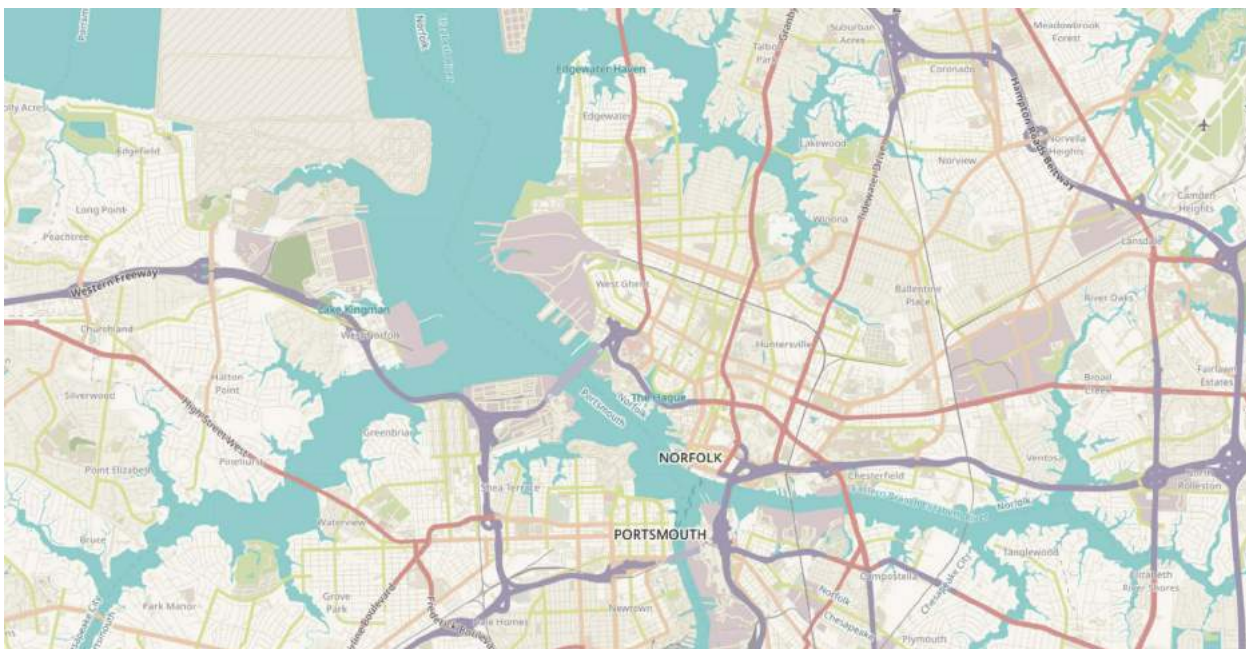
Map 9 : Location of ODU campus in Norfolk Source: *https://www.openstreetmap.org*

BOX 7: Google Employee Shuttle

Google employees from the San Francisco region who work at the corporate campus at Mountain View, California have a free company shuttle commuting service option. These shuttles bring approximately 6,400 employees to Google each day from all over the Bay Area. There are about 200 private shuttle stops in San Francisco. In addition to the high comfort level and air-condition, the shuttle buses also have Wi-Fi. According to DAI and WEINZIMMER (2014), 48 per cent of riders would drive alone by car if it were not for the shuttles. Similar services are taken up by other tech companies in the San Francisco bay area like Facebook, Apple and Yahoo or eBay. Microsoft adopted the idea in the Seattle region. The morning service is from 5 am until 11 am. Drop-off is from 4 pm until 10 pm. The frequency and schedule vary by location and demand. The service is managed by a transport team employed by the tech company. The team also evaluates routes and schedules and adapts it to new traffic data and possible changes in employee demographics or residence. Real-time vehicle tracking allows to communicate delays and other information to passengers via telecommunication. Meanwhile, the free commuting shuttle is recognized as a selling point in recruiting. As a result, employees have moved to new areas for a closer connection to the service. This resulted in heavy debates on the influence of this program in gentrification processes going on in San Francisco.

Fig. 29 : Old Dominion University campus map (OLD DOMINION UNIVERSITY, TRANSPORTATION AND PARKING SERVICES 2018)

Further universities that are already using mobility management include the following:

■ Oregon Health & Science University offers a range of incentives to access campus by a variety of modes. For more information click here.

■ Oregon State University Transportation Services supports the University's mission by providing safe, sustainable, customer-focused and fiscally-sound transportation programs and services. Find brochures with more informtion here.

If you are aware of any additional Universities using Mobility Management already, we would be happy to include them in this list. Please feel free to contact us.

5 Conclusion

Current mobility patterns worldwide are rather unsustainable, accelerate climate change, have a negative impact on human health and global resources, and are characterized by social inequality on different levels. Technological innovations, alternative fuels and individual modes of transport will not be sufficient to solve the problems caused by our current mobility behavior. There is a need for behavior-changing policies and most promising seems to be a well-coordinated approach of specific measures that aim to avoid unnecessary trips, move people and goods with sustainable modes, and to make transport systems as efficiently as possible.

Many university campuses need to decrease their commuters' dependency on private cars and the resulting negative effects this brings along such as land use problems, congestion, and air and noise pollution. Companies as well as universities need to consider several measures to promote sustainable transportation, to meet their emission reduction goals (if they have some), and to use their available land optimally. At the same time, both the company - respectively the university - and its employees and students could benefit financially. They need to discourage IMT and actively promote alternative sustainable transportation modes. As the case studies in this publication highlight, successful MM can induce modal shifts to sustainable modes of transport, bring benefits to the university, its employees and students, and the neighborhood respectively municipality. Measures need to be tailored to local conditions; they should always be accompanied by a set of tools (including communication and marketing) as the potential to improve sustainability could be increased in this way.

Key MM aspects for universities include:

1. Walk around your campus and identify mobility needs
2. Define a vision how mobility should be – find inspiration
3. Define which tools you need to realize your vision
4. Acknowledge the role that MM can play
5. Recognize that universities are major traffic generators and must act
6. Communication and awareness-raising
7.

Specifically:

1. Learn from Best-Practice around the world (e.g. by reading this technical document), and use the power of networks and partnerships with other universities
2. Develop a plan: measures to promote sustainable transport can be implemented successfully only in the framework of a long-term, overarching concept. Including:

a) Status analysis – you need to know your target group

b) Planning, identification and preparation of priority measures including:

  • Parking management (no successful MM without parking management)

  • Improvement of walking environment

  • Promotion of cycling – parking facilities, bike sharing scheme

  • Carpooling, carsharing and e-mobility (increase vehicle efficiency)

  • Marketing & information concept – promote what is available

  • Monitoring and evaluation concept – to justify the necessary expenses

  • Integration of public transport (PT) (tickets, routes etc.)

3. Address capacity: an institutionalized MM plan is required to successfully meet the many challenges in the mobility sector. This includes appropriate staffing and the establishment of cooperation between stakeholders.
4. Planning and implementation of MM requires funding: identify financial and human resources, needs and potential savings.

If you have the luxury to plan a new campus: please note that MM needs to be considered already at the planning and construction phase of a campus. The way you plan and build the campus will influence traffic demand over long periods of time. New campuses need to be adequately served by PT, offer facilities for walking and cycling, and provide mixed landuse.

And remember: use the power of the students for ideas, implementation and financial sources!

> **BOX 8: Avoid-Shift-Improve Approach**
>
> A quick introduction to GIZ's approach to sustainable urban mobility is available in a *Fact Sheet*. The approach, known as A-S-I (from Avoid/Reduce, Shift/Maintain, Improve), seeks to achieve significant greenhouse gas emission reductions, reduced energy consumption, less congestion, with the final objective to create more liveable cities.

Where to look for more information:

- **Fact Sheet** – Sustainable Urban Transport: Avoid-Shift-Improve (A-S-I), 2011.

- **SUTP Technical Document #4:** Transport Alliances. Promoting Cooperation and Integration to offer a more attractive and efficient Public Transport, 2010.

- **SUTP Technical Document #12**: Carsharing Services in Emerging Economies, 2014.

- **SUTP Technical Document #14**: On-Street Parking Management. An International Toolkit, 2016.

- **SUTP Technical Document #15**: Electromobility, 2016.

- **SUTP Module 1e** – Sustainable mobility: getting people on board. GIZ Sourcebook on Sustainable Transport for Policy-makers in Cities, Update 2018.

- **SUTP Module 2c** – Parking Management: A Contribution Towards Liveable Cities. A Sourcebook for Policy-makers in Developing Cities, 2010.

- **SUTP Module 3f** – Public Transport Integration and Transit Alliances. A Sourcebook for Policy-makers in Developing Cities, 2018.

- **SUTP iNUA implementation guide #2:** Solution: Cycling, 2017.

- **SUTP iNUA implementation guide #5:** Transit Alliances, 2017.

- **SUTP iNUA implementation guide #8:** Walking, 2018.

- **Benchmark Report:** Climate and Environmental Impact Assessment of Electro Mobility in China, Version 2.0, 2013.

Various other publications are available on SUTP.org.

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