MAS.552J / 4.557J
Design Workshop: Mobility-On-Demand Systems in Vienna, Austria
Spring 2011

Instructors
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MIT Course Collaborators
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Prereq Permission of instructor
H (Spring)
Units (3-0-9)
Wednesdays 2-5 pm
Room E14-493
First Class, Feb 2nd, 2011 in E14-240 (new Media Lab building)
**Requirements below*

Summary
This workshop will explore Mobility-on-Demand (MoD) systems for new urban villages. Each student will focus on the design of one selected system component, which may include charging stations, an all-weather electric vehicle for bike-lanes, building design for autonomous parking, mobility pathway and streetscape typology, fleet management, MoD interfaces, and vehicle-to-grid energy systems. We will explore how MoD systems can be divided into a number of key elements that work together under a set of established rules, and how this component typology can be applied to the new neighborhood of Aspern in the City of Vienna, Austria.

The class will travel to Vienna during MIT's spring break (March19-27) for a one-week design charrette. Travel and accommodations will be funded by the City of Vienna. Travel is not mandatory to participate in the course. Enrollment will be limited to 15 students.

Mobility-on-Demand Systems
MoD systems consist of a fleet of lightweight electric vehicles placed at recharge points distributed in an urban area. They form a new type of mobility service whereby users pick-up vehicles from charging stations and are allowed to drop-off at any other charging station (otherwise known as shared one-way rental). A fully networked MoD system will intelligently respond to peak user demand for vehicles, parking space, and energy supply. As MoD systems evolve they will serve not only as a new mobility system for cities, they will be become part of an energy ecosystem which will integrate renewable power generation and distribution as well as efficient buildings to form a new urban nervous system for cities.

Course Details
This workshop will include travel to Vienna to participate in a one-week design charrette with the Austrian Institute of Technology (AIT) during MIT's spring break. We will coordinate the workshop with a parallel studio at AIT. Viennese students will focus on site analysis and the urban master plan, while MIT students focus on design and technology interventions. Key city

officials and stakeholders will participate in these sessions.

Students will work in small teams throughout the semester lead by project leaders from Changing Places research group at the MIT Media Lab. Projects will run the throughout the term with several joint design reviews with invited academic and industry guests. Students will be encouraged to develop physical and/or computational models for their final project. A detailed project description for the upcoming term will be discussed at the first class meeting for each project. Current project descriptions, visuals, and references can be found at: http://cities.media.mit.edu (under "Mobility" tab).

Neighborhood of Aspern in Vienna, Austria
The City of Vienna is a center of historic and cultural importance within continental Europe. In response to projected growth within the city, Vienna's Urban Lakeside area has been identified as a key new development area. Economic development plans has been made for the creation of research facilities, commercial and retail office space, housing, public space, and manufacturing (Opel-GM plant is in Aspern). The plans also include the extension of the underground (2 U-Bahn stations) as well as the creation of a dense network of bikeways and footpaths.

Primary focus of the Workshop
The kit-of-parts of MoD comprise of the following elements which we will focus on this term are:

Lightweight Electric Vehicles (LEVs) – The Smart Cities group (now Changing Places) has developed 3 LEVs for MoD systems: The CityCar, RoboScooter, and GreenWheel Electric bicycle. This term we will consider how to best deploy these vehicles and their unique capabilities in a MoD implementation. We will also explore the design of a new "Persuasive" LEV that encourages healthy and sustainable mobility. The vehicle should incorporate the latest in-wheel motor technologies so that the rider has the option of providing their own propulsion through exercise (i.e., pedaling), power solely from electric motors, or combination of human effort and electric-assistance. In order to attract a broad audience, the vehicle should be capable of being driven in bicycle lanes, should be stable (i.e., 3 wheels or more), provide shelter and minimal climate control, as well as easy ingress/egress. In addition to the physical design of the vehicle, we will explore incentive based systems to encourage the minimal use of electric power and maximize exercise.

Electric Charging Infrastructure – The deployment of electric charging infrastructure is vitally important to the adoption of electric mobility. This term we will learn about existing electric charging technologies as well as nascent technologies such as rapid charging, inductive contactless charging (or wireless power transfer), Smart Grids, Vehicle-to-Grid technologies, and innovative energy storage. We will focus on the development of charging station typologies for urban environments (both on-street and off-street). The design of the charging station should consider available charging technologies, space for vehicles, vehicle/pedestrian circulation, charging interface (i.e., kiosk design), shelter, and integration into the landscape. We will employ rapid prototyping techniques to fabricate scale models of the various designs.

Connective Pathways – The deployment of alternative transportation systems will undoubtedly change the fabric and texture of city streets. Velib's bicycle sharing program in Paris included the introduction of additional bike lanes (400+ km) and bike stations (1400+), which has dramatically changed the streetscape. This term we will examine

existing and novel pathways (such as bike and bus rapid transit lanes) to determine their applicability to MoD Systems. We are particularly interested in circulation patterns, lane widths, lighting, signaling and signage, landscaping, material use, lane sharing, and intersection strategies, in order to develop new street typologies for MoD. The pathway team will then prototype an array of street configuration designs that consider differing combinations pathways for specific sets of vehicles.

Smart Fleet Management Systems – One-way shared use schemes (i.e., bicycle sharing programs) that allow users to pick up and drop off at any station provide extremely high levels of convenience, flexibility, complementarity to public transit, and ability to reach a mass market. However, they are challenged with redistribution problems which are currently solved by utilizing trucks that move bicycles from full stations to empty ones. This term we will examine existing vehicle sharing programs (like Car2go, Bixi bikes) and develop alternative strategies for creating an economically sustainable MoD management system that exhibits high level of service. We are particularly interested in developing variable or dynamic pricing systems that incentivize users to create a self-organized system. One of our key assignments will be to brainstorm and quickly develop a MoD board game that mimics MoD scenarios and constraints (cost, time, vehicle/parking availability, and impact on the environment).

Integration with Energy Efficient buildings – The introduction of electric charging infrastructure will necessitate the rethinking of the built environment. New hardware such as chargers, battery storage, wiring, displays, and in some cases a new substation, will need to be retrofitted into existing buildings in order to provide a physical conduit between the energy source (the utility grid) and the energy sink (EVs). In buildings with renewable power generation, EVs can provide additional energy storage for the building or utility thus acting as an energy source. Therefore, the integration of EVs and charging infrastructure into energy producing buildings provides the framework for the creation of a new energy ecosystem. In addition to electric charging the emergence of autonomous driving technologies will also influence the design of buildings. Autonomous vehicles can self-park and self-charge, thus it enabling tighter fit and better use of space (i.e., elimination of the aisle in parking structures). We can take advantage of these technologies to rethink both existing and new structures. In new buildings we have the opportunity to design this new ecosystem from the ground up by rethinking the traditional parking bay. This term we will design a new building archetype that considers a parking module based on the requirements of EV charging infrastructure, Autonomous driving, as well as the space savings provided by MoD EVs. This new module can then become the basis for floor plates for multistory buildings and provide a new construction logic. We will explore these issues through the fabrication of scale mockups using rapid prototyping techniques.

Urban Implementation - Working with the city of Vienna, we will examine how MoD can be best implemented in the Aspern neighborhood of the Urban Lakeshore area. We will conduct urban analyses to determine the ideal locations for charging stations and overall fleet size, in order to create the optimal mix of vehicles for an eventual pilot program. By examining the existing and projected demographics, current and anticipated transportation patterns, and critiquing the urban development plans, we can develop a MoD master plan for this area which can be cross-validated with our colleagues at AIT. This team will also incorporate the developments of each of the research groups to develop a typical city cross section for MoD systems.

Project Collaborators
Katja Schechtner, Austrian Institute of Technology (AIT)
Carlos Fernandez Isoird, Denokinn
Chris Borroni-Bird, General Motors
Phil London, Schneider Electric
Mark Kocher, Schneider Electric

Key Texts
William J. Mitchell, Christopher Borroni-Bird and Lawrence Burns, *Reinventing the Automobile: Personal Urban Mobility for the 21st Century,* (MIT Press, March 2010).
William J. Mitchell, Me++ (MIT Press, 2004).

***Requirements**
Prior enrollment in the previous workshops is NOT a requirement for this class. Both graduate and undergraduate students are encouraged to apply to the course. Backgrounds in Architecture, Computer Science, Electrical Engineering, Management, Material Science, Media Arts and Sciences, Mechanical Engineering, and Urban Planning are preferred.

Term Schedule: Spring 2011

Week	Dates	Wednesday
1	Feb. 2	First Class meeting, Introduction, Student Interviews (conducted on Feb 3rd and 4th)
2	Feb. 9	Present first assignment, divide into small project teams
3	Feb. 16	Review first assignment, "Electric Charging systems" Guest Lecture by Schneider Electric.
4	Feb. 23	Group work time, Guest lecture (TBC)
5	Mar. 2	2nd assignment and Charrette no. 1
6	Mar. 9	Interim review
7	Mar. 16	Final preparation before trip to Vienna (Depart for Vienna at end of week)
8	Week of Mar. 23	Spring Break + Workshop in Vienna (Return to Boston on Mar. 26 or 27th).
9	Mar 30	Final assignment, Guest Lecture (TBC)
10	Apr. 6	Charrette no. 2
11	Apr. 13	Work time (Media Lab Sponsor week – Apr 13-15)
12	Apr. 20	Guest Lecture (TBC)
13	Apr. 27	Work time
14	May 4	Work time
15	May 11	Final Class Meeting (prep for final review)
16	May 18	Final Review (with invited guests)
End of Spring Term		