Mobility Planning

Conversation with Satish Udpa
March 28, 2017
Mobility
What is the problem?
What do we want to accomplish?

- Improve traffic safety
- Decrease commuting times
- Enhance infrastructure
- Integration of scholarship and teaching into solving mobility problems
  - Leadership in autonomous vehicle development
  - (Big) Data analysis on mobility and traffic
Mobility Apps

March 29, 2017
Mobility Apps

Transit Times:
• Data provided by CATA
• GPS on all buses
• But: data may be up to 120 seconds out of date
Mobility Apps

Double Map:
• ~15 seconds accurate bus arrival predictions
• Better than UM’s own App
• 3rd party vendor
• Western, Central, Indiana, Northwestern, many others
• Could also load CATA data
Mobility Apps

Adi Mathew

- Presently in beta
- Rollout in fall
- Planned: crowd-sourced visualization and data mining
- Rich environment for variety of research and thesis projects

March 29, 2017
Position MSU as test bed for autonomous vehicle development

- Corporate partnerships
- Government grants
- Research & teaching opportunities

March 29, 2017

Website: http://adminsv.msu.edu/mobility
Structure

Steering Committee
- Udpa, chair
- Bauer
- Beekman
- Gaboury
- Erhardt
- Bollman
- O’Donnell
- Prush
- Troost
- Witter
- Verboncoeur

Enablers: Technology, Policy Changes, Stakeholder Input
INFRASTRUCTURE

MOVING PEOPLE

INFRASTRUCTURE TEAM

- Steve Troost
- Tim Potter
- Stephanie O’Donnell
- John LeFevre
- Ann Erhardt
- Mark Wilson
- Scott Witter
“If you plan cities (campuses) for cars and traffic, you get cars and traffic. If you plan for people and places, you get people and places!” [Fred Kent]
Framing Our Work

- Today’s Mobility Infrastructure
- What It Needs to be in 5 Years
- Visioning What it Could be in 6+ Years
Campus is a Big Place

- 5200 Acres
- 2100 Acres North of Mt. Hope
- 3100 Acres South of Mt. Hope
Mobility Arteries

- Roads - 57.44 Miles
- Sidewalks - 120.81 Miles
- Bike Lanes - 19.51 Miles
Our Mobility Infrastructure Must Handle Daily

- 17,500 Students that Live on Campus
- 32,500 that Go To & From Campus
- 12,500 Employees
- 100’s to 10’s of Thousands of Visitors
- Construction & Delivery Crews?

26,000 PARKING PLACES
Public Transit

Number of CATA Bus Riders Per Fall Semester

- 2012 - 1,212,586
- 2013 - 1,247,899
- 2014 - 1,274,058
- 2015 - 1,193,488
- 2016 - 1,134,060

1,134,060/40 PER BUS=28,351 trips
Accessibility

Currently - Over 500 Building Access Sites

- Building Entrances, Sidewalks, Road Crossings, Traffic Flows
Motorized Circulation Framework from MSU’s Land Use Master Plan Update 2017

Examples of Near-Term Motorized Priorities

- Develop a Comprehensive Mobility Plan
- Extend Wilson Rd to Hagadorn Rd
North Campus
Motorized
Non-Motorized Circulation
From the 2017 Plan

Examples of Near-Term Priorities

► Meet the Needs of People with Disabilities
  ► Working with IPF, FPSM, RCPD, RHS & Athletics

► Construct Final Segments of MSU River Trail
Non-Motorized
Potential Construction

- Potential Footprint Updates
  - 2,000,000 new gross sq. ft. per decade AVERAGE
What Can We Learn From Others About Mobility

- Ohio State University
  - Privately Owned Parking
- University of Minnesota
  - 5 Minute Bus Access on Main Lines
- Europe
  - SUMP - Creating Places
Information Needs

Research and Outreach

a. Central Data Storage System
b. Flow Patterns
c. User Needs and Preferences
d. Benefit/Cost of Management & Design Options - Help with Prioritization

+++
Would You Like to Help?

- Ideas
- Data
- References
- Examples

Please Contact Dr. Scott Witter at Witter@msu.edu
Structure

Mobility Source Management (Gaboury)

Technology & Optimization (Verboncoeur)

Infrastructure (Witter)

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- Prush
- Troost
- Witter
- Verboncoeur

Enablers: Technology, Policy Changes, Stakeholder Input
• Enhance mobility and convenience

• Position MSU as recognized mobility leader

• Improve MSU Community and Visitor experience

• Influence behavior and find new ways to optimize mobility
Mobility Source Management

Campus pedestrian, bike, auto, scooter, bus, and other traffic ebbs and flows, driven by class changes, work day hours, deliveries, game day and many other daily activities.

**Can we change this mobility demand and alter behavior?**

*Example Ideas:*
- Analyze classroom assignments to minimize student pedestrian flow at peak class change times.
- Explore a transportation demand program (TDM) to influence behaviors and reduce vehicular use.
- Evaluate and change how truck deliveries are made on campus.

Infrastructural

Campus movement follows paths established through campus layout, parking lots, and other physical infrastructure.

**Can we find new ways to optimize mobility through campus design?**

Technology & Optimization

Even with guidance from campus design, mobility challenges around safety, congestion, parking, and others remain.

**Can we address these challenges, and improve movement and safety of existing traffic on campus?**

*Example Ideas:*
- Connected traffic signals for adaptive timing to improve traffic flow at peak times and in emergency situations.
- Evaluate the regulations concerning the driving and parking of mopeds on campus.

**Enablers:** Technology, Policy Changes, Stakeholder Input
MSU Mobility is complex and dynamic
Campus Events

SPARTANS FOR LIFE
homecoming.msu.edu
#MSUHomecoming

GREEN AND WHITE DAY
DISCOVER WHAT IT MEANS TO BE A SPARTAN

Spartan Youth Programs
Programs and Activities for Pre-K through 12th Graders
Examples for Presently Available Data

MSU Mobility: Non-Motorized Circulation

[Map of MSU campus with various pathways and markers indicating bike paths, amenities, and signs.]
Examples for Presently Available Data

Friday Average Boardings per Trip: Route 31 East Neighborhood to Brody Neighborhood

- Fall 2016
- Fall 2015
Scheduling Optimization of Academic Classrooms

• MSU’s classroom scheduling software uses an optimizer algorithm to assign sections into classrooms
• Campus is divided into 17 “partitions” with groups of buildings in each partition
• Each department is assigned to partitions based on campus location and building preferences
• Each partition includes a walking distance of approximately 10 minutes or less
Classroom Scheduling Data Reviewed

- Average walking distance and time for students between on-campus classes from fall 2006 through fall 2016
- Fall 2006 and fall 2016 on-campus enrollment in 30-minute increments, examining MWF, MW, and TTh meeting patterns
- Fall 2016 on-campus enrollment in 30-minute increments, examining days of the week
# Average Walking Distance and Time for Students between On-Campus Classes

## Examples for Presently Available Data

<table>
<thead>
<tr>
<th>Term</th>
<th>Average Distance between On-Campus Classes for No-Preference First-Year Students</th>
<th>Average Distance between On-Campus Classes for Juniors and Seniors</th>
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<tbody>
<tr>
<td></td>
<td>Average Distance in Feet*</td>
<td>Average Distance in Walking Minutes</td>
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<tr>
<td>Fall 2012</td>
<td>2,663</td>
<td>10</td>
</tr>
<tr>
<td>Fall 2013</td>
<td>2,476</td>
<td>9</td>
</tr>
<tr>
<td>Fall 2014</td>
<td>2,312</td>
<td>8</td>
</tr>
<tr>
<td>Fall 2015</td>
<td>2,435</td>
<td>9</td>
</tr>
<tr>
<td>Fall 2016</td>
<td>2,407</td>
<td>9</td>
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</tbody>
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*Distance data between buildings from Campus Wayfinding (http://wayfinding.msu.edu/). The calculation of average walking minutes is based on an assumed walking speed of 3 mph.
Examples for Presently Available Data

Fall 2016 On-Campus Enrollment in 30-Minute Increments
MWF, MW, and TTh Meeting Patterns

0 2000 4000 6000 8000 10000 12000 14000 16000 18000
8:00  8:30  9:00  9:30  10:00  10:30  11:00  11:30  12:00  12:30  1:00  1:30  2:00  2:30  3:00  3:30  4:00  4:30  5:00  5:30+

MWF  MW  TTh

Fall 2016 On-Campus Enrollment in 30-Minute Increments
MWF, MW, and TTh Meeting Patterns

Examples for Presently Available Data
Examples for Presently Available Data

Fall 2016 On-Campus Meeting Time Enrollment in 30-Minute Increments
Days of the Week
Themes Emerging from the Review of Data

Meeting Time Enrollments

- 50-53% of all on-campus enrollments Monday-Thursday occur between 10:30 a.m. and 2:00 p.m.
- 63% of enrollments on Friday occur between 10:30-2:00
- Less than 1% of enrollments occur at 12:30 p.m., as there are no 50-, 80-, or 110-minute standard meeting times occurring at 12:30
Example of data needed regarding MSU employees
Connecting Teaching and Research with Practice, Policy, and Economic Development
Academic/Research Opportunities: Mobility Planning

A living test-bed connecting Teaching and Research with *Practice, Policy, and Economic Development*.

Graduate Certificates and/or Interdisciplinary Graduate Program.

Undergraduate and graduate research opportunities that guide MSU and positions us as a Recognized Leader in mobility.
Mobility Planning Opportunities:

A prototype for designing cost-effective and impactful solutions fueled by stakeholder input to improve mobility on campus

Campus wide adoption of Technology solutions:
- Business Practices: Virtual Meeting applications
- Academic: Virtual labs/classrooms

A comprehensive and adaptable roadmap that guides MSU and positions us as a Recognized Leader in mobility
Conversation Starters

- Campus Operations:
  - Off-Peak Delivery Access
  - Limited Delivery Access

- Explore modifying class schedule
  - Positives/Negatives
    - Scheduling optimization of academic classrooms

- Feasibility of modifying work schedules (start/stop times between 7:30 a.m. and 5:30 p.m.)

- Institution wide creative application of technology
Questions?

- Feedback/Information: http://www.adminsv.msu.edu/mobility
- Contact: mobility@msu.edu
- Contact: gaboury@msu.edu
MSU Campus Mobility

Technology and Optimization Committee

<table>
<thead>
<tr>
<th>Name</th>
<th>Department</th>
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</thead>
<tbody>
<tr>
<td>Subir Biswas (ECE)</td>
<td></td>
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<tr>
<td>Xiaoming Liu (CSE)</td>
<td></td>
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<tr>
<td>Kalyan Deb (ECE/BEACON)</td>
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<td>Hayder Radha (ECE)</td>
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<tr>
<td>Tim Gates (CEE)</td>
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<tr>
<td>Ali Zockaie (CEE)</td>
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<td>Mehrnaz Ghamami (CEE)</td>
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<td>John Verboncoeur (ECE/CMSE)</td>
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<td>Nizar Lajnef (CEE)</td>
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Canvas is the centerpiece to MSU’s Mobility Studio – an integrated system of communication and control for autonomous vehicles and their environment.
CANVAS

Seamlessly integrating mobility, safety, and security in autonomous and connected vehicles.

MSU KEY AREAS

- Multi-modality sensing
- Radars and antenna design
- X2X networking
- Sensor and data fusion
- Deep learning
- Biometrics and cybersecurity
Other aspects of the Mobility Studio are research programs focused on **Smart Infrastructure** and **Traffic & Mobility Management**.

### Smart Infrastructure
- Communicating pavement, environmental, and vehicle-pedestrian traffic conditions in real time.

#### MSU Key Areas
- Sensors
- Urban cameras
- Pedestrian integration

### Traffic/Mobility Management
- Vehicle and pedestrian modeling and management for safety, efficiency, and predictive control.

#### MSU Key Areas
- System-level modeling, safety, optimization, and control
canvas RESEARCH GOALS

**external sensing**
- Pedestrian & Cyclist Activity
- Vehicular Activity
- Traffic Monitoring
- Road/Weather Conditions

**internal sensing**
- Emotive & Cognitive State
- Gesture/Posture Analysis
- Age Estimation
- Occupant Personalization
Situational awareness
“Superhuman-level” sensing of EXTERNAL and INTERNAL environments

Cost & economics
Maximizing situational awareness and minimizing “sensing redundancy”

Anytime/anywhere autonomous driving
Four-season autonomous driving under any conditions on any road
canvas RESEARCH FOCUS

Multi-modality sensing

LIDAR

THERMAL

VISIBLE
canvas  RESEARCH FOCUS
Park Once Self-Driving Vehicle Model

- Park once on periphery or south campus
  - Parking cost reduced
- High frequency bus lines to major centers
- Lightweight self-driving electric vehicles
  - Mobile app hailing
Campus Mobility Technologies

Technologies
- Multispectral cameras
- Pavement sensors
- Mobile ped/cyclist app synced with signals
- Parking app
- Lightweight CAV shuttles
- EV charging stations

Processes
- Mapping optimization
- Ped, cyclist, vehicle throughput optimization
- Bus routes and stops
- Emergency vehicle prioritization
- Classroom optimization
- Park once, buses and CAVs, ride-sharing
- Distributed services (e.g. food trucks)
Join Us!

• Comments
• Ideas
• Best practices
• Connect to teaching and research
  • Capstone projects
  • R&D projects

• Contact John Verboncoeur: johnv@egr.msu.edu
Clicker Quiz

results will be posted soon!
1. Which is your predominant means of commuting to campus?

A. I walk
B. I ride my bike
C. I use public transportation
D. I drive a car, alone
E. I carpool with others
2. What is your major mobility safety concern on campus?

A. Inexperienced drivers
B. Flow of pedestrians and cyclists through traffic
C. Pedestrians not paying attention
D. Vehicles not respecting pedestrian right-of-way in crosswalks
E. Bus drivers
3. How much time do you spend looking for parking after a mid-day meeting or lunch?

A. None
B. < 5 minutes
C. 5-10 minutes
D. More than 10 minutes
4. Parking! What would you change?

A. I would build additional parking decks close to academic buildings
B. I would eliminate reserved parking spaces
C. I would gradually reduce parking on central campus
D. I would implement a system that guides people to empty parking spots
E. Nothing; I am happy with the way things are now
5. Driverless cars: When do you predict you will buy one?

A. Within the next 5 years
B. Within 5-10 years
C. Within 10-15 years
D. Sometime after 15 years
E. Never
6. Which of the following would be the most effective incentive for you to use the bus system for transportation on campus?

A. Free parking in south campus commuter lots
B. Frequent bus service (5-10 minutes)
C. Heated/cooled bus terminal at commuter lots
D. All of the above
E. None of the above
7. Should MSU invest in covered walkways/skywalks between some of the most-used buildings?

A. No, it is a waste of money  
B. I don’t care  
C. Yes, but only if it can be done inexpensively  
D. Absolutely
8. How do you feel about a “take-your-bike-to-work” initiative?

A. Strongly opposed
B. Moderately against it
C. Neutral
D. Moderately for it
E. Strongly in favor
9. How do you feel about a ‘buses and bicycles only’ zone on central campus?

A. Strongly opposed  
B. Moderately against it  
C. Neutral  
D. Moderately for it  
E. Strongly in favor
10. Would you personally like to get involved with any of the groups working on mobility?

A. Yes, I can see myself contributing to all of them
B. Yes, I want to work with John Verboncoeur’s group
C. Yes, I want to work with John Gaboury’s group
D. Yes, I want to work with Scott Witter’s group
E. No, it is more fun to just complain after the work is done
Thank you!

- Feedback/Information: [http://www.adminsv.msu.edu/mobility](http://www.adminsv.msu.edu/mobility)
- Contact: [mobility@msu.edu](mailto:mobility@msu.edu)