UTRC 2014

Transportation Symposium

Session 7 Transportation Simulation

contributed by
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A view to future models for transportation

- The 21st Century IT-driven potential
- How intelligent is IT-intelligence?
- Research questions and simulation

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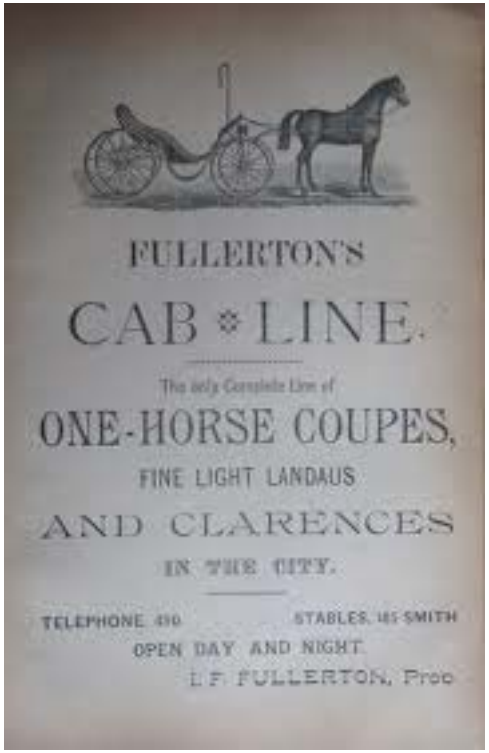
Dramatic changes in past 20 years



Although the technology was much advanced by 2000, the basic operation of public transportation remained the same as in the 1900's

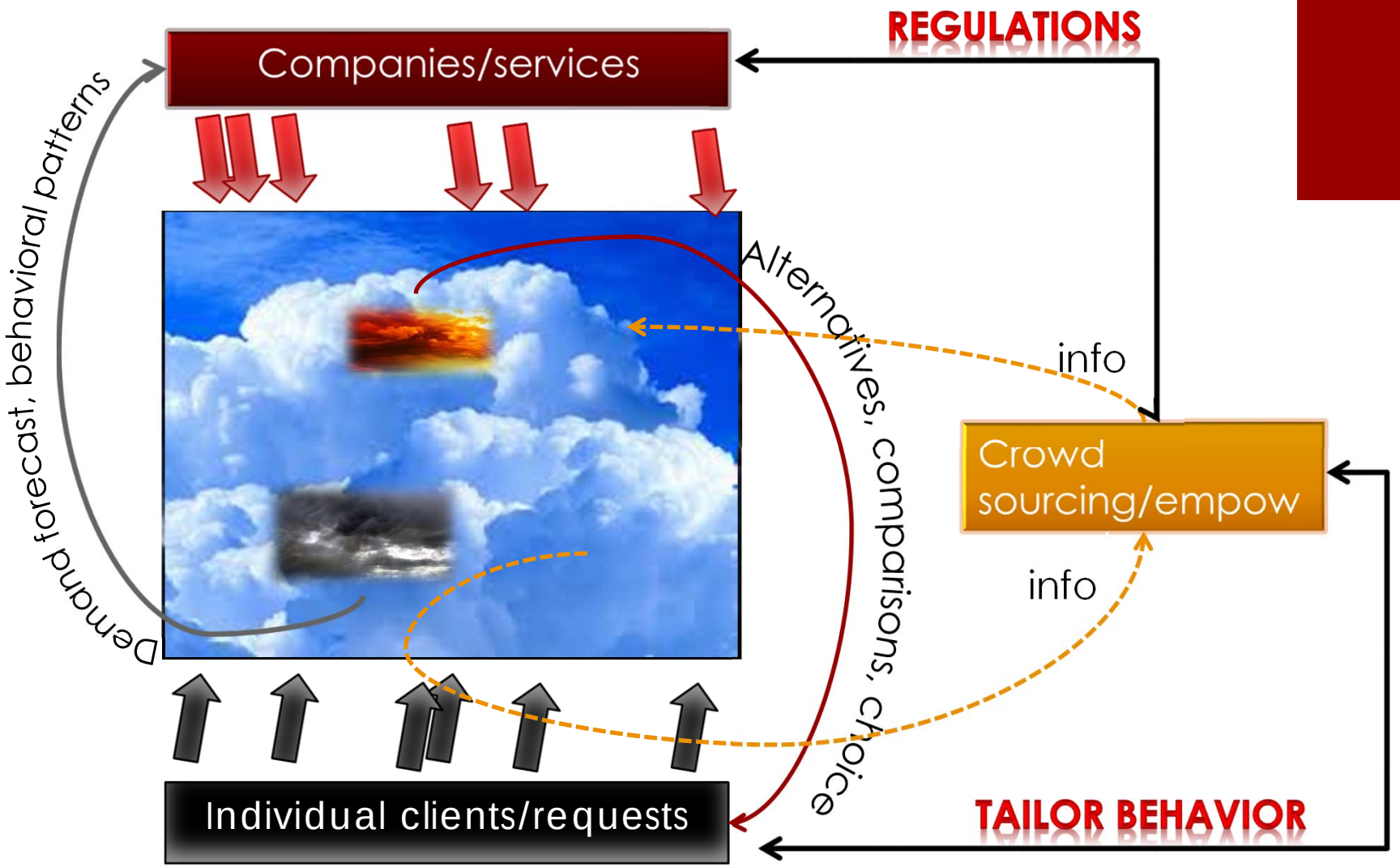
What do we see now?

- Demand: exponential growth in urban areas
- Reservations: new apps for handheld devices
- Vehicles: state of the art sensor and wireless communication technologies
- Cloud computing: data analysis, forecasts, patterns, reservations (allocation algorithms)
- Optimization: demand satisfaction, mathematical models for cost optimization, opportunities
- Intelligence: IT-driven systems, crowd sourcing

Future public transport

Information and Sensor technology

- Client patterns, traffic and routing information for providers
- Routes, availability, choices, prices for individuals
- Energy consumption, health indicators
- Feedback information from crowds
- Need to understand interactions and “big data”.


REGULATIONS
Companies/services
Demand forecast, behavioral patterns
Alternatives, comparisons, choice
info
Crowd sourcing/empow
info
Individual clients/requests
TAILOR BEHAVIOR

What can we do better?

- Demand: exponential growth in urban areas, use this to generate better data for analysis
- Reservations: apps for information, empower public decisions
- Vehicles: state of the art sensor and wireless communication technologies
- Cloud computing: who is in charge? Controls? Algorithms? Communication?
- Optimization: emphasize environment and human health priorities, not just profits
- Intelligence: IT-driven self-awareness, crowd sourcing and engagement
- Mathematical modeling: study pricing models and understand systems' reactions, complex simulations, multimodal transit, behavior, etc.

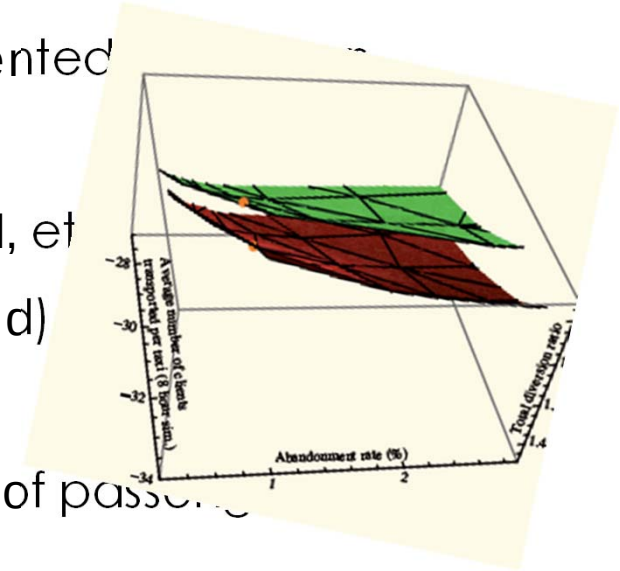
How many idle taxis?
How long the wait?

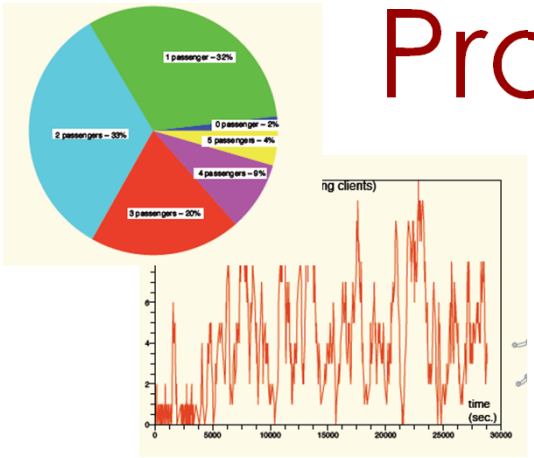
Collective Taxis

Work done for the Paris metropolitan area (Cohen, de la Fortelle, Lioris). How it works:

- Clients may hail an occupied taxi at any “node”
- Control accept/reject algorithms: based on route deviations and delays
- Environmental, economic and social impact:
  - Reduction of idle vehicles
  - Impact for affordable better transport
  - Demographics, system provides the “best of both worlds”

- Control algorithms are based on thresholds
- All data analytics can be implemented
- Discrete event simulation to assess
  - Time statistics (dialogue, travel, et
  - Client abandonment (threshold)
  - Queue lengths at nodes
  - Taxi occupation, avg number of passe
    time statistics, etc





Proof of Concept

Computer Simulations

By Jennie Lioris, Guy Cohen

Extensions; pubic transport on-demand

- Central operation: read current traffic conditions and schedule vehicles
- Reservations: handheld devices for communication (optimal allocation)
- Optimization: acceptance of clients and reservation rules based on threshold policies (sensitivity analysis)
- Economic modeling: study pricing models with priorities, relationship between cost and thresholds

Towards Intelligence

- Meta-model: data analytics to learn about patterns
  - customer behaviors,
  - traffic patterns,
  - demand,
  - availability
- Use machine learning algorithms to predict changes and provide better planning
- Advantages of “software-based” adaptation: infrastructure costs, disruptions, etc.

The Public Bikes

Are they suitable for Manhattan?

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How it works

- Short distance, **shared** bikes
- Membership for residents, or daily/weekly passes for tourists
- Any time, anywhere, for “free”
- Targets healthy population, movements within city centers
- Environmental impact, health impact, economic impact from shared resources

Is it working?

SECTIONS

The New York Times

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Citi Bike System Successful, but Wobbly From the Start

By MATT FLEGENHEIMER MARCH 26, 2014

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The hard truth lurked behind the gates of the Brooklyn Navy Yard, where employees of Citi Bike were tasked with testing the program last spring after nearly a year of delays.

As workers soon realized, the system was not completely ready, plagued fussy software and managed Oregon company that its sprawling

A Citi Bike repair and storage station underneath the Williamsburg Bridge on Delancey Street in Manhattan. Ashley Gilbertson for The New York Times

Citi Bikes' Canadian manufacturer files for bankruptcy: report

Montreal-based PBSC Urban Solutions, a nonprofit known as Bixi, has debt of almost 50 million in Canadian dollars, the Montreal Gazette reported.

NEW YORK DAILY NEWS / Tuesday, January 21, 2014, 2:26 AM

AAA

Can we save the Public Bikes?

Availability. Failures when no bikes or no posts when needed. We model customer behavior.

Solution 1: Software based changes only

- Improved availability by up to 20%
- Improved safety on roads, decreased vandalism
- Improved utilization

Solution 2: . Pricing alternative

- Exploit wisely the use of alternative pricing. Use simulations to decide on a pricing system.

Pilot simulations show feasibility, on-going study.

Parking agents

Intelligent streets?

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Intelligent parking agents

- Use information from available parking
- Create learning algorithms for visual recognition of free space
- Allow for reservations
- Cloud computing to “pool resources”
- Improve traffic, safety
- Simulations to assess feasibility, data requirements and economic analysis (tipping points)

Conclusions

- City transportation: public or private: challenges due to growth

- Alternatives must be studied together

- Use of computer simulations to assess feasibility

Novel approaches for simulations

- Tipping (critical) points: how much do we have to change to assess significant improvement

- Focus on sustainable systems, rather than individual profit, and safety on the street

Collaborations

- Students at Graduate Center and Hunter College: Tereza Shterenberg, Thomas Flynn, Agis Mesolongitis, Luis Silva Yáñez, and others.
- Current research plans with Ted Brown, Carson Farmer, Carlsten Kessler, Hongmian Gong, Matt Daus, Olympia Hadjiliadis, Ioannis Stamos.
- International collaborations Frédéric Meunier, Ecole des Ponts et Chausées and Arnaud de la Fortelle, Ecole des Mines, Guy Cohen, etc.

- Projects for joint collaboration
- CUNY ideally placed to get involved in community development
- Please give us your ideas

Thank you!