

Incentive Mechanisms for Societal Networks

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Background

Research

Until 2008: Computer Networks—Internet Algos, Cloud Computing

2008—2015: Societal Networks—Transportation, Wellness, Recycli

Dec 2007

I visited Bangalore...



me

08—2011: Stanford Research

Developed large-scale “nudge engines” for:

- Infosys (Bangalore)
- Singapore Public Transit
- Stanford (U.S. DoT)
- Bay Area Rapid Transit (BART)
- Accenture, USA → Wellness

12—now: Urban Engines

- Co-founded with some students and ex-Googlers
- Developed a big data system for large-scale mobility networks
 - Transportation systems: road, bus, train (metro) systems
 - Logistics and delivery chains
- Urban Engines acquired by Google (Google Maps) in Sep 2016

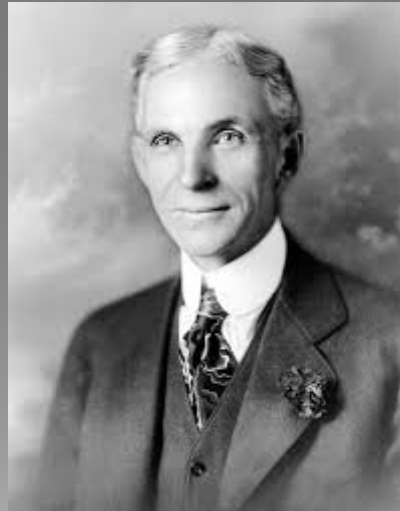
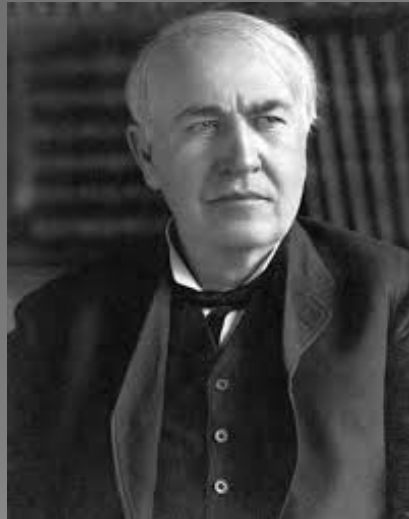
Smart City Programs: A Personal Perspective

Engineering at the beginning of the 20th century

Civil Engineering, Mechanical Engineering, Power Engineering

→ Call it the Edison-Ford type of engineering

→ *Highly resource-constrained, "built to last"*



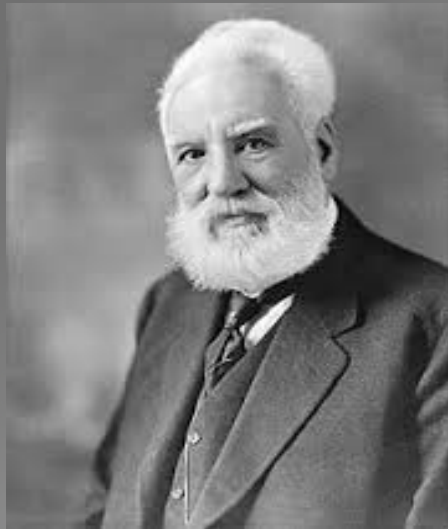
Smart City Programs: A Personal Perspective

Engineering in the middle of the 20th century

Electrical Engineering (VLSI, Comm) and Computer Science

→ Call it the Bell-Watson type of engineering

→ *Moore's law, short product cycles, disruption*



Smart Cities = Bell-Watson-ites working with Edison-Ford-

Urban Immobility







JanDC Filmkes

The Telegraph

HOME NEWS SPORT FINANCE COMMENT CULTURE TRAVEL

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China

Chinese drivers stuck in the longest traffic jam

Authorities in China are racing to unscramble the world's longest traffic jam, a 60-mile tail of trucks stretching from the capital Beijing to the northern province of Inner Mongolia.



A jammed section of the Beijing-Zhangjiakou highway in Huailai, in north China's Hebei province Photo: AP

**Not just commuter
frustration and indignity...**

The Cost of Congestion

Time and fuel wasted (TTI)

- \$115 billion In 2007
- \$121 billion in 2011

Emissions due to traffic

- 27% of all U.S. emissions (EIA)
- 25% for U.K. (DoE&CC, UK)

Safety, ...



The Visible Problem

Demand >> Supply

The Real Problem

Dated Transportation Architecture

Transportation Architecture of the 20th Century

Agencies / Operators



Departments of Transportation

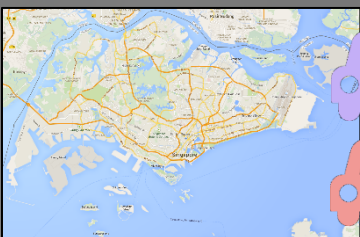
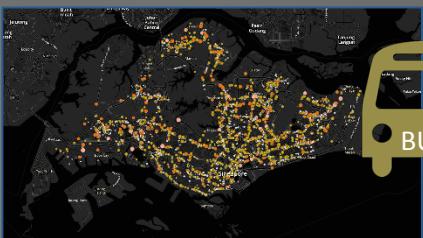
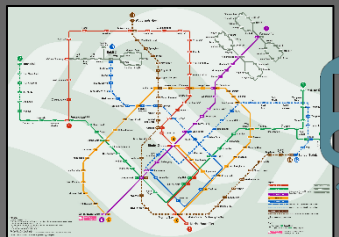


Public transit operators



Taxi companies

Networks



Commuters



No flow of information
Demand doesn't talk to supply!

Transportation Systems of the 21st Century

Agencies / Operators



Departments of Transportation

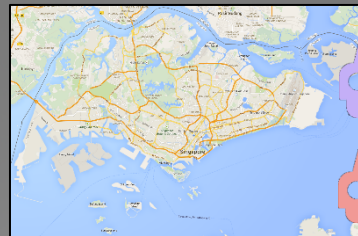
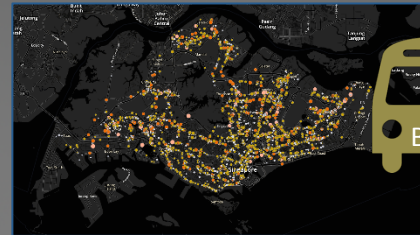
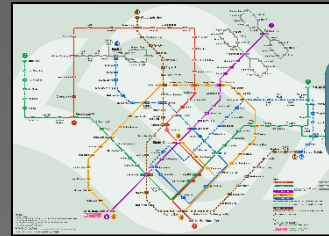


Public transit operators

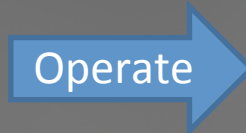


Taxi companies

Networks



Commuters



Transportation Systems of the 21st Century

Agencies / Operators



TAXI



Networks



Commuters



Real-time analytics



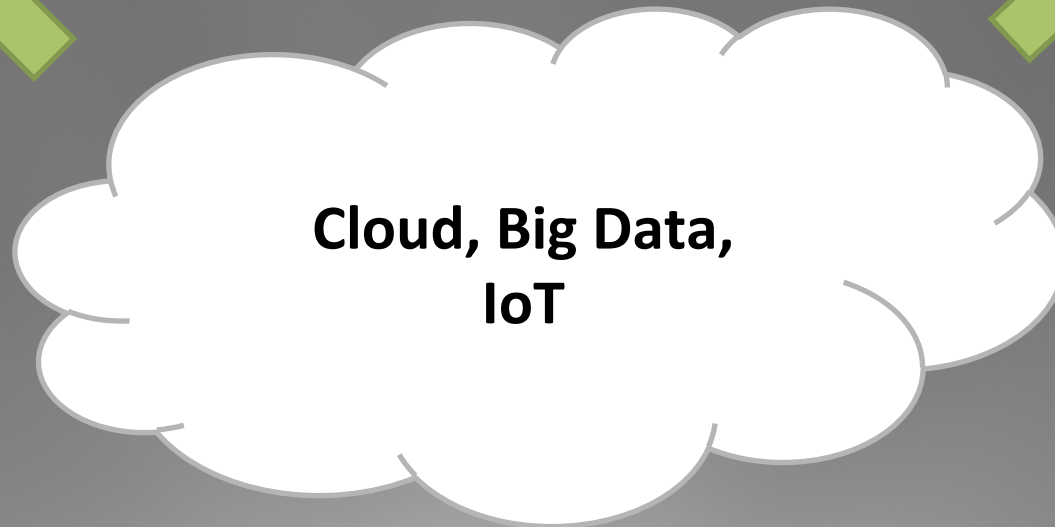
Real time usage data



Incentives



User behavior



Transportation Systems of the 21st Century

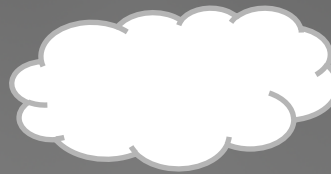
Agencies / Operators



Networks



Commuters



Key Enablers

Cheap, ubiquitous sensors



GPS



RFID/NFC



Bluetooth

Abundant bandwidth



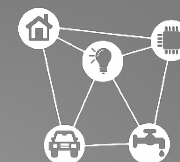
Cellular



WiFi



Technological advances



Internet of Things



Cloud computing



Big data

Commerce and Retail in the 20th Century

The Producers Designers/Manufacturers



Stores

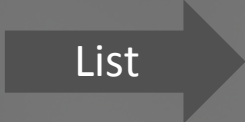


The Consumer Customers



Commerce and Retail in the 21st Century

The Producers Sellers/Manufacturers



Online + Delivery



eCommerce + Delivery



Pickup + Delivery



The Consumer Customers



Basic Problem

Demand >> Supply

Our Work

Increase supply using
big data, matching markets



Demand >> Supply

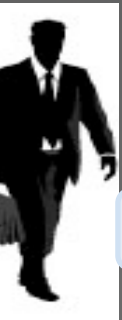


Reduce demand using
incentives, not penalties

Incentives: Singapore MRT

- The INSINC project
 - Primary goal: Incentivize offpeak travel
- Launch and current status
 - Stanford + NUS, Jan—Jun 2012
 - Urban Engines, July 2012
 - Currently: Travel Smart Rewards
 - 380,000+ registered participants & 75+ corporate members
 - Shift in peak load: ~ 10%

INSINC Demo



Commuter



Electronic Ticket

Commuting History

kms to credits
3x for off-peak

The Insinc portal

Credit History

| Date | Time | Credits |
|----------------------------|----------|---------|
| 15 th June 2010 | 09:00:19 | 20 |
| 16 th June 2010 | 08:10:45 | 10 |
| 16 th June 2010 | 16:20:17 | 22 |
| 18 th June 2010 | 06:15:20 | 20 |



Rewards



INSINC: Jan 2012—June 2012

registered/admitted and activated

22867/20319

random/deterministic redeemers

87.6%/12.4%

number of recommend-a-friend emails sent

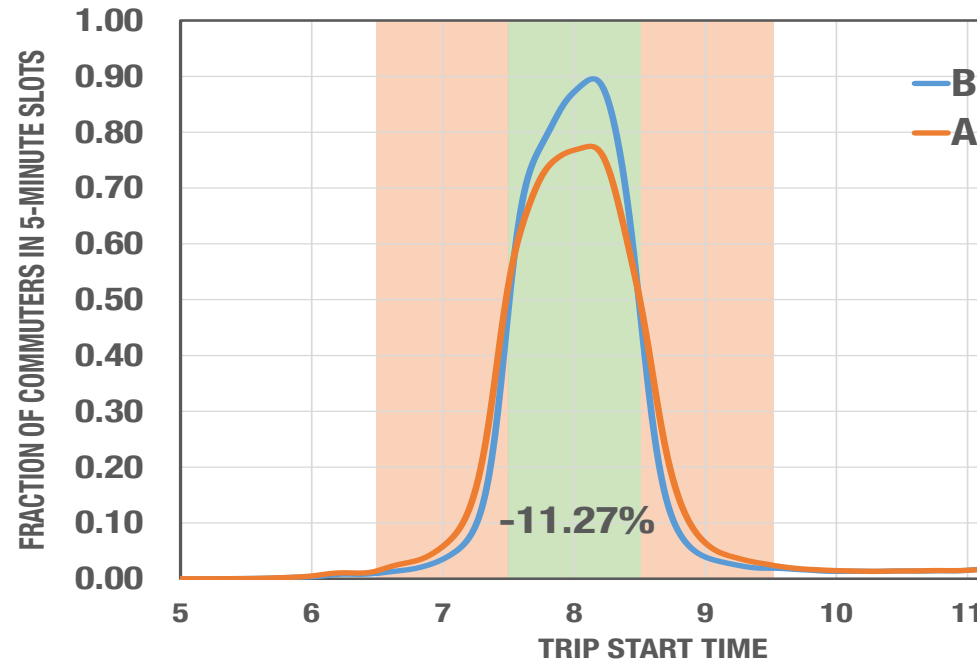
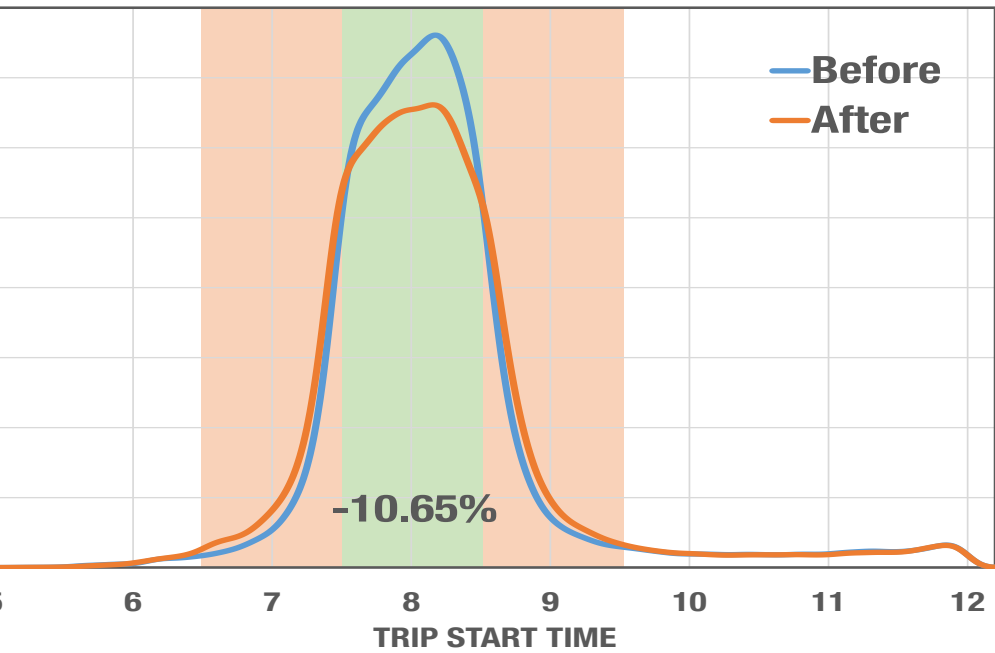
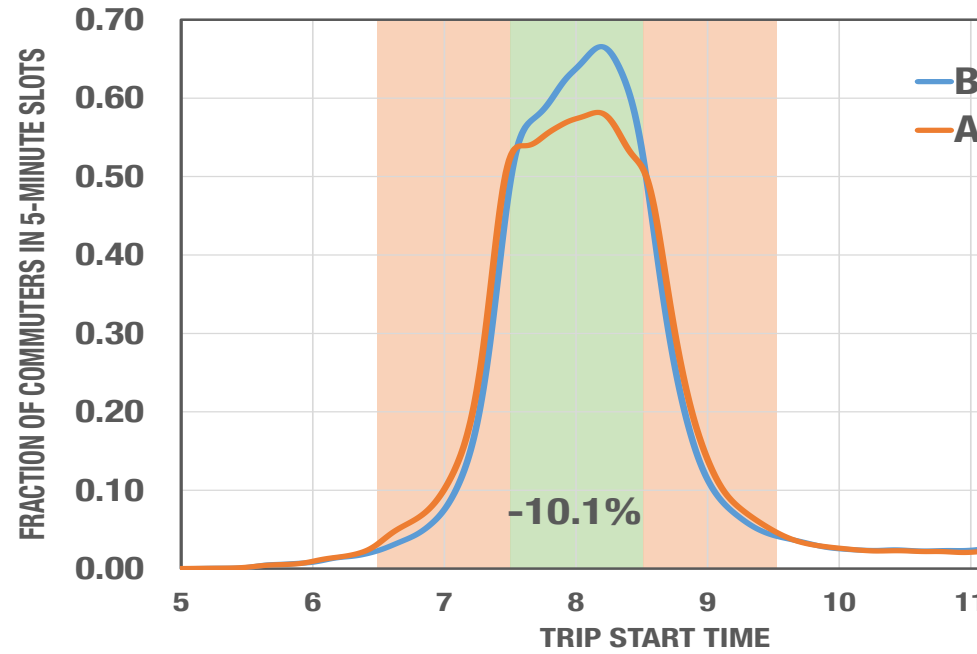
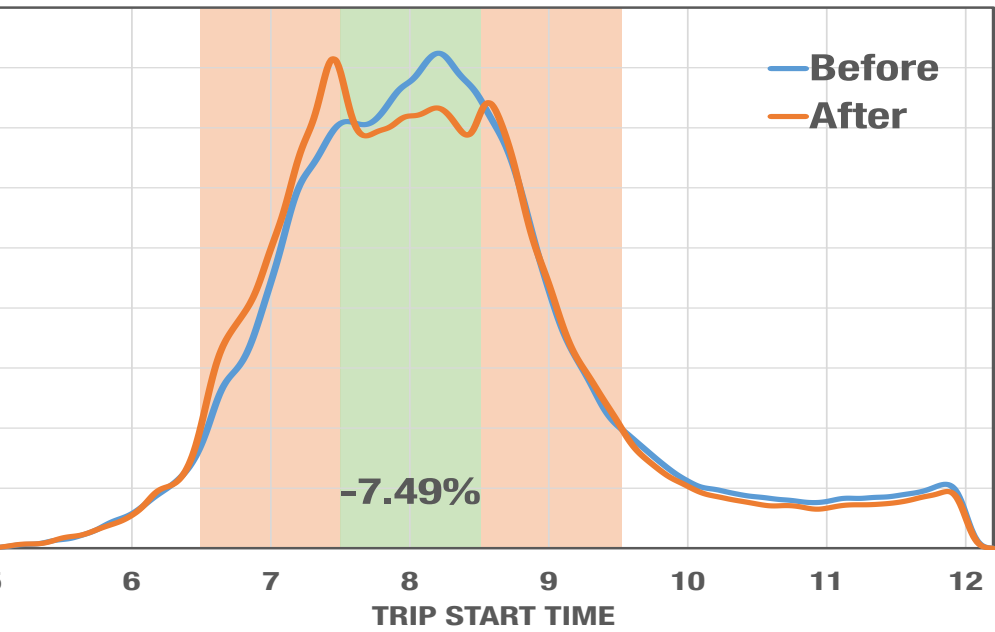
98834 (excluding reminders)

people with friends

12163 (59.9%)

total rewards (including referral and joining bonuses)

\$137,639



| Group of participants | All in the group | Mild peakers | Medium peakers | Heavy peakers |
|--------------------------------------------|------------------|--------------|----------------|---------------|
| All participants | - 7.49 | - 10.10 | - 10.65 | - 11.20 |
| Participants with Insinc friends | - 9.70 | - 10.61 | - 11.14 | - 11.40 |
| Participants without Insinc friends | - 3.70 | - 9.00 | - 9.69 | - 10.70 |
| Online players | - 8.40 | - 10.79 | - 10.92 | - 11.30 |
| Participants with a friend exchange | - 5.07 | - 10.24 | - 10.96 | - 12.10 |
| Participants with short distance commuters | - 4.96 | - 10.49 | - 10.83 | - 11.80 |
| Participants with long distance commuters | - 9.13 | - 9.77 | - 10.51 | - 10.80 |

Our Work

Increase supply using
big data, matching markets



Demand >> Supply



Reduce demand using
incentives, not penalties

Things that move in a city

GPS



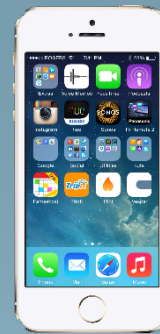
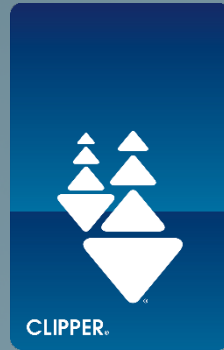
Smart travel card



Smart phone



Barcode / RFID



Lots of data, but it is...

Piecemeal: tap-in/tap-out, train loads, ...

Error-prone and noisy: needs healing and curing

Siloed: different orgs, database technologies and formats

What's needed: A system and algorithms for solving a massive jigsaw puzzle