Technology And Cities: A Systems Perspective

Daniel Roos
Professor Emeritus of Engineering Systems
Founding Director Engineering Systems Division

MIT
Cambridge, MA

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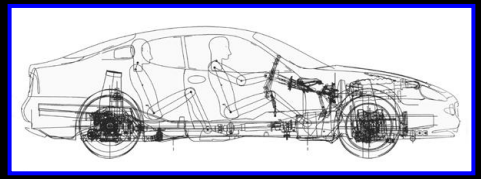
Technology and Cities
The Need For A Systems Perspective

- Technology Provides Transformational Opportunities
  - Reinvent Existing Cities
  - Develop New Cities
- Need For Systems Perspective
- Cities Consist Of Systems-Transport, Energy, Water, Buildings
  - Increased System Scale And Complexity
  - Multiple Objectives-Resilience, Flexibility, Sustainability
  - Increased System Connectivity
- The City Is A System Of Systems-Focus On Transportation And The Automobile

Automotive System of Systems



ITS, GPS

Smart Grid

Internet

Infrastructure System

Energy System

Information System

Intelligent Transportation Systems (ITS)

- Electronic Toll Collection
- Driver Navigation Systems
- Transportation System Management
  - Optimize Traffic Signals
  - Control Ramp Access
  - Freeway Incident Management To Speed Removal Of Disabled Cars
  - Parking Lot Availability, Smart Meters
  - Road Pricing To Limit Entry To Central City

An Information Infrastructure
To Manage and Control The Physical Infrastructure

Electronic Road Pricing (ERP) in Singapore

North Bridge Road, Singapore

Automotive Energy System: Smart Energy Networks

Renewable energy source

Electricity flows into the "grid"

Smart Grid

Excess electricity can be stored in a driver's EV battery and uploaded back to the grid when the wind is not blowing

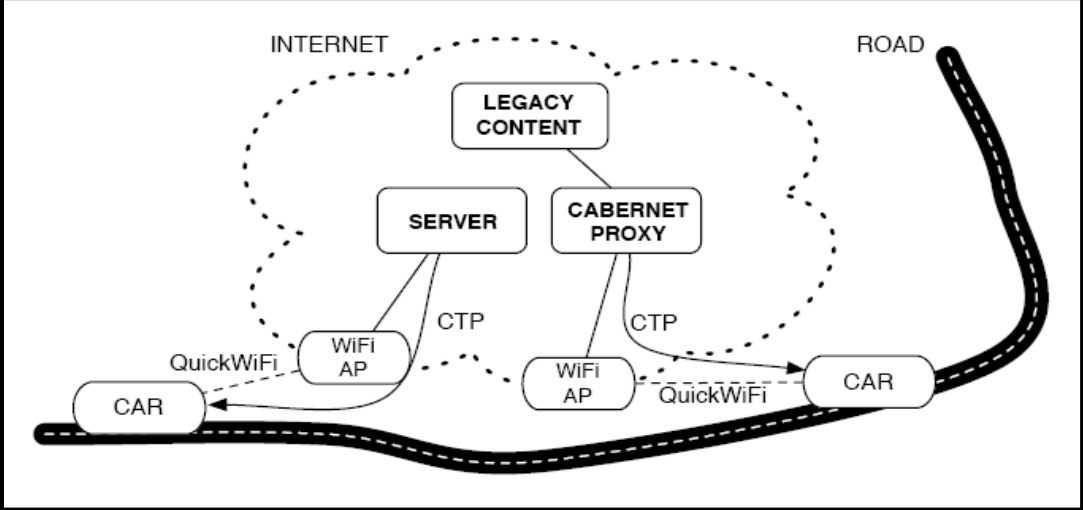
Driver's home and Charge Spot

Driver's EV

Source: Better Place

Automotive Communication/ Internet System

- Vehicles Can Communicate With Each Other
- Connectivity To The Internet Using Internet Standard, WiFi



Source: Eriksson, J., Balakrishnan, H., Madden, S., 2008

Disruptive Technology
Autonomous Driverless Vehicles

- Google- 12 Driverless Vehicles
- Artificial Intelligence Software-Video Cameras, Radar, GPS, Light Detection, Remote Sensors.
- Legal In Three States – Nevada, California And Florida
- Many Benefits:
  - Safety
  - Mobility For Elderly Unable To Drive
  - Productivity – Platooning, Increased Roadway Capacity
  - Remote Parking
- Google Predicts Implementation In 5 years
- Volvo, VW, BMW, Cadillac-Traffic Jam Assistance in 2014

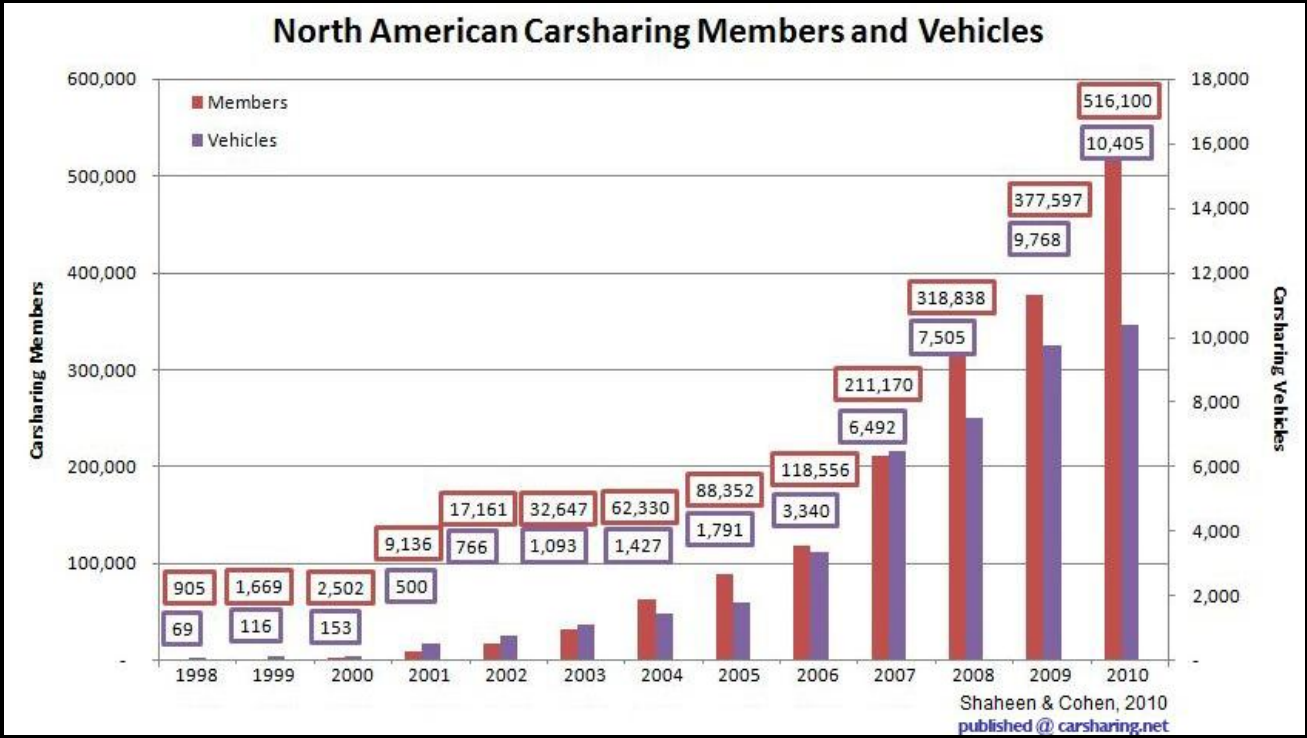
Alternatives To Auto Ownership
Mobility On Demand

- Short Term Car Rental
- Drive When You Want Without Ownership

zipcar wheels when you want them

cars by the hour or day,
just around the corner.
(gas and insurance included)

Owner Car Sharing Systems



Velib Bike Rental System – Paris, France

- 23,500 Bikes, 1,400 Stations
- 110,000 Daily Trips – Tourists And Residents
- Expanded To 34 French Cities And Implemented Throughout The World

LES NOUVEAUX PRIX

	Les nouvelles offres		2007	2011
COURTE DURÉE	• Ticket 1 jour	30 min offertes	1 €	1,70 €
	• Ticket 7 jours	30 min offertes	5 €	8 €
ABONNEMENTS ANNUELS	• Classique	30 min offertes	29 €	29 €
	• Passion	45 min offertes		39 €
	• 14 - 26 ans	45 min offertes		29 €
	• Boursiers et insertion pro	45 min offertes		19 €

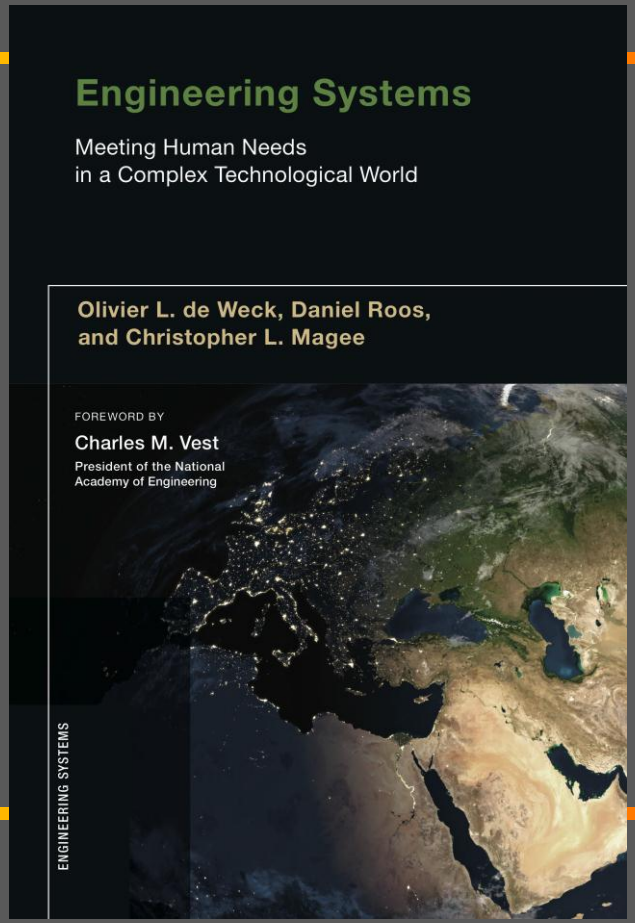
Transportation Technology Impacts On Urban Planning and Development

- Less Reliance On Autos-Changes In Consumer Behavior
  - Younger Generation Substitutes Internet Experiences
  - Fewer Trips – Shop at Home, Work at Home, Satellite Offices
  - Auto Sharing VS. Auto Ownership-Entrepreneurship Opportunities
- More Efficient Travel
  - Transportation System Management
  - Driver Information on Where, How, When to Travel
  - Road Pricing To Encourage Transit Use and Balance Peak/Off Peak Travel
- Reduction In Infrastructure Needs
  - Digital Investments Rather than Physical Investments
- Two Way Balanced Energy Flow
  - Electric Vehicles and Smart Networks
- Disruptive Technology-Automated Vehicles
  - System-Wide Changes
  - Who Controls the Supply Chain

The City Is A Socio-Technical System

- Technology Is Significant But Not Sufficient
- Urban Planning and Development Needs to Include:
  - Individual and Societal Objectives, Livable Cities
  - Facilitate Technological Innovation, Entrepreneurship, Creative Communities- Cities Impact Technology
  - Social, Political, Economic Factors
  - Institutional Opportunities – Public, Private Partnerships
- Utilize Interdisciplinary Engineering Systems Approaches- Integrate Technology, Management, Social Sciences

NEW MIT PRESS BOOK ON ENGINEERING SYSTEMS



THANK YOU!

Overview

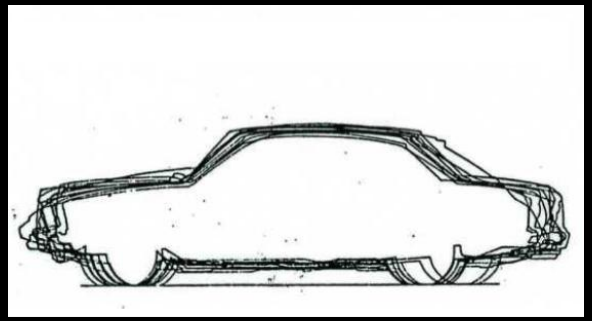
- The City As A System Of Systems
- The Transportation System Of Systems
- Transportation-Energy-Communications
- How Communications Technology Will Transform Automotive Travel And Automotive Ownership
- How That Transformation Will Affect Urban Form And Urban Design
- Utilize New Computational And Modeling Approaches For Urban Design – Big Data, Data Mining, Urban Metabolism Models.

Product – Dominant Design

- Automotive Architecture (ICE+Chassis+Wheel+Body) Has Existed For 120 Years
- Styling: Convergence

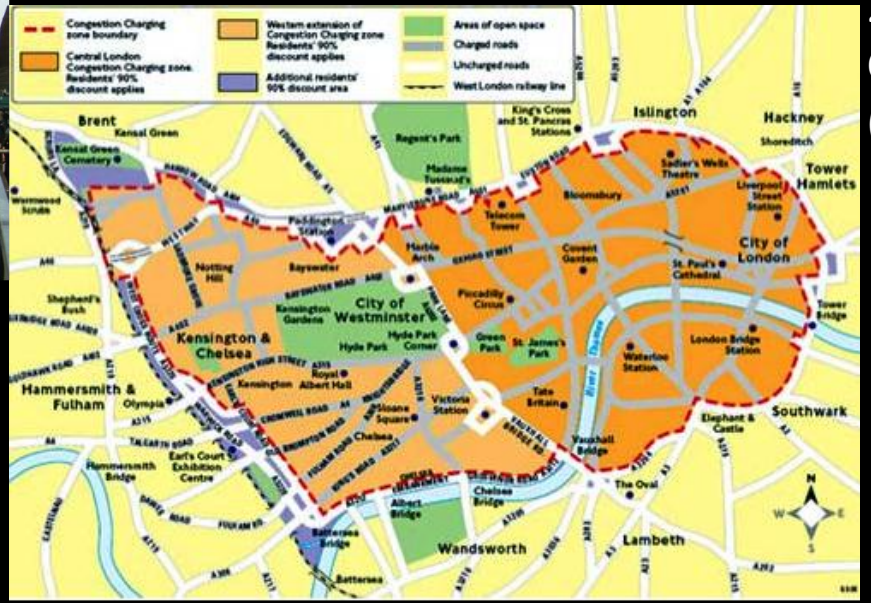
Model T

Longitudinal Cross-Section of 10 European Upper-Middle-Class Cars



The Central London Congestion Charging Zone

Old Street, London



2003 Original Charging Zone (8 Square Miles)

Zone Expanded In 2005

New Business Model: Better Place

As a renewable energy source, intermittent wind power generates electricity

Electricity flows into the "grid"

Better Place Grid

Excess electricity can be stored in a driver's EV battery and uploaded back to the grid when the wind is not blowing

Driver's home and Charge Spot

Driver's EV

Electricity Flow

Source: Better Place

Higher Resolution Research

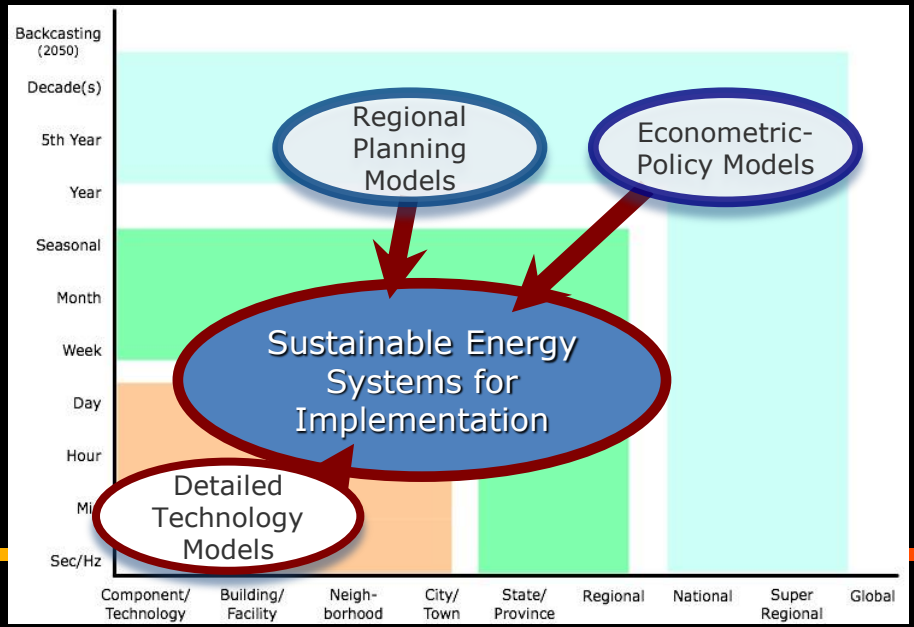
The Convergence of Planning and Operations in Energy Systems Design and Implementation

Meso-Scale Modeling

"Designing for the Dynamics"

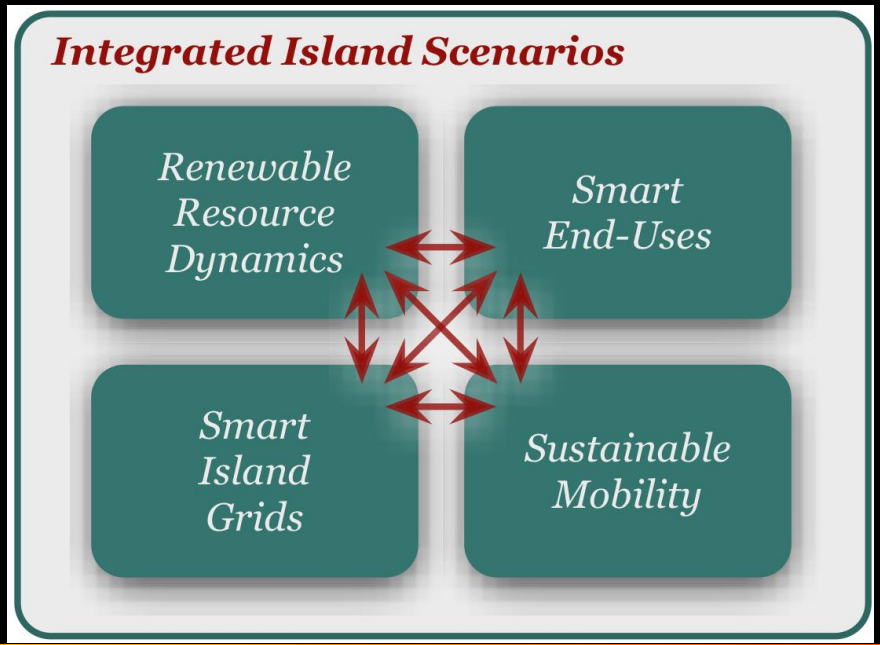
- Aggressive End-Use Efficiency
- Diversify Domestically
- Modernize Energy Networks

- 50-80% Reduction = Local Energy



Green Islands Research Themes

- Five Innovative Research Areas



<u>Meso-Scale Modeling</u>

"Designing for the Dynamics"

- Aggressive End-Use Efficiency
- Diversify Domestically
- Modernize Energy Networks

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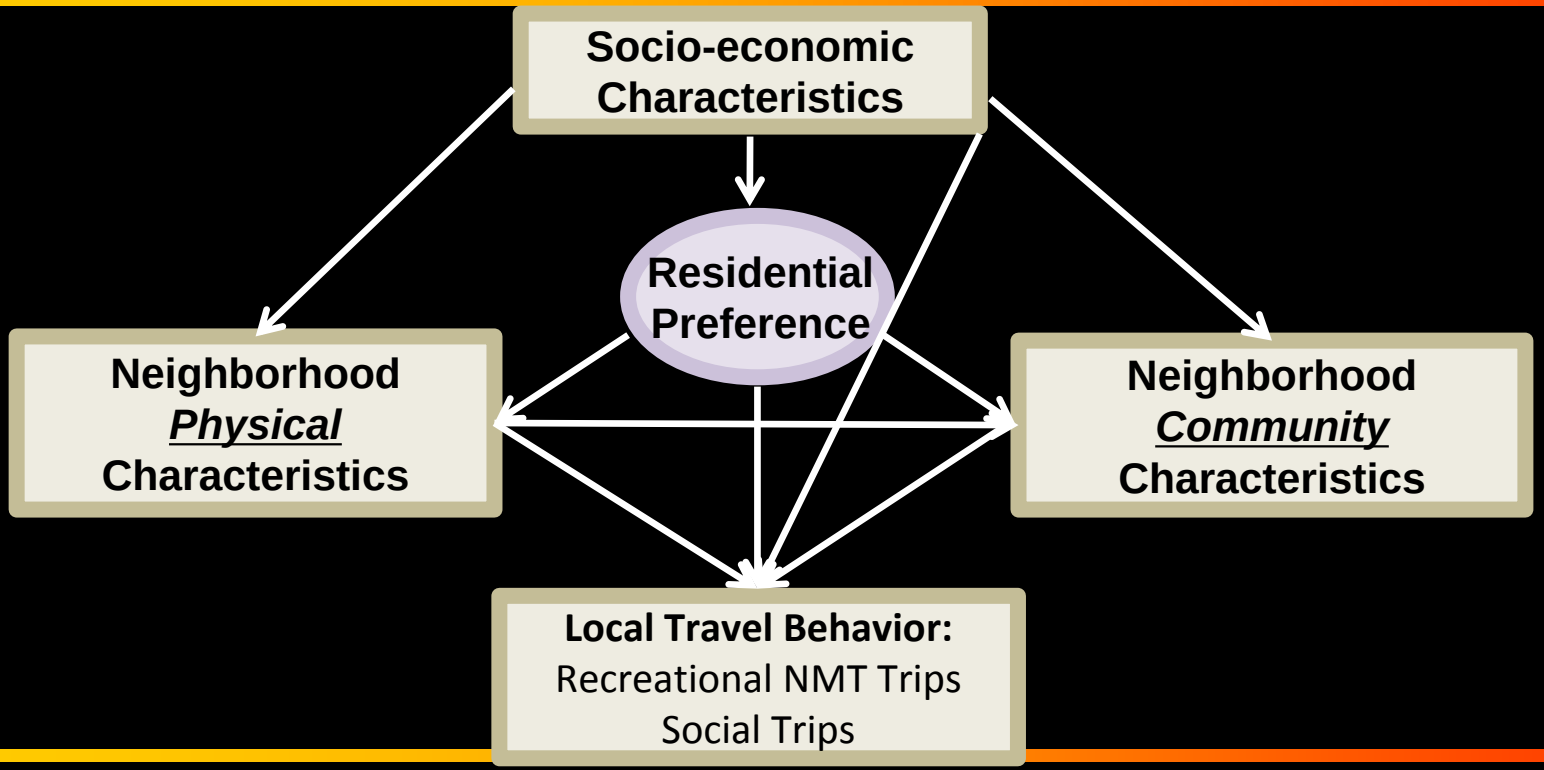
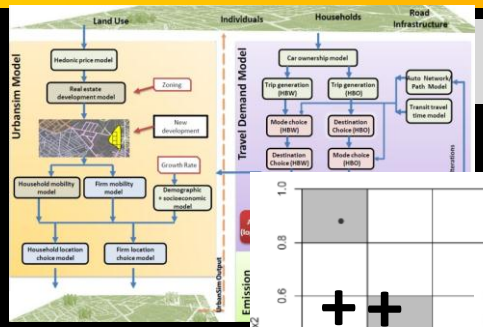
Lessons For The Longer Term

- New, Smart Technologies Need to "Talk to One Another," So Real "Field Tests/Test Beds" Are Essential.
- We Need to Demonstrate Options
  - Technology Demonstrations
  - Integration Demonstrations
  - Commercial Demonstrations

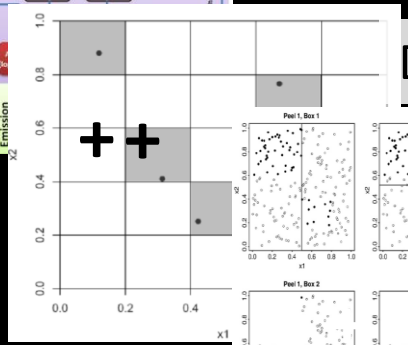
Better Understanding System Interactions Community Or Design?



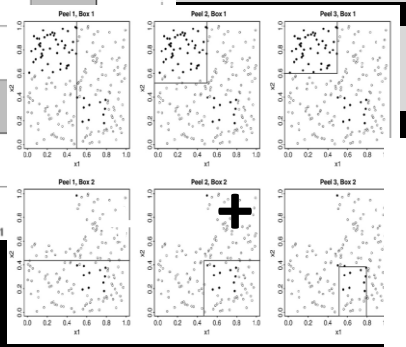
Quantitative Scenario Discovery



Integrated Models



Data Farming



Data Mining

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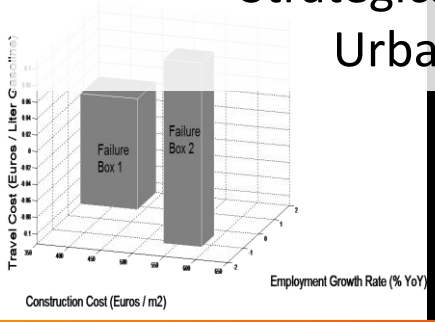
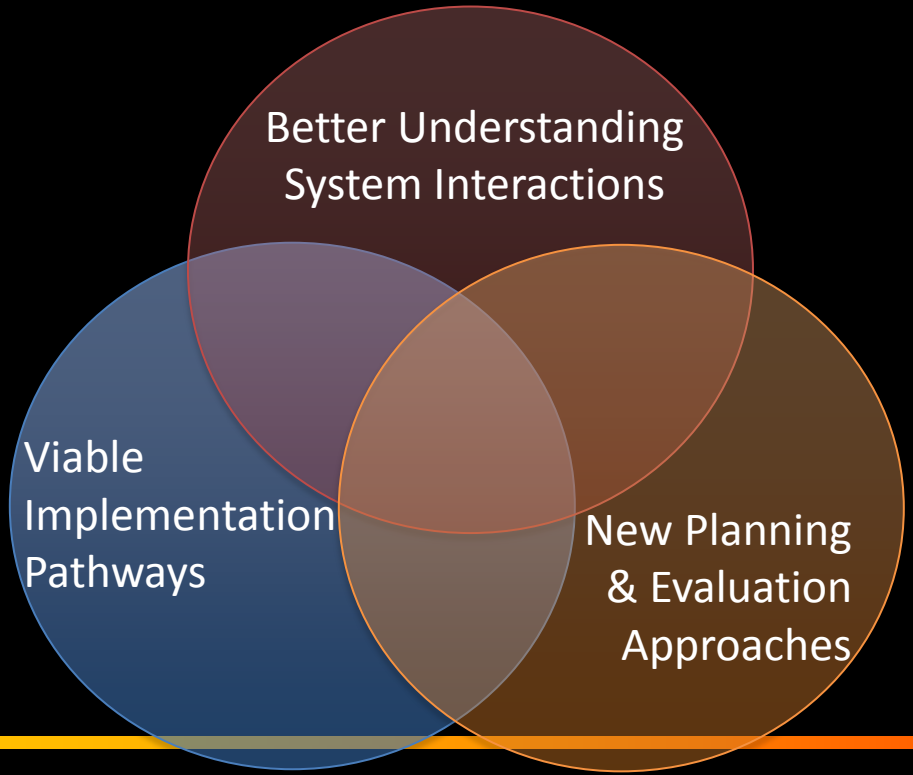
Strategically Robust Urban Planning



Unanticipated Major Changes

- 60's Societal Concerns – "Unsafe At Any Speed", "Silent Spring"
- 70's Energy Crisis
- 80's End Of Cold War
- 90's Internet/World Wide Web
- 00's 9/11 Terrorism/Global Warming

Moving Towards The Sustainable Metropolis Requires



New Automotive Systems

- Car Sharing Vs. Ownership
- Short-Term Car Rental Systems
- Owner Car Sharing Systems
- Bike Rental Systems

Looking Ahead
An Urban Transportation System

- Less Reliance On Automobiles
- More Efficient Use of Automobiles
- Increased Modal Choices
- An Inclusive Transportation Pass
  - Public Transport
  - Taxi
  - Bicycle Rentals
  - Short-Term Car Rentals
  - Owner Car Sharing