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My Course Overview

Massachusetts Institute of Technology

Urban Transportation Planning

MIT Course 1.252j/11.380j

Fall 2006

Mikel Murga, MIT Research Associate and Lecturer

MIT First, a confession...

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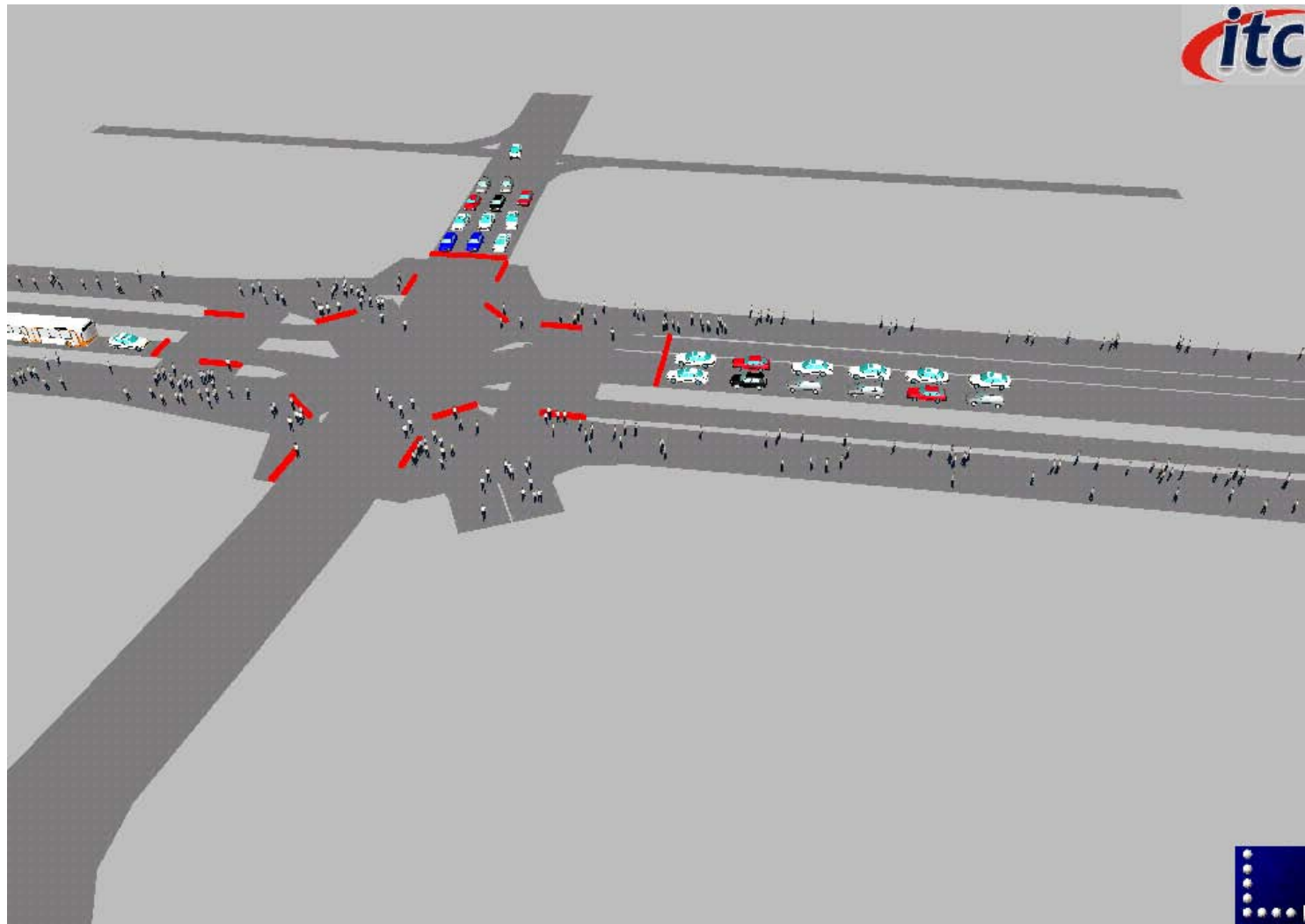
I make a living selling ideas to design roads, to upgrade transit systems or to rehabilitate cities and towns



MIT First, a confession...

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Day 1

Transport a Complex Organic System

- The microscopic simulation shows pedestrians, cars, buses, taxis... We are trying to model individuals:
 - Who appear to behave sometimes in irrational, chaotic or emotional ways
 - Who are driven by habits (change takes time!)
 - Who learn and adapt (specially under worsening conditions)

- Predicting their collective behavior through models is never easy. That is why we do not have “to educate them”, but rather:
 - Observe their behavior and search for their “logic bubble”
 - Ask their opinions and find out about their perceptions

Transport a Complex Organic System

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- Many of us went into Engineering to deal with predictable systems, but NOT WITH PEOPLE!

In Engineering Schools:

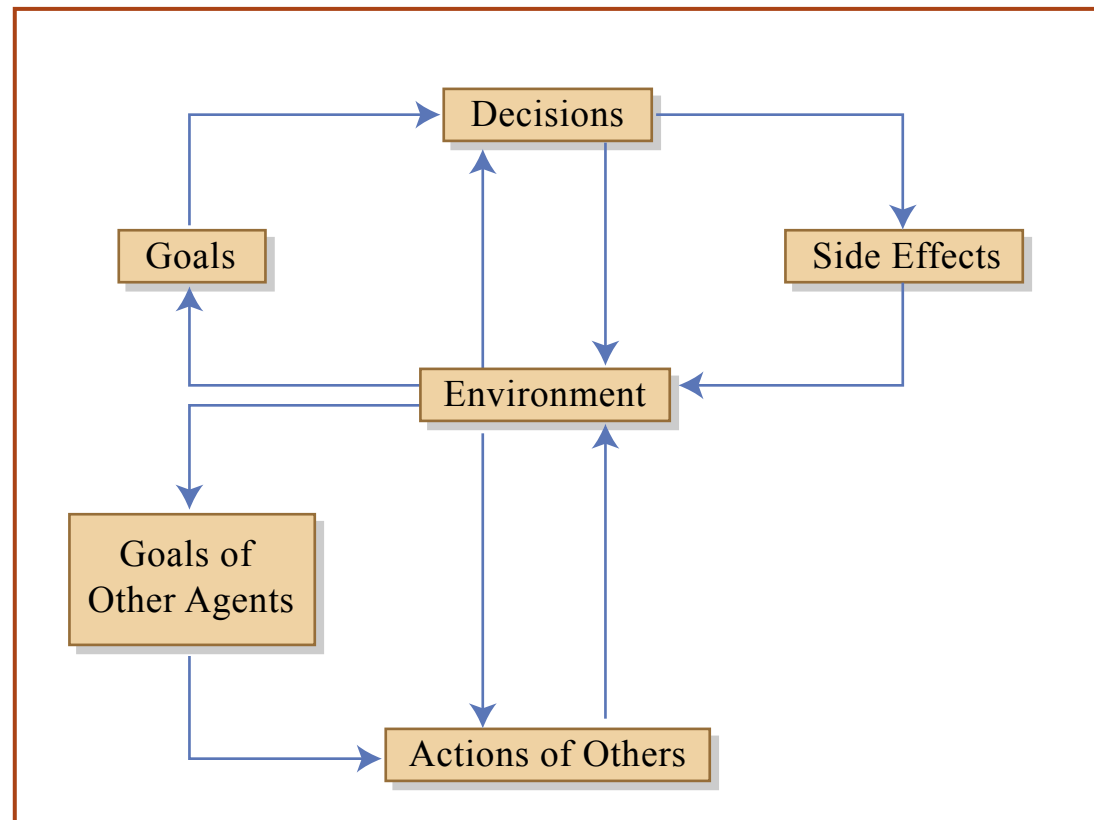
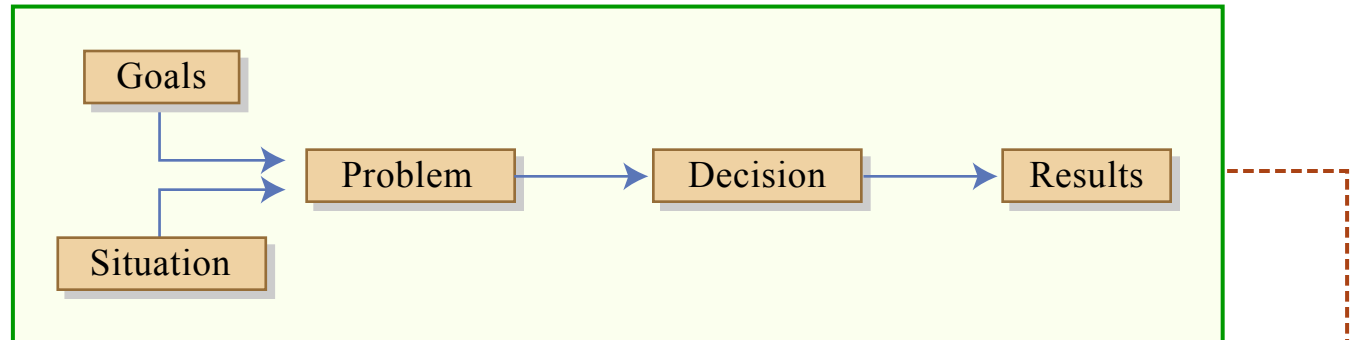
- This is THE problem
 - We want THE solution
-
- Transport deals with people who appear to behave: Irrationally, Intuitively, Unpredictably ...

Transportation: A Complex System

- Action and reaction:
 - Same dosage, different reaction
 - Learning and adapting
 - Space and time non-linearities
 - Latent demand
- Facts and perceptions:
 - Elected officials believe that voters...
 - Voters believe that...

Systemic Thinking

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From: *Business Dynamics*,
by John Sterman

ROAD CONGESTION SYSTEM COMPLEXITY

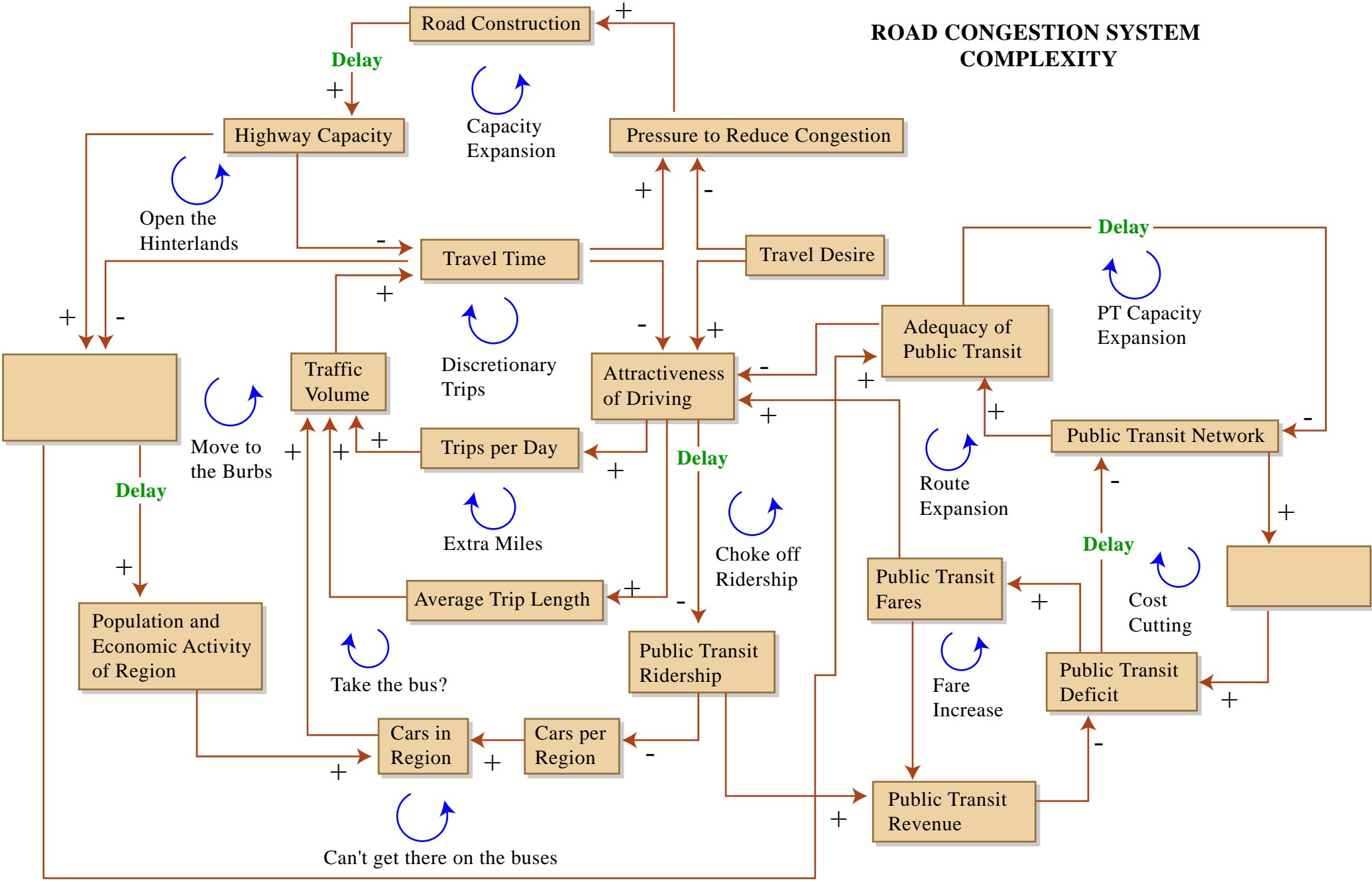


Figure by MIT OCW.

Transport a Complex Organic System

- We need a holistic approach to transportation to recognize and take advantage of all the interactions among:
 - Transportation modes
 - Land use
 - Quality of life of residents
 - Economic development
 -

- Just focusing for instance on transit will not do it!

Transportation is a great field to be in!

“... simplistic solutions are proposed with sublime assurance, as if the construction of some type of transportation used in another city, would suddenly solve all problems”

“And these large matters are discussed without any organized framework, without any consideration of goals, mostly without any data ...”

“It is almost as if people delight in having an area in which anybody can speculate because nobody knows anything”

Roger L. Creighton, Urban Transportation Planning, 1970

A Quick Overview of Transport Issues

- The automobile
- Transit: Past ... and Future
- Transportation
- ... And Land Use
- Technological Fixes
- Closing Thoughts

- Convenience, comfort, flexibility...
- Who is against the American way of life?
- It drives the economy!
- *Don't leave home without it!*

- How much does it cost?
 - To the driver
 - To the rest of society
- Fixed and operating costs
- What is the required infrastructure?
- What do we mean by externalities?



- Current urban development trends increase car ownership and use
- Car operating costs are lower than ownership costs. So once you buy it...
- Drivers do not pay full costs (despite lobby claims to the contrary)
- Main Threat:
IRREVERSIBILITIES

- Some prevailing popular beliefs:
 - car taxes exceed car induced costs
 - car mobility is a right
 - proper technology will solve the problem
- which together with the lack of "quick fixes", compound the problem



Suburban sprawl:

- A dream made true by the car
- Have we locked ourselves into it?
- What does it imply?
- From city life to *Edge Cities*?



Trends in Modal Split for Daily Travel in the United States (1969-2001)

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Mode of Transportation	1969 ¹	1977	1983	1990	1995	2001
Auto ²	81.8	83.7	82.0	87.1	86.5	86.4
Transit	3.2	2.6	2.2	2.0	1.8	1.6
Walk ²	na	9.3	8.5	7.2	5.4	8.6
Bicycle	na	0.7	0.8	0.7	0.9	0.9
Other ³	5.0	3.7	6.5	3.0	5.4	2.5

Source: Socioeconomics of Urban Travel: Evidence from the 2001 NHTS by John Pucher and John L. Renne, . *Transportation Quarterly*, Vol. 57, No. 3, Summer 2003 (49–77). Eno Transportation Foundation, Inc., Washington, DC.

Federal Highway Administration, *Nationwide Personal Transportation Surveys 1969, 1977, 1983, 1990, and 1995*; and *National Household Travel Survey, 2001*.



US Public Transport Today : Metropolitan Areas

Trends in the Modal Split of the Home-to-Work Journey (1990-2000)

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Modal Split % 1990 - 2000	Car	Transit	Non Motorized	Work at home
Greater Boston	82.7 - 82.7	8.6 - 9.0	6.2 - 5.1	2.5 - 3.2
Chicago Counties	79.5 - 81.5	13.4 - 11.5	4.9 - 4.2	2.1 - 2.9
NY-NJ-CT-PA	65.8 - 65.7	24.8 - 24.9	7.0 - 6.4	2.4 - 3.0
San Francisco - Oakland	81.3 - 81.0	9.3 - 9.5	5.9 - 5.5	3.5 - 4.1
Washington DC- Baltimore	81.5 - 83.2	11.0 - 9.4	4.8 - 3.9	2.7 - 3.5

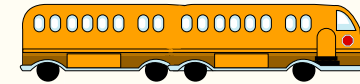
Source: Journey to Work Trends in the United States and its Major Metropolitan Areas 1960-2000

Transit to the rescue!

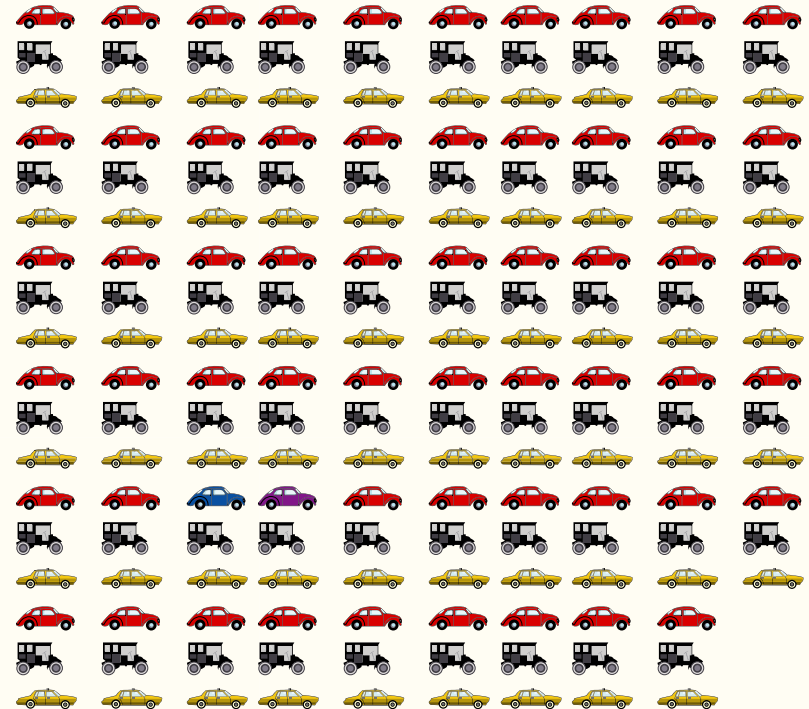
- We are all in favor!
- But **my** case is special
- Choice ... and captive riders
- Levels-of-Service (LOS) like the car?
It's about time!

Is it a panacea?

A tram with say **230 riders** is equivalent to **177 automobiles** with an occupancy ratio of 1.3...
provided they are all choice riders



A tram with 230 passengers is equivalent to



177 automobiles with 1.3 average occupancy

MIT Transit

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Same menu for all
like the Ford T?

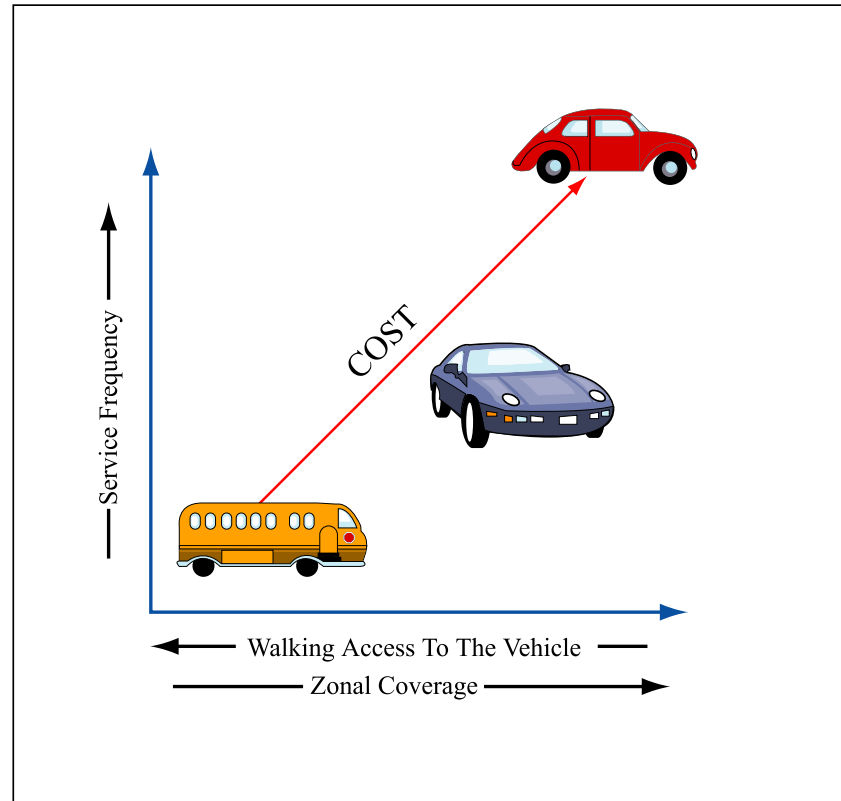


Figure by MIT OCW.

- Every major transit project (as every road scheme) is announced as “the solution”
- Sometimes hard to see the opportunities which open up if the right process is engaged



- How do we rate it a success?
 - Total number of trips?
 - The % of patrons: captive vs choice riders?
 - Total transit trips per capita?
 - Transit share of the overall mobility market?
 - The level of city traffic?
 - The density of jobs?
 - The impact on the real estate and retail markets?
 - The Bump Factor?





The Competition from the Car Road System

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- Urban parking supply is relatively widely available and often free
 - 95% of car commuters enjoy free parking
 - 380 parking spaces per 1000 central city workers in 10 largest US cities
- Highly developed urban road system
 - 6.6 metres of road per capita in 10 largest US cities; 3 times European levels

**Source: The Urban Transportation Crisis in Europe and North America, by John Pucher and Christian LeFevre, 1996.*

Arguments Supporting Public Transport

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- Equity:
 - Access for those who cannot or do not choose to drive
- Congestion:
 - The need for a high-quality alternative
- Land use influence:
 - Public transport is necessary, but not sufficient to change trends
- Environmental:
 - Are car technology strategies effective?
- Energy:
 - Are car technology strategies effective?

Other Arguments Supporting Transit

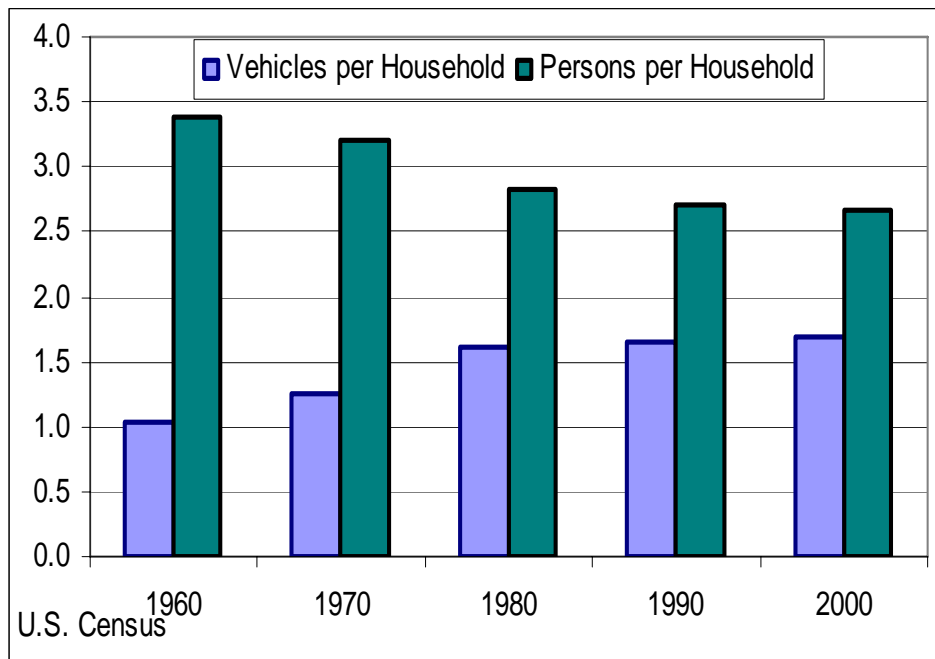
- Transit allows agglomeration of economic activity in cities:
 - New York, Boston, San Francisco, etc could not have developed without transit
 - The current contribution of earlier investments in heavy rail is not valued today appropriately
 - New investments bound to have a lasting impact – thus the need for a long view

Other Arguments Supporting Transit

- Transit is a most effective tool to decrease external costs in cities:
 - These costs may exceed \$1,000 per person per year (Ref: External Costs Study for the Basque Country, 2006)
 - They correspond in order of importance to accident-related costs, impacts on human health, congestion, noise impacts and the current market value of global warming

Other Arguments Supporting Transit

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- Business as usual translates into annual congestion cost today of more than \$ 60 billion/year (AASHTO)
- Implications of the number of automobiles in USA exceeding the number of licensed drivers

Other Arguments Supporting Transit

- Transit reduces the auto ownership need:
 - This should be converted into a yearly stream of net benefits, based on the savings of capital and operating costs (*the hidden part of the iceberg - F.Salvucci*)
 - This and the previous arguments underline the need to define a new evaluation framework for public transport

Other Arguments Supporting Transit

- Transit is often associated to operating inefficiencies, but:
 - Most agencies have already improved efficiency
 - Many of today's new technologies just focus on the quality of service perceived by users, not on efficiency
 - Similarly to other fields (Education, Health...) heavily dependent on local labor, transit is subject to "Baumol's Disease.

Other Arguments Supporting Transit



- The key is the enhancement of the quality of the urban space
- Public Transport can be a catalyst for this process:
 - Melbourne is clearly one of the new success stories as described so well by Jan Gehl (*Places for People*. Melbourne, 2004)
 - Seoul received an award during last year's TRB

Other Arguments Supporting Transit

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Improvement of Public
Transport often brings
enhancements of the quality
of the urban space



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Other Arguments Supporting Transit

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Improvement of Public Transport
often brings enhancements of the
quality of the urban space

Other Arguments Supporting Transit

- The **Land Use** Connection:
- We tend to concentrate our analysis on the disaggregate behavior of individual drivers to anticipate their reaction to system changes
- However a more relevant question is who is **shaping the “maze”** into which the mice are constrained

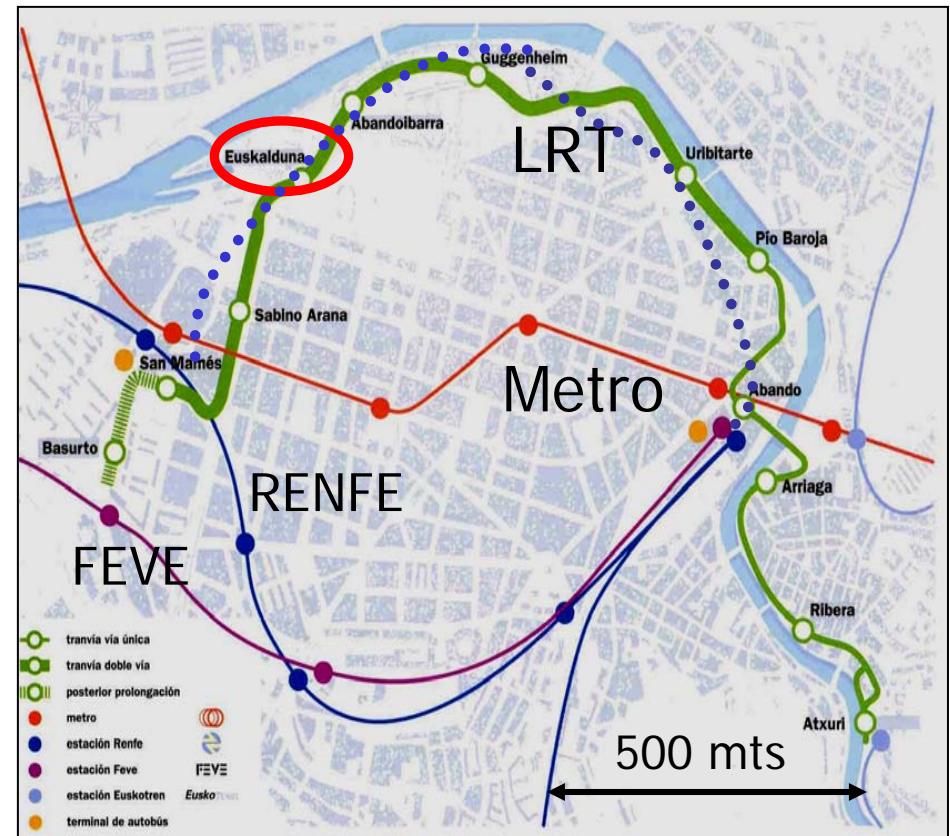
Other Arguments Supporting Transit

- The lesson is that rail transit needs to resume its traditional role as shaper of urban development
- By abandoning that role, highways are the ones guiding the location of new residential and job centers developments

MIT Transit: The example from Bilbao

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- Metropolitan Bilbao, in the Basque Country of Spain, is a good example of balanced investments between highways and transit
- In the last decade, the transit network added a state-of-the-art new subway, a new Light Rail and new refurbishment of the RENFE, FEVE and ET rail networks



Transit: The example from Bilbao

Massachusetts Institute of Technology

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Transit: The example from Bilbao

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- In parallel to the new infrastructure projects, the quality of the urban space has been improved
- However experience shows that this has not been enough to turn the tide...



Transit: The example from Bilbao

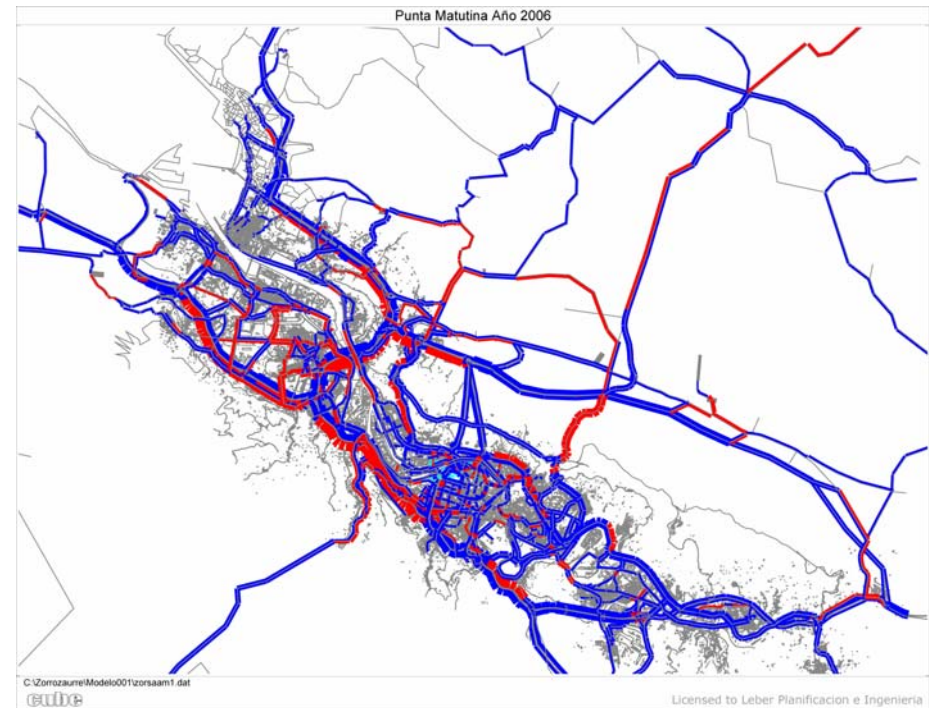
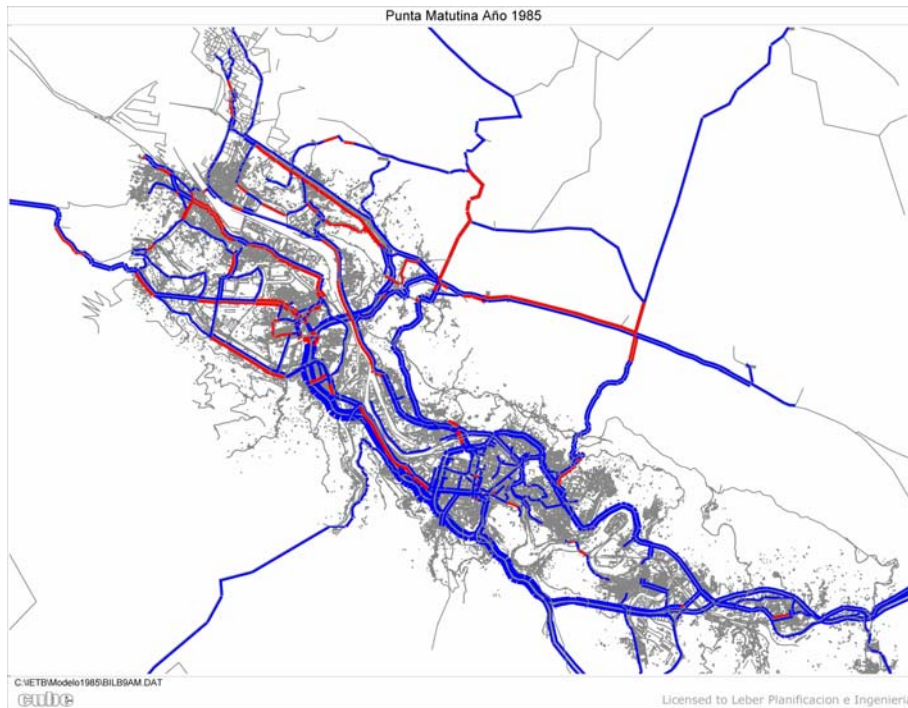
In parallel, new expressways have attempted to build their way out of congestion but have in fact served to foster new suburban developments



Transit and Road Congestion

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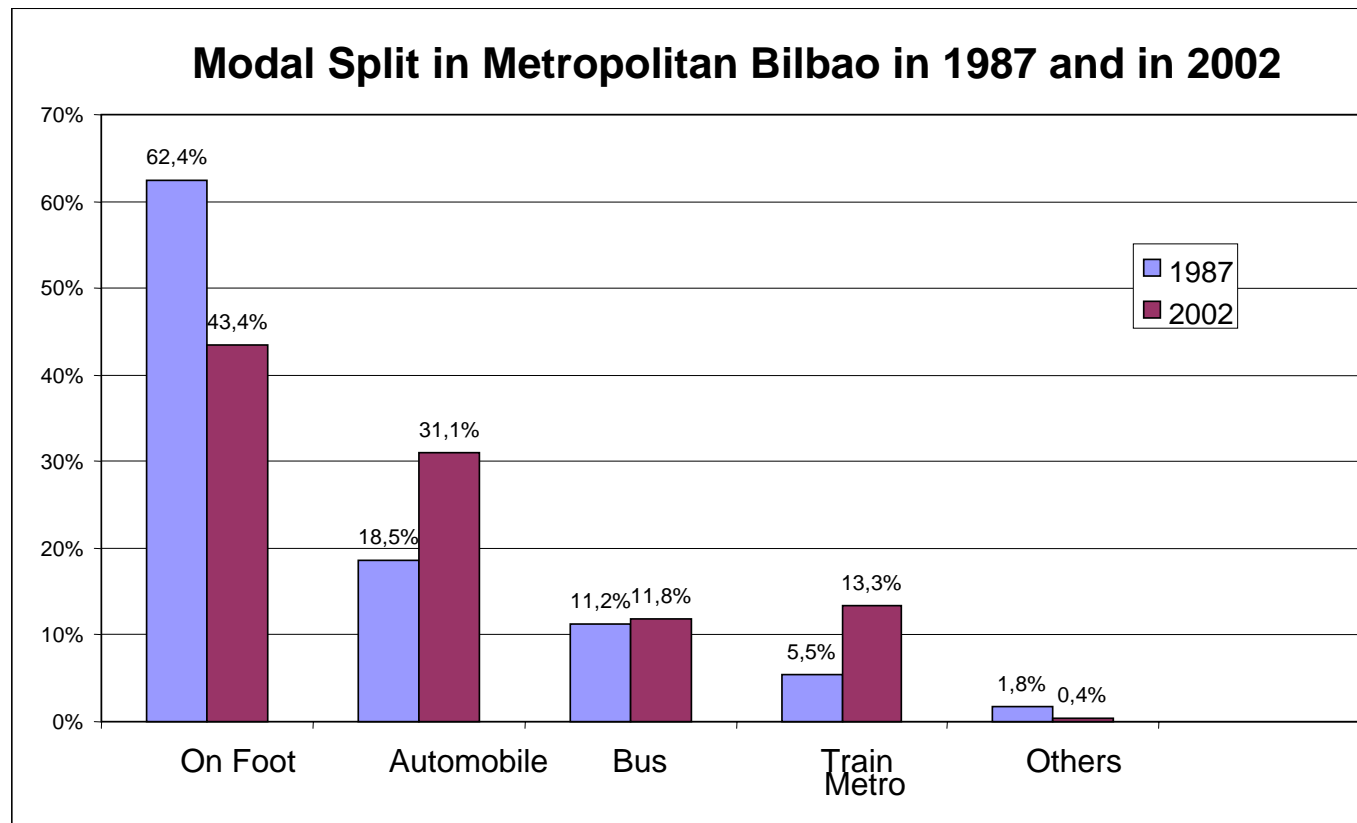
The reality modeled for 1985 and 2004 in Bilbao shows similar congestion levels but with higher flows



Transit and Road Congestion

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The home surveys from 1987 and 2002 describe a clear unsustainable trend



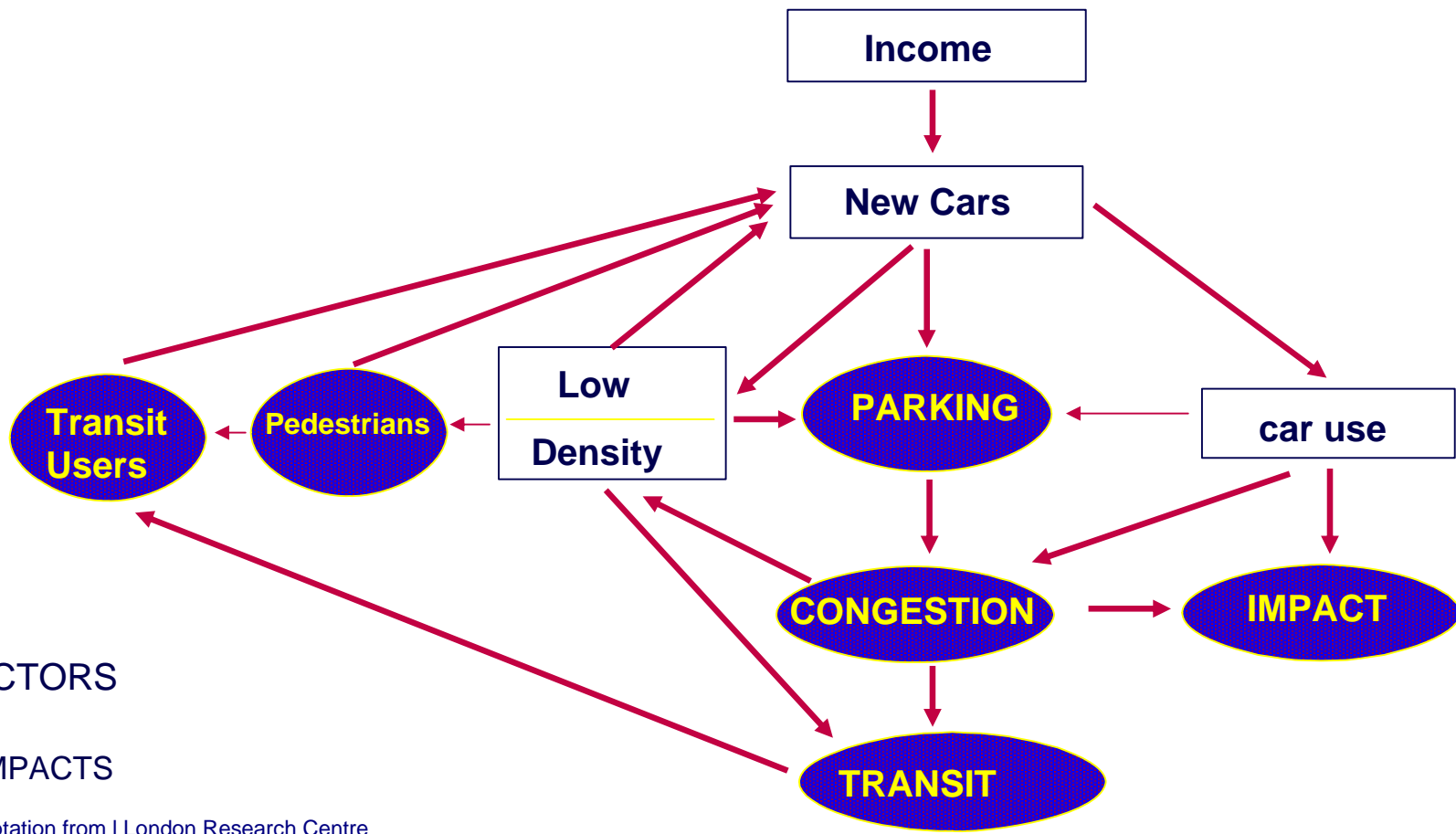
- Service quality is a prerequisite, but transit is part of a bigger whole ...
 - Urban Density
 - Parking policy
 - Priority
 - Information
 - Pricing
 -



- Opening the new frontier...
- Who gains with a new expressway?
 - New access opportunities?
 - Faster times for present users?
 - New development opportunities?
 - Induced demand to get back to square one?

A simplified interaction model

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FACTORS

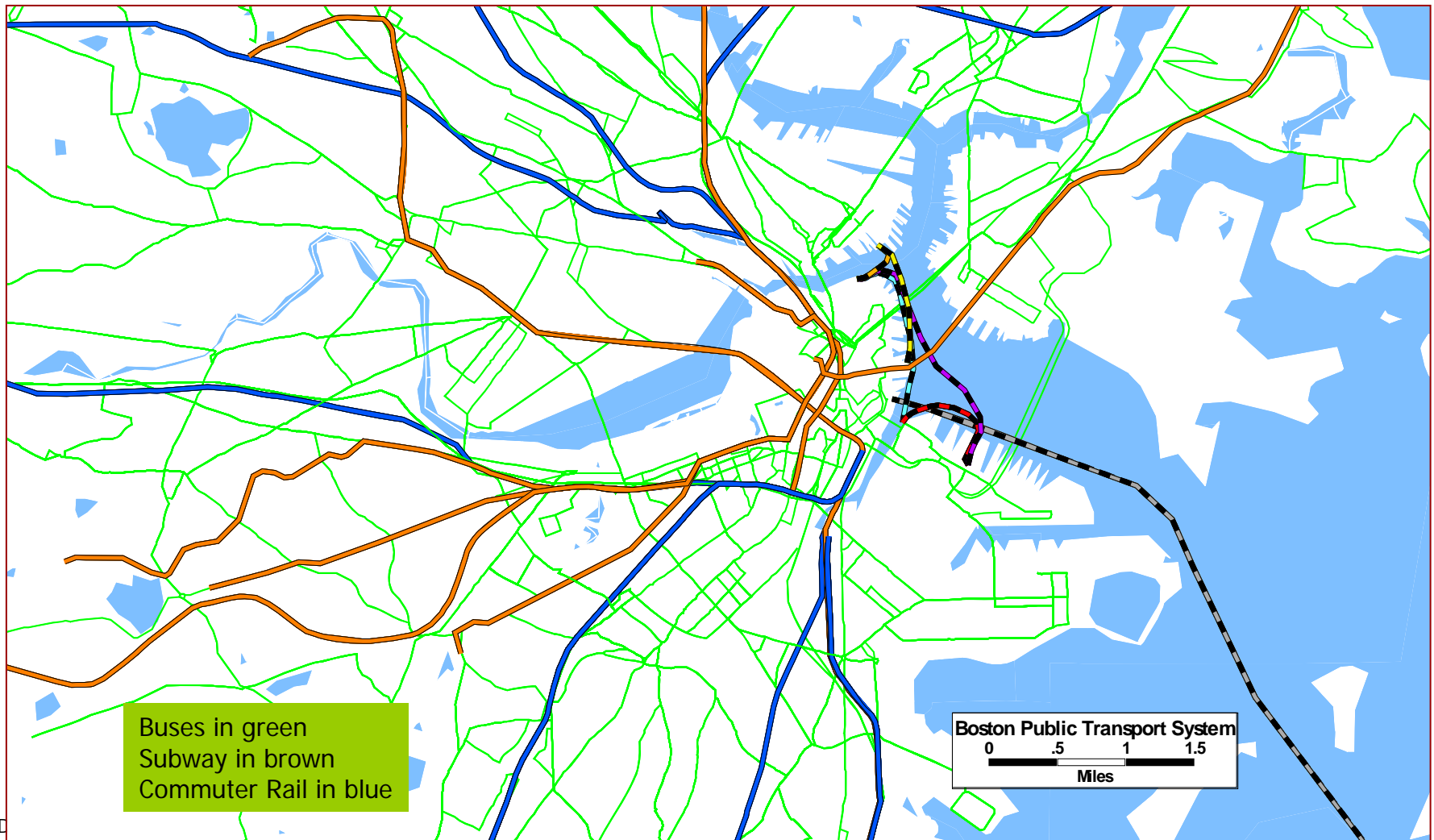
IMPACTS

Source: Adaptation from I London Research Centre

The Land Use-Transport Link

Boston's Public Transport System

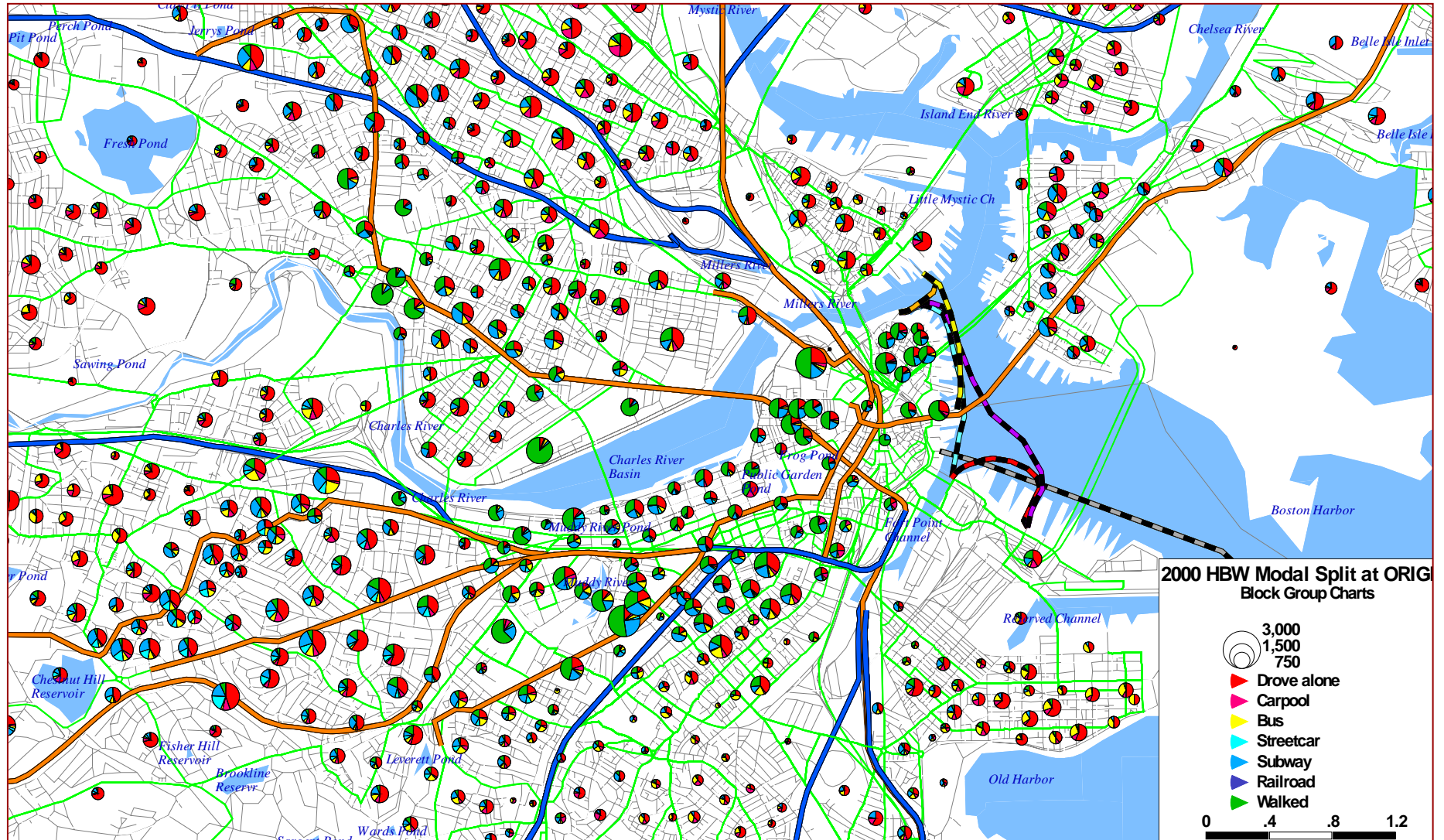
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The Land Use-Transport Link

Boston's Commuter Trip at Residence End

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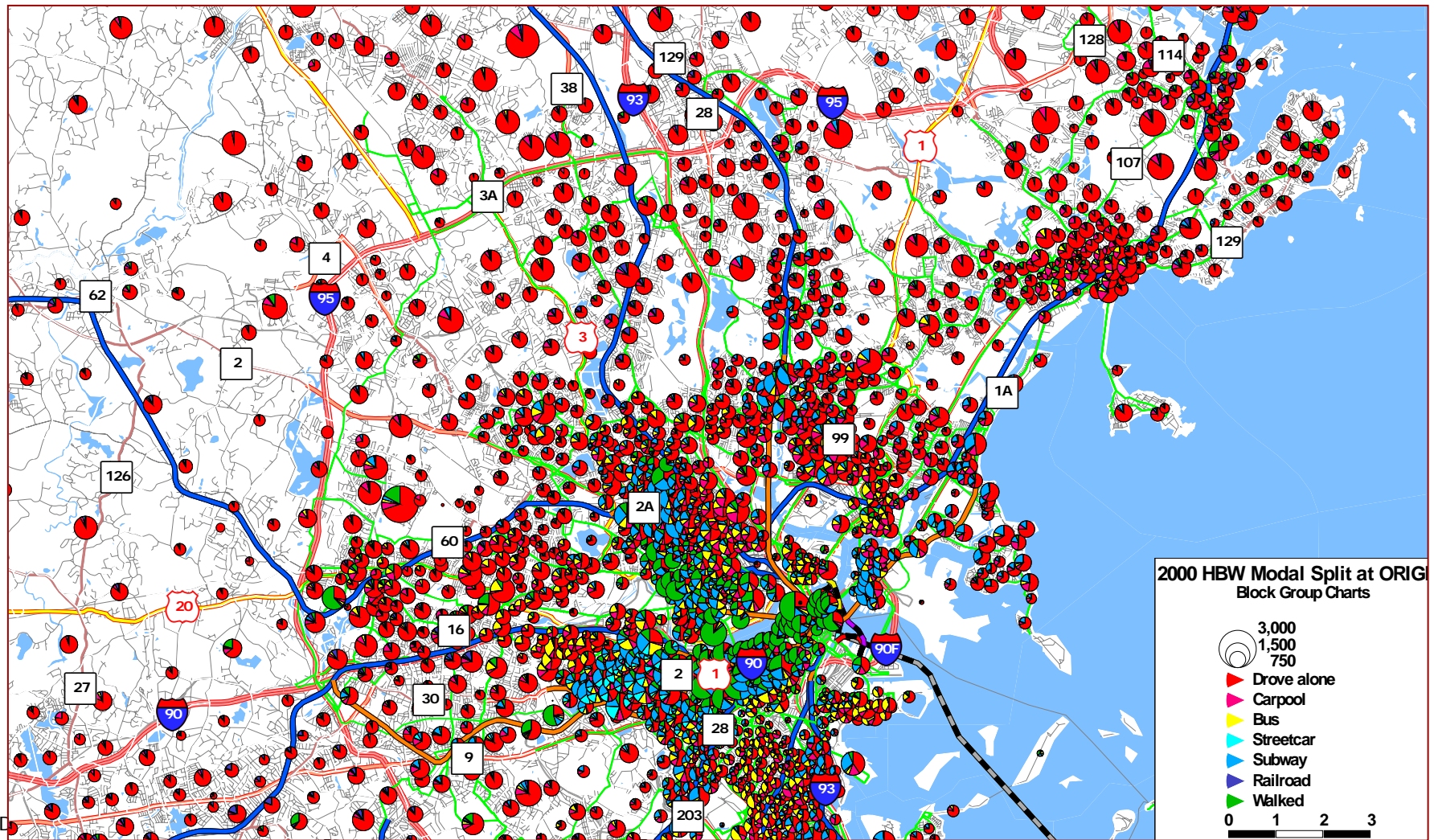




The Land Use-Transport Link

Boston's Commuter Trip at Residence End

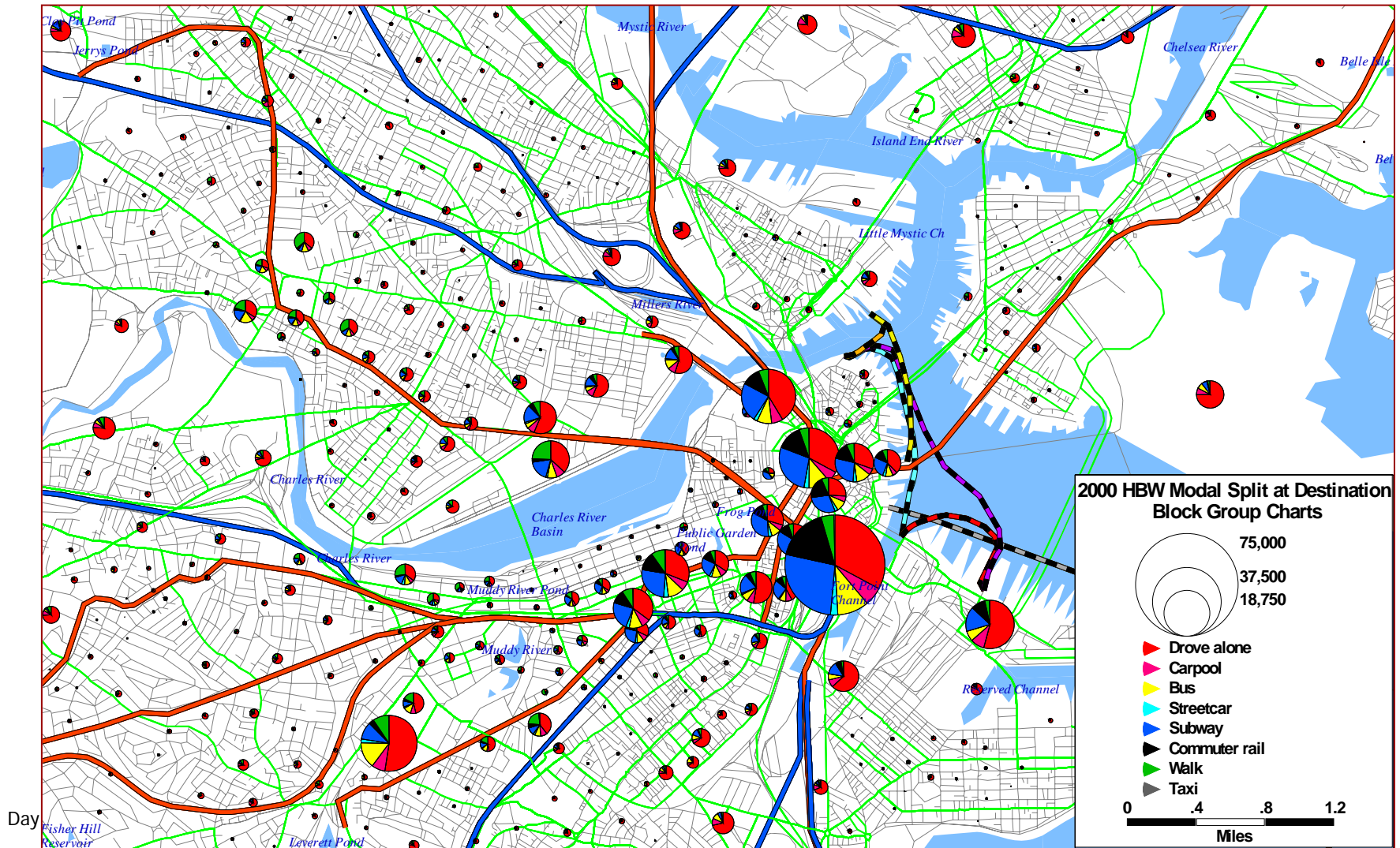
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The Land Use-Transport Link

Boston's Commuter Trip at Destination End

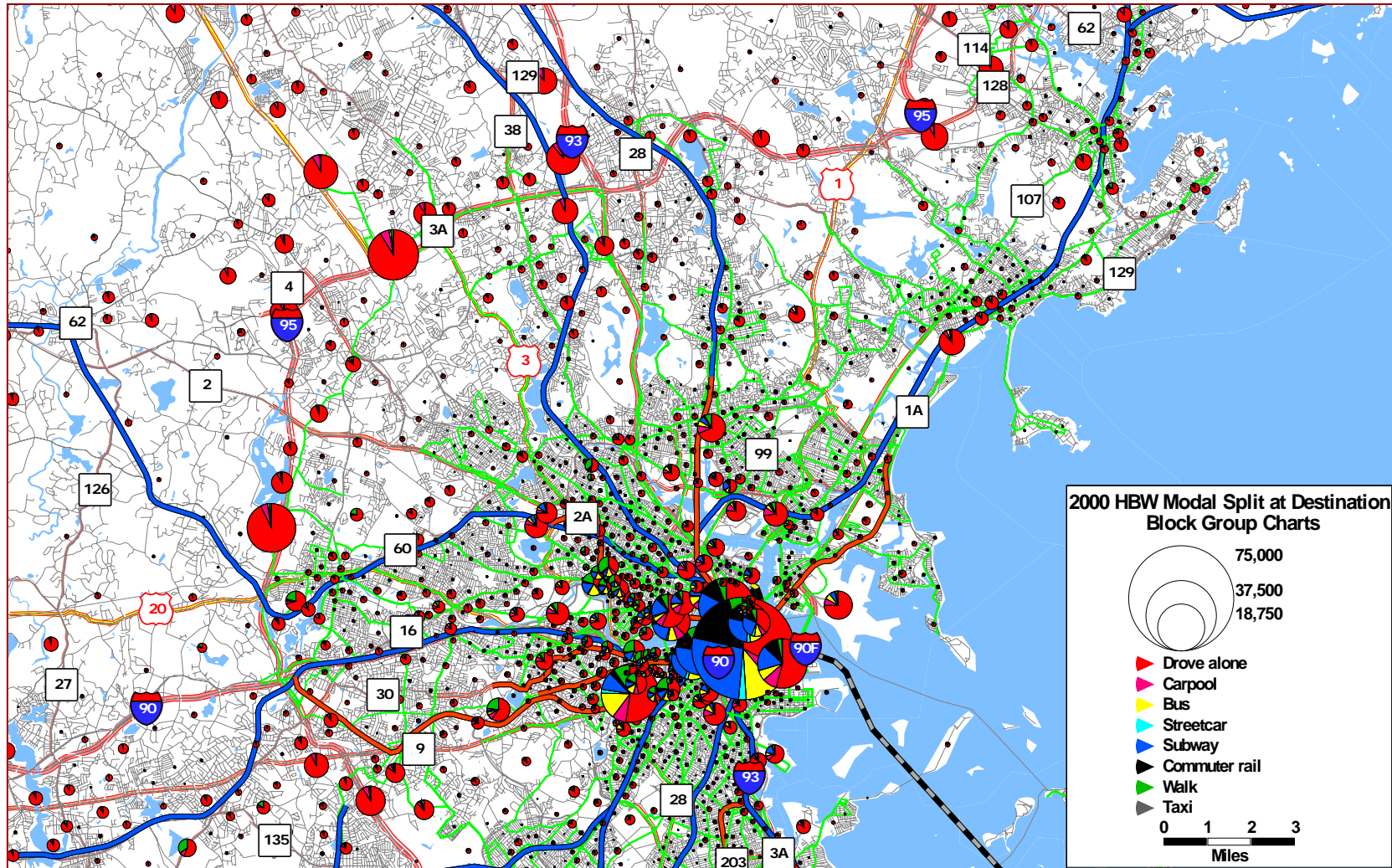
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The Land Use-Transport Link

Boston's Commuter Trip at Destination End

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The Land Use-Transport Link

- As a chicken and egg problem, job density and parking restrictions go hand in hand
- But parking restrictions do not impede economic development
- In fact, Boston development has been very impressive, since its EPA led parking freeze in 1973

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The Land Use-Transport Link: Boston's 1973 Parking Freeze and ...

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Photographs courtesy of Ken Kruckemeyer, MIT. Used with permission.

- Suburban sprawl and the car
 - Did we want to segregate society?
 - Downtown vs the Mall
 - Public vs private space, or
 - Public poverty vs private wealth
- Transit and density
- Infill development around stations

- New car technologies:
 - Increased efficiency
 - Lower pollution levels
 - Safer operation (mainly for the driver)

- ITS or how to get *more mileage* from our present system

Typical ITS priorities

- Common Transport Vision
- Common Strategic Approach
- Reduction of Road Congestion
- Improvement of Road Safety
- Decreased Negative Environmental Impacts
- Supply and Demand Systems Management
- New Model for Institutional Cooperation

The long road to ITS Deployment

- ITS tools easy to buy... but difficult to integrate
- They require organizational changes and new networking schemes
- Existing technological, political and jurisdictional barriers have to be addressed
- ITS itself has to be integrated into conventional planning

Transportation: New Trends

Old

Independent Modes
Local Economies
Independent Jurisdictions
Users
Build

New

Intermodal
Regional/Global Economies
Coalitions/Seamlessness
Customers
Manage

Transportation In a nutshell



First, we'll fix the access to the thruway, then we'll fix the city...

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Transportation In a nutshell

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The clothes of the King ...
or dismantling an interchange in Montreal

- Means to an end, not an end by itself
- Optimizing a sub-system?
- What is then our goal?
 - The daily life of our citizens?
 - Who are the transport actors?
 - Is it the most tractable urban problem?
 - Is it a governance model for other areas?

“The Future of Operations Research (OR) is Past” by Russell Ackoff 1979

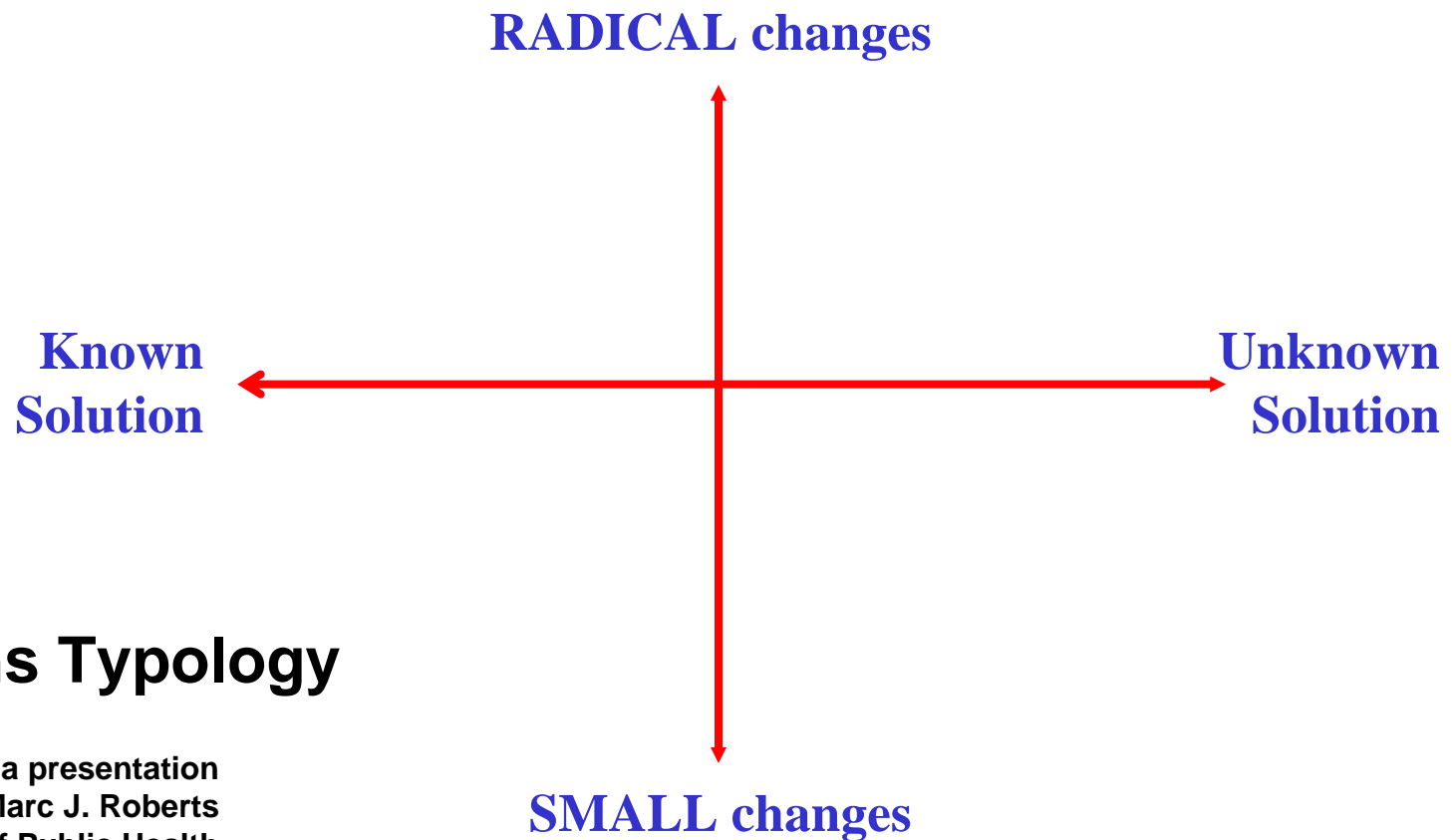
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1. First, there is a greater need for decision-making systems that can **learn and adapt** effectively than there is for optimizing systems that cannot.
2. Second, in decision making, account should be taken of aesthetic values-stylistic preferences and progress towards ideals because they are relevant to **quality of life**.
3. Third, problems are abstracted from systems of problems, messes. Messes require **holistic treatment**. They cannot be treated effectively by decomposing them analytically into separate problems to which optimal solutions are sought.
4. Fourth, OR's analytic problem-solving paradigm, "predict and prepare," involves internal contradictions and should be replaced by a synthesizing planning paradigm such as "**design a desirable future and invent ways of bringing it about**".
5. Fifth, effective treatment of messes requires **interaction of a wide variety of disciplines**, a requirement that OR no longer meets.
6. Sixth and last, all those who can be **affected by the output of decision** making should either be involved in it so they can bring their interests to bear on it, or their interests **should be well represented** by researchers who serve as their advocates.

This course: All lectures w/o numbers???

- You will be asked to:
 - Count traffic volumes and pax flows
 - Compare cities transport “numbers”
 - Analyze urban and suburban settings
 - Come up with improvement proposals
 - ... and during IAP, use several models

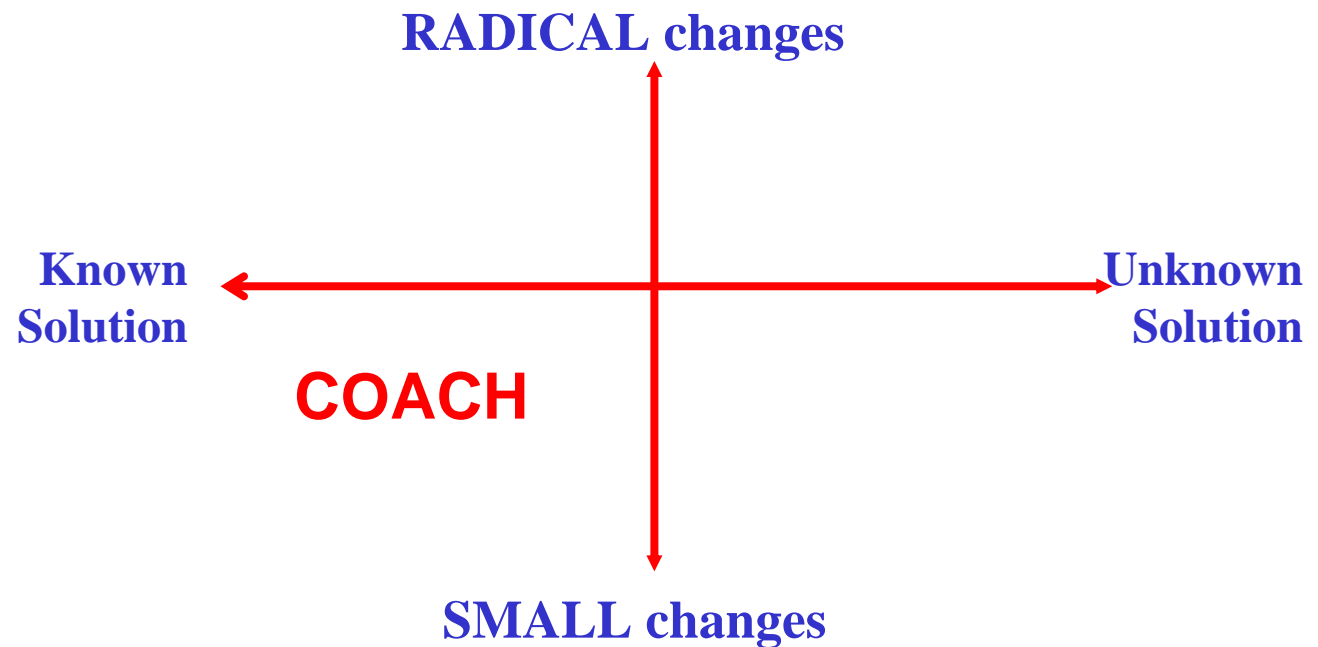
- Big numbers versus *little* numbers



Adapted from a presentation
by Marc J. Roberts
Harvard School of Public Health

Vision... and Leadership

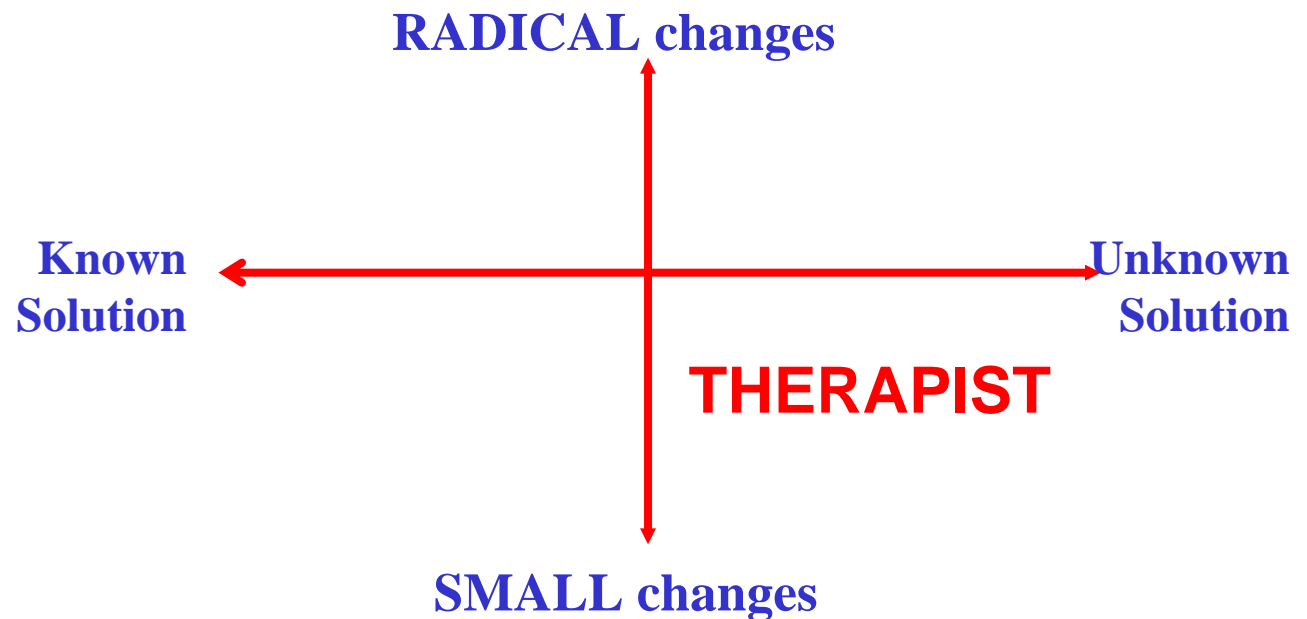
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Coach:

- He/she knows the rules of the game
- People accept her/him as an expert
- Leadership is easy

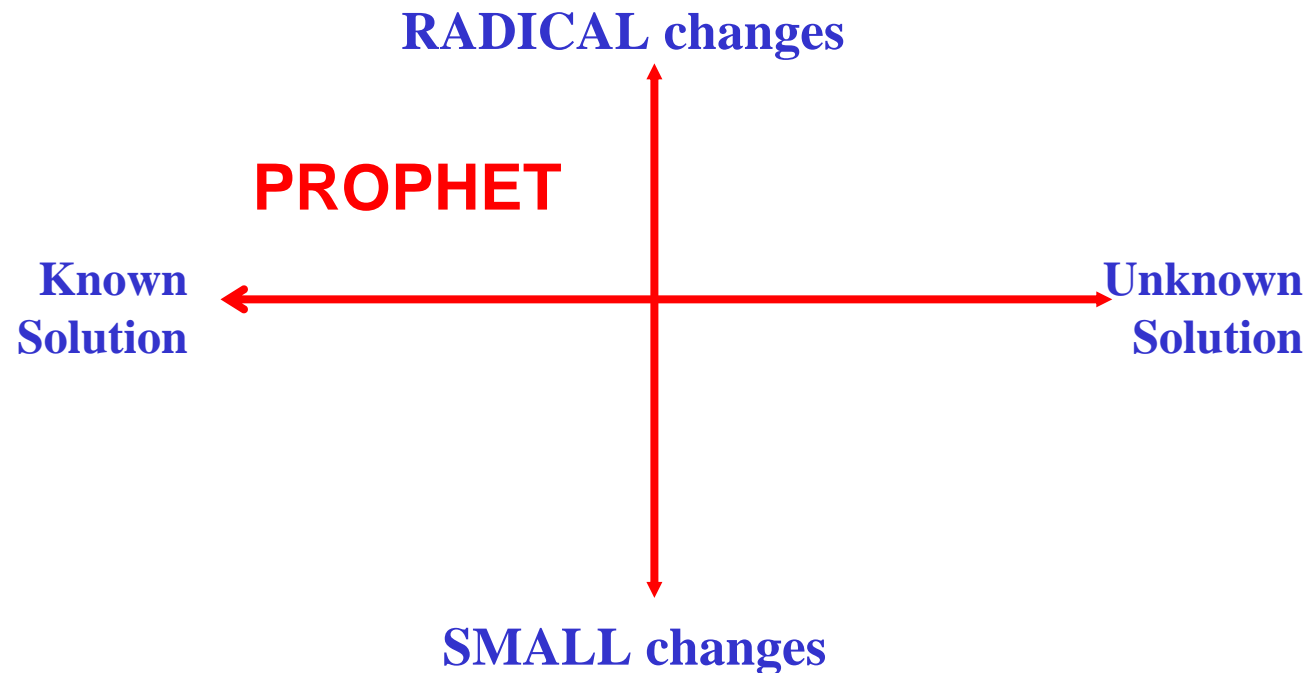
Vision... and Leadership



Therapist:

- He/she possesses certain expertise
- Still it requires a joint search for the solution
- As a leader, you delegate on the organization

Vision... and Leadership

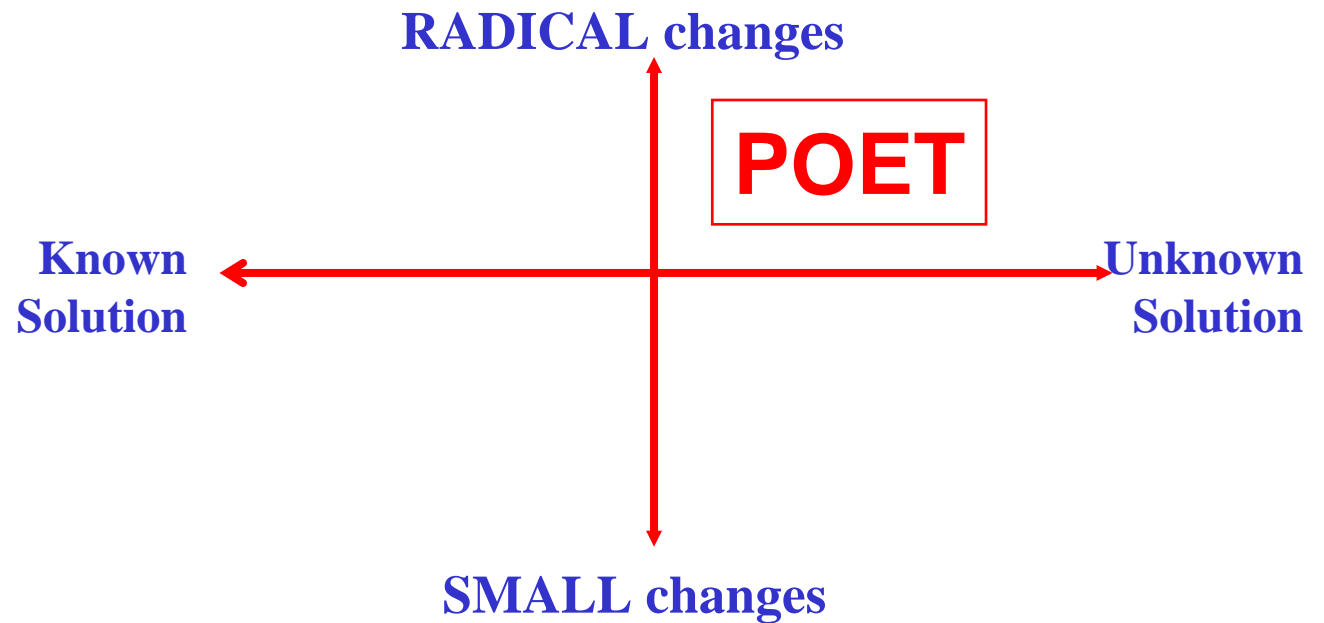


Prophet:

- "I know what to do and I am convinced"
- "Those who question me are heretics"
- A leader who does not accept interpretations

Vision... and Leadership

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A Poet:

- Different people see the world differently
- Most of our understanding is imperfect
- Many options to accomplish a vision
- Ambiguity and the embracing of contradictions