

A new model for models: thinking differently about forecasting and policymaking

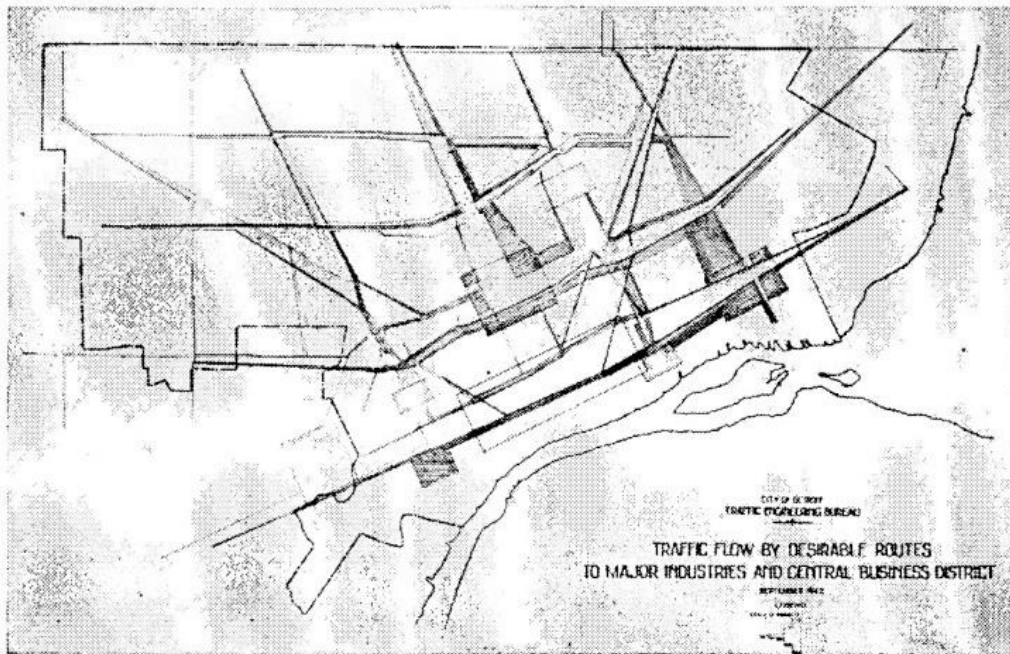
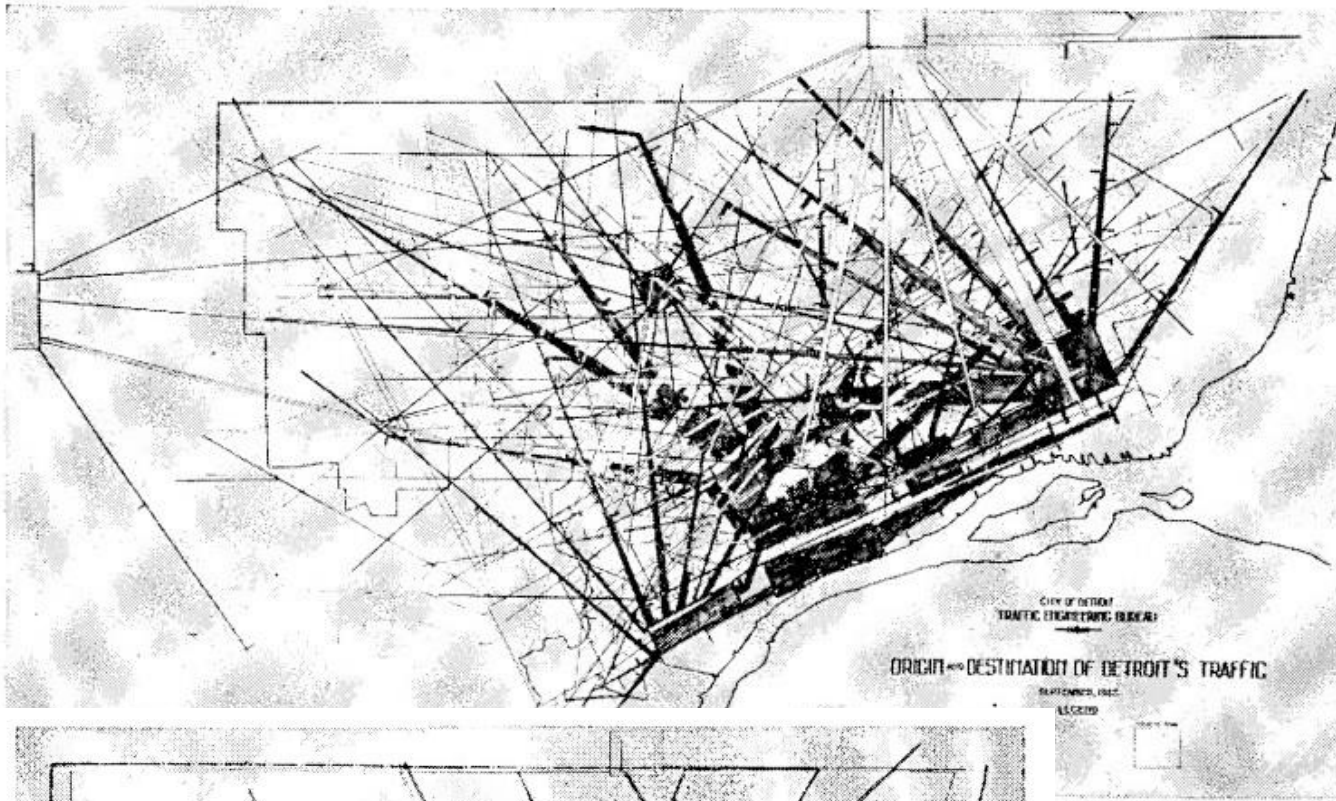
Martin Wachs, Distinguished Professor Emeritus, Dept. of Urban Planning, UCLA

Presented at TRB Workshop

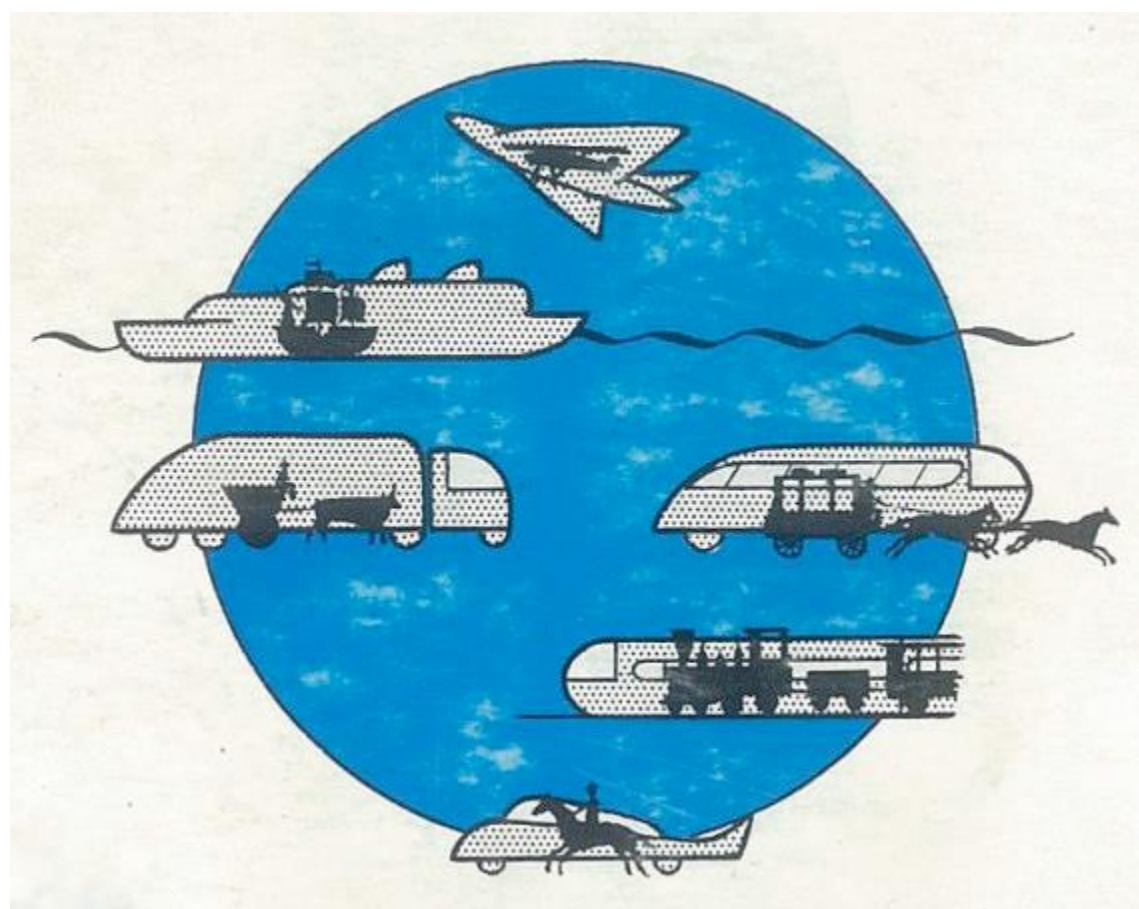
**Integrated Land-use,
Travel Demand, Air Quality & Exposure Modeling:
The Future of Regional Transportation Planning?**

January 12, 2015

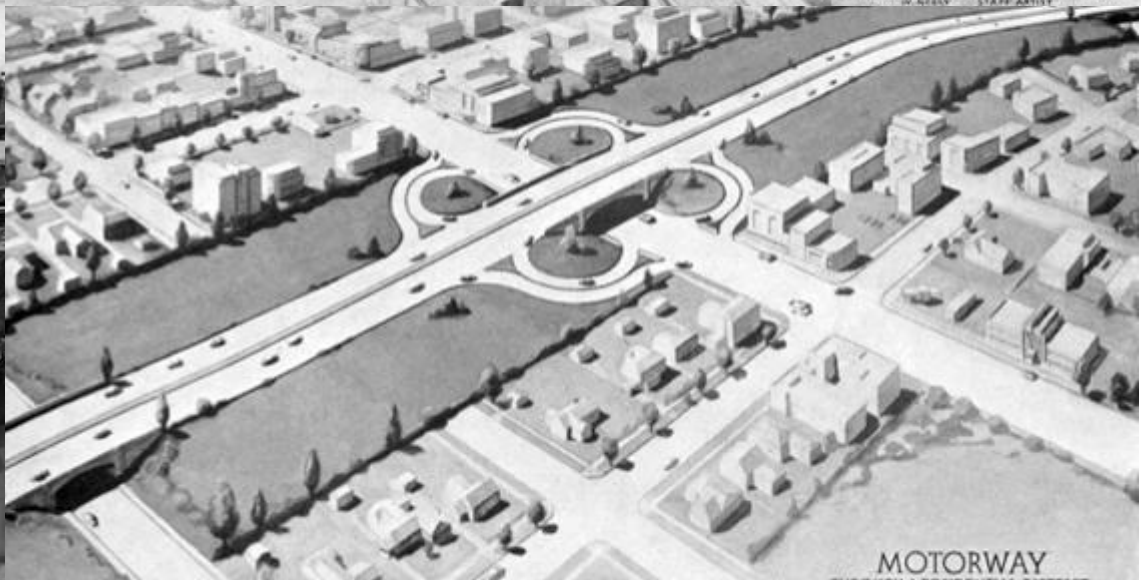




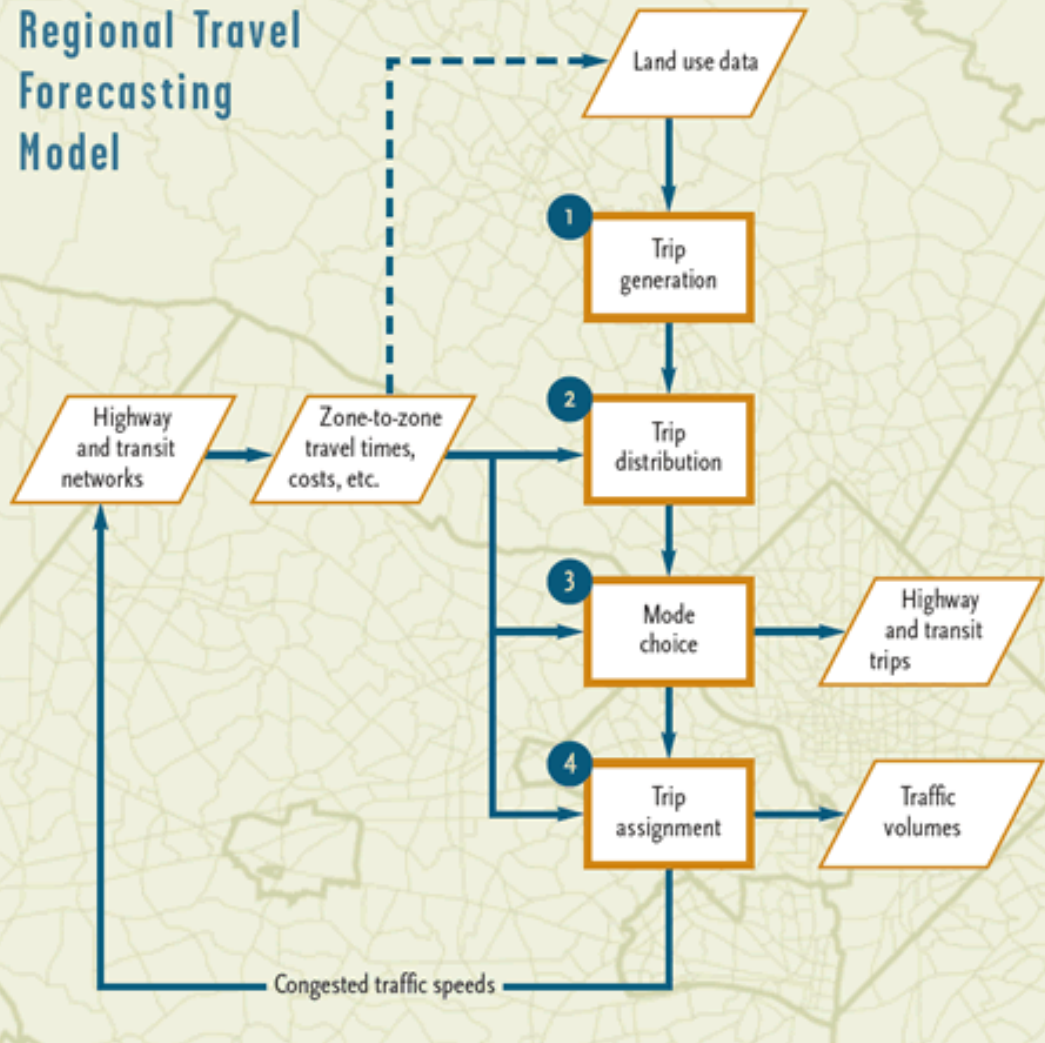
**Desire line charts from Detroit, 1942
(printed in McLachlan & Lynch, 1950,
p.365).**

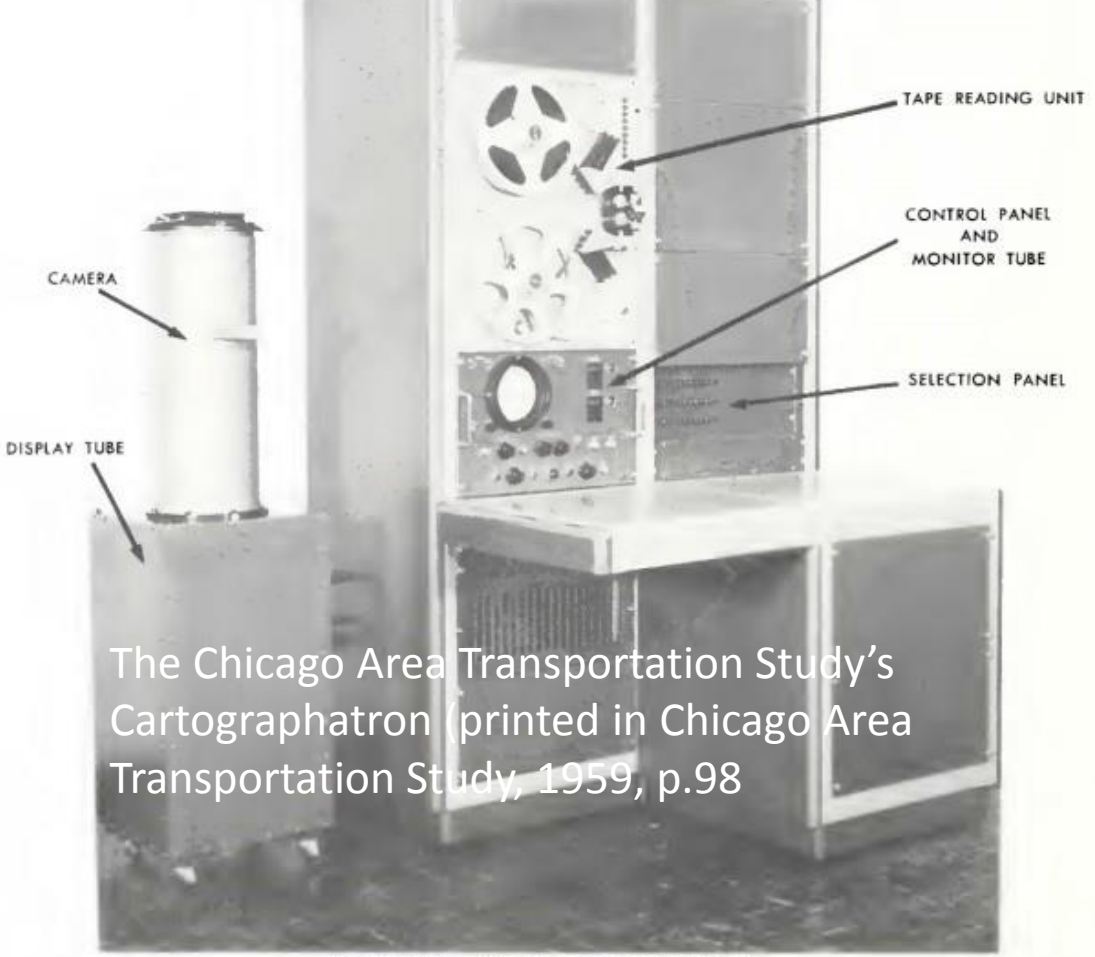
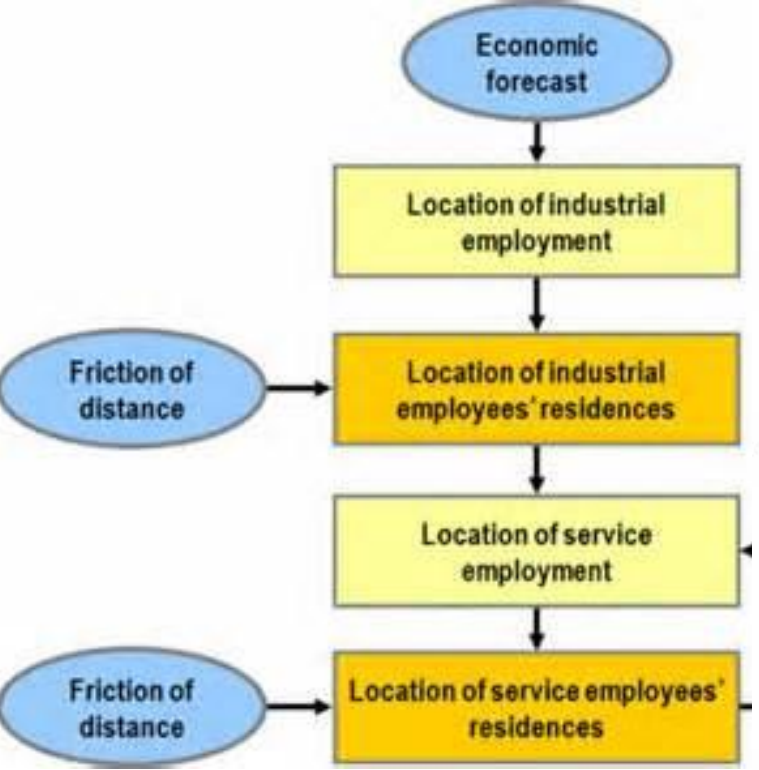


**Transportation of the future in San Diego
(printed on the cover of San Diego
Metropolitan Area Transportation Study,
1957)**



Four-Step Regional Travel Forecasting Model





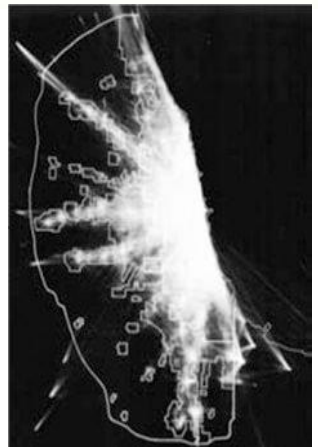
The Chicago Area Transportation Study's Cartographatron (printed in Chicago Area Transportation Study, 1959, p.98)

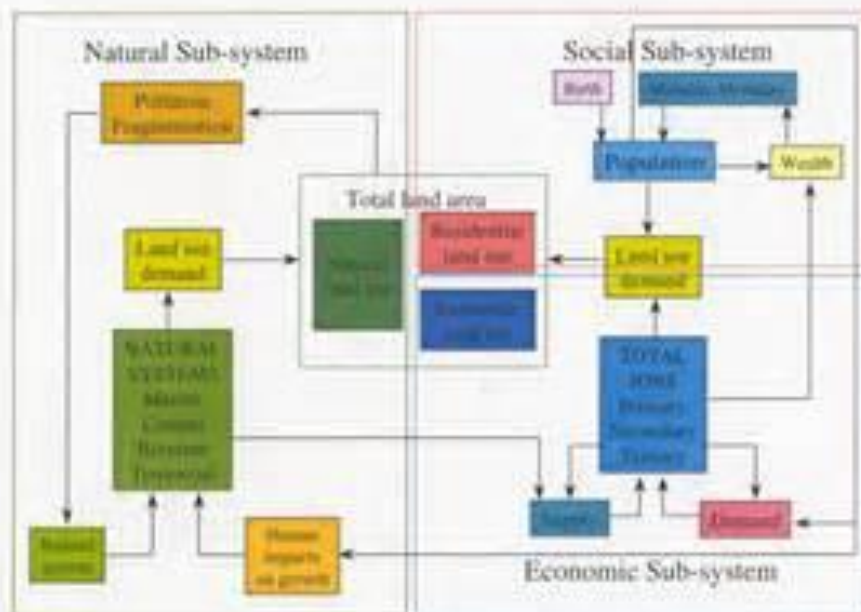
FIGURE 52—THE CARTOGRAPHATRAN



FIGURE 7—TOTAL PERSON TRIP DESTINATIONS

The destinations of 10,212,000 person trips, on the average weekday, are distributed throughout the Study Area as shown in this model. The highest blocks in the model represent 144,000 trip destinations per quarter square mile grid, the lowest blocks 5,000. the shaded areas less than 5,000 but more than 2,500.





The macro-model in the context of of the cellular automata modeling approach

Source: Adapted from Engelen et al. 1997

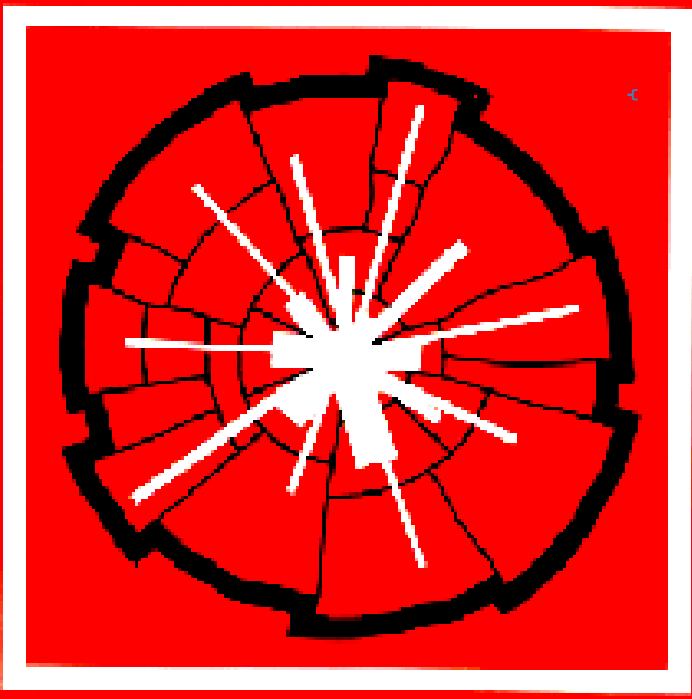
Figure 4.2j

Cambridge Urban & Architectural Studies

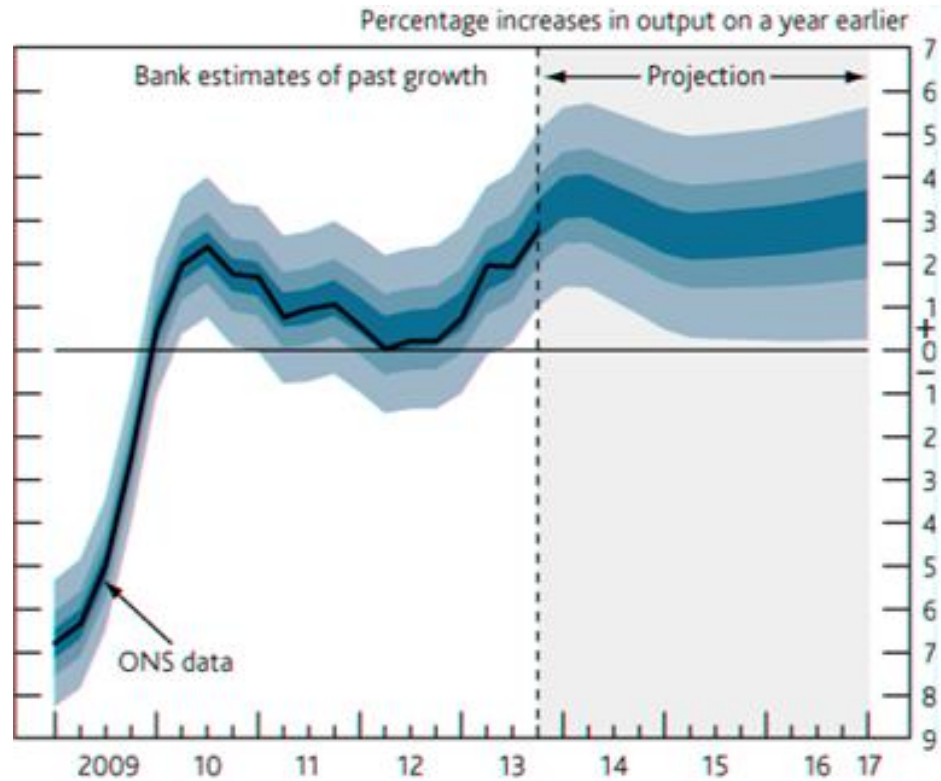
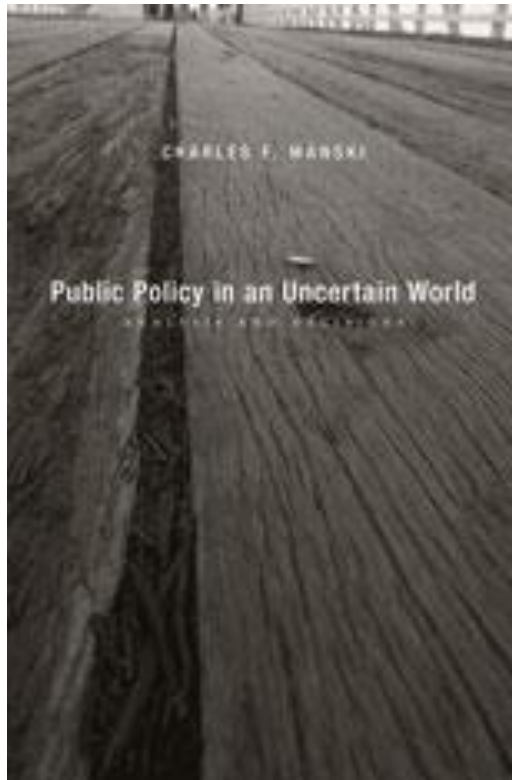
Urban Modelling

Algorithms, Calibrations, Predictions

Michael Batty







Even some official government statistics today are presented as ranges to incorporate uncertainty – note uncertainty is even acknowledged in the past data but is greater in estimates for the future - these are Bank of England GDP estimates

PREDICTION

- Data + Assumptions + Model = Prediction*



*(The only equation in my presentation)

Exhibit 7.-Distribution of All Warehousing Demand to Vacant and Developable Space (square feet)

| | 1 | 2 | 3 | 4 | 5 | 6 | 74 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|--------------|-----------|-----------|--------------|-----------|-------------|------------|-----------|------------|-----------|-------------|-------------|------------|-----------|-----------|
| Vacant | L.A. | L.A. | L.A. | L.A. | L.A. | San Bdno | Orange | L.A. | Ventura | Riverside | San Bdno | Riverside | Orange | Orange |
| | South Bay | Mid-I 710 | Central L.A. | I-605 | San Gabriel | Westend | W Orange | I-5 | P Hueneme | W Riverside | E SB Valley | March JPA | Airport | N Orange |
| 2008 actual | 7,453,913 | 3,646,143 | 10,568,120 | 8,672,231 | 13,211,974 | 24,684,222 | 3,079,069 | 8,015,532 | 3,146,459 | 19,936,397 | 42,696,416 | 41,657,340 | 6,363,166 | 5,723,002 |
| 2009 actual | 8,169,048 | 4,170,157 | 12,086,907 | 9,820,784 | 14,826,828 | 28,250,373 | 3,924,215 | 8,819,806 | 3,399,802 | 22,286,753 | 48,264,078 | 46,125,694 | 7,230,824 | 6,429,976 |
| 2010 | 6,748,772 | 3,872,598 | 11,278,747 | 9,187,760 | 14,705,499 | 28,262,365 | 4,176,908 | 9,227,379 | 3,499,920 | 22,867,554 | 49,794,252 | 47,677,172 | 7,345,843 | 6,354,911 |
| 2011 | 5,700,712 | 3,683,848 | 10,744,039 | 8,739,131 | 14,714,616 | 28,487,008 | 4,483,606 | 9,651,450 | 3,604,627 | 23,542,764 | 51,385,824 | 49,284,466 | 7,492,374 | 6,308,767 |
| 2012 | 4,590,500 | 3,473,662 | 10,157,134 | 8,257,752 | 14,691,494 | 28,653,266 | 4,768,540 | 10,059,693 | 3,705,300 | 24,176,065 | 52,918,124 | 50,833,418 | 7,627,108 | 6,256,813 |
| 2013 | 3,414,346 | 2,957,762 | 8,948,911 | 7,571,843 | 13,728,664 | 26,776,792 | 3,926,802 | 9,319,265 | 3,518,723 | 22,501,145 | 50,142,992 | 48,075,929 | 7,183,384 | 6,113,804 |
| 2014 | 3,247,024 | 1,337,157 | 7,678,382 | 6,848,000 | 12,723,867 | 24,822,183 | 3,053,652 | 8,553,930 | 3,325,832 | 20,764,864 | 47,274,541 | 45,226,170 | 6,722,834 | 5,963,724 |
| 2015 | 3,247,024 | 1,116,860 | 4,672,829 | 6,083,997 | 11,675,026 | 22,785,726 | 2,147,761 | 7,762,773 | 3,126,392 | 18,964,689 | 44,309,352 | 42,280,786 | 6,244,732 | 5,806,185 |
| 2016 | 2,444,906 | 938,611 | 2,361,015 | 4,873,468 | 10,639,065 | 20,762,045 | 1,930,497 | 6,956,666 | 2,923,313 | 17,147,627 | 41,288,004 | 39,278,060 | 5,764,085 | 5,653,390 |
| 2017 | 1,967,490 | 663,179 | 2,361,015 | 1,696,633 | 8,680,461 | 18,657,949 | 1,701,248 | 6,123,930 | 2,713,492 | 15,266,007 | 38,166,882 | 36,176,589 | 5,265,842 | 5,493,504 |
| 2018 | 1,967,490 | 663,179 | 2,361,015 | 1,600,520 | 3,643,641 | 17,793,920 | 1,459,320 | 3,553,351 | 2,525,655 | 13,549,032 | 35,376,977 | 33,407,420 | 4,807,222 | 5,334,852 |
| 2019 | 1,967,490 | 663,179 | 2,361,015 | 1,600,520 | 2,206,020 | 12,852,479 | 1,203,976 | 1,636,867 | 1,691,514 | 11,775,194 | 32,504,267 | 30,556,597 | 4,332,756 | 5,168,840 |
| 2020 | 1,630,548 | 663,179 | 2,361,015 | 1,600,520 | 2,206,020 | 7,030,856 | 934,435 | 1,521,350 | 953,131 | 7,432,035 | 28,872,053 | 27,621,370 | 4,178,733 | 4,995,080 |
| 2021 | 1,630,548 | 663,179 | 2,361,015 | 1,600,520 | 2,206,020 | 2,734,108 | 393,101 | 652,822 | 636,998 | 6,958,190 | 28,105,314 | 18,739,650 | 4,028,306 | 4,822,907 |
| 2022 | 1,630,548 | 663,179 | 2,361,015 | 1,600,520 | 2,206,020 | 2,734,108 | 393,101 | 652,822 | 622,962 | 2,240,043 | 25,672,537 | 17,965,860 | 3,763,723 | 4,643,133 |
| 2023 | 1,630,548 | 663,179 | 2,361,015 | 1,600,520 | 2,206,020 | 2,734,108 | 393,101 | 652,822 | 622,962 | 2,240,043 | 18,319,391 | 17,524,505 | 3,597,174 | 4,509,894 |
| 2024 | 1,584,016 | 663,179 | 2,267,951 | 1,600,520 | 2,128,467 | 2,734,108 | 253,505 | 652,822 | 622,962 | 2,240,043 | 10,580,864 | 17,060,018 | 3,421,896 | 4,369,671 |
| 2025 | 1,552,336 | 663,179 | 2,267,951 | 1,600,520 | 2,128,467 | 2,639,067 | 253,505 | 605,301 | 543,761 | 2,240,043 | 2,400,868 | 16,495,195 | 3,237,410 | 4,222,083 |
| 2026 | 1,552,336 | 663,179 | 2,219,421 | 1,600,520 | 2,128,467 | 2,639,067 | 253,505 | 605,301 | 495,231 | 2,240,043 | 2,400,868 | 8,185,381 | 3,059,850 | 4,080,035 |
| 2027 | 1,542,424 | 638,398 | 2,219,421 | 1,600,520 | 2,128,467 | 2,639,067 | 253,505 | 595,389 | 495,231 | 2,220,219 | 2,381,043 | 1,191,269 | 1,099,744 | 3,931,086 |
| 2028 | 1,542,424 | 638,398 | 2,219,421 | 1,600,520 | 2,128,467 | 2,639,067 | 253,505 | 595,389 | 495,231 | 2,220,219 | 2,381,043 | 1,191,269 | 482,641 | 447,767 |
| 2029 | 1,542,424 | 638,398 | 2,219,421 | 1,600,520 | 2,128,467 | 2,639,067 | 253,505 | 595,389 | 495,231 | 2,220,219 | 2,381,043 | 1,191,269 | 482,641 | 447,767 |
| 2030 | 1,542,424 | 638,398 | 2,219,421 | 1,600,520 | 2,128,467 | 2,639,067 | 253,505 | 595,389 | 495,231 | 2,220,219 | 2,381,043 | 1,191,269 | 482,641 | 447,767 |
| 2031 | 1,542,424 | 638,398 | 2,219,421 | 1,600,520 | 2,128,467 | 2,639,067 | 253,505 | 595,389 | 495,231 | 2,220,219 | 2,381,043 | 1,191,269 | 482,641 | 447,767 |
| 2032 | 1,542,424 | 638,398 | 2,219,421 | 1,600,520 | 2,128,467 | 2,639,067 | 253,505 | 595,389 | 495,231 | 2,220,219 | 2,381,043 | 1,191,269 | 482,641 | 447,767 |
| 2033 | 1,542,424 | 638,398 | 2,219,421 | 1,600,520 | 2,128,467 | 2,639,067 | 253,505 | 595,389 | 495,231 | 2,220,219 | 2,381,043 | 1,191,269 | 482,641 | 447,767 |
| 2034 | 1,542,424 | 638,398 | 2,219,421 | 1,600,520 | 2,128,467 | 2,639,067 | 253,505 | 595,389 | 495,231 | 2,220,219 | 2,381,043 | 1,191,269 | 482,641 | 447,767 |
| 2035 | 1,542,424 | 638,398 | 2,219,421 | 1,600,520 | 2,128,467 | 2,639,067 | 253,505 | 595,389 | 495,231 | 2,220,219 | 2,381,043 | 1,191,269 | 482,641 | 447,767 |
| Vacancy Rate | 2.5% | 2.6% | 2.5% | 2.5% | 2.4% | 2.4% | 2.6% | 2.1% | 2.3% | 2.3% | 2.2% | 1.7% | 2.4% | 2.5% |

See: “Ridership Technical Advisory Panel
Review of the California High-Speed Rail
Ridership and Revenue Forecasting Process:
Findings and Recommendations from the
May-June 2014 Review Period”

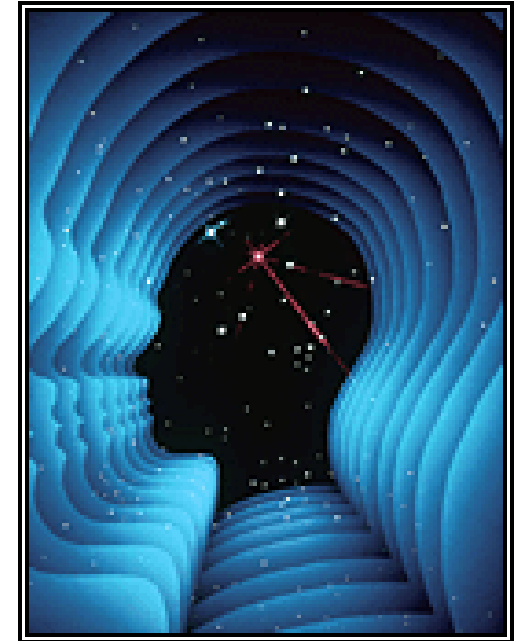


Consider large ensembles of plausible futures, not a single best estimate forecast

Seek robust strategies that perform well across many plausible futures, not a strategy optimal for one particular view

Employ adaptive strategies, ones that evolve over time in response to changing conditions

Use the computer as a “prosthesis for the imagination,” not a calculator





ROBUST DECISION MAKING

Virtually all RDM analyses use an exploratory modeling approach, with computer simulations used not as a device for prediction, but rather as a means for relating a set of assumptions to their implied consequences. One draws useful information from such simulations by running them many times using an appropriate experimental design over the uncertain input parameters to the model(s), collecting the runs in a large database of cases, and analyzing this database to determine what policy-relevant statements can be supported. RDM represents a particular implementation of this concept. An RDM analysis typically creates a large database of simulation model results, and then uses this database to identify vulnerabilities of proposed strategies and the tradeoffs among potential responses

Use repetitive modeling to

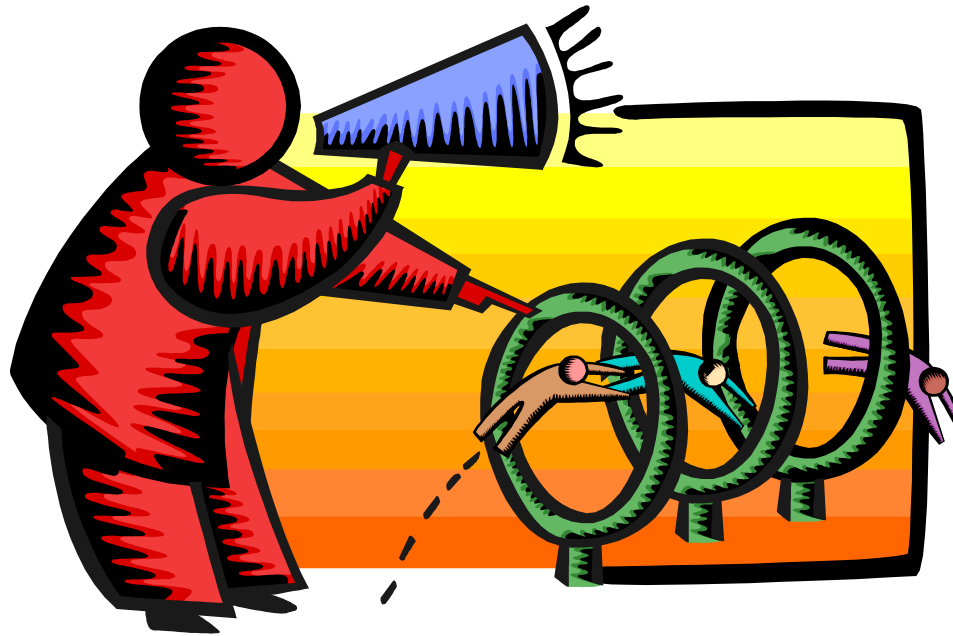
- Identify the assumptions that are most critical to the resulting forecasts and then focus on those assumptions in greater depth
- Develop monitoring strategies to watch the system unfold over time – are assumptions holding or not?
- Develop hedging strategies – what to do if critical assumptions are not holding?
- Develop forcing strategies where we can – drive the system toward assumptions needed to achieve the intended outcomes

Further Reading

- **Shaping the Future: The Next 100 Years** Steven W. Popper, Robert J. Lempert & Steven C. Bankes
- **Thinking Inside the Box: A Participatory Computer-Assisted Approach to Scenario Discovery** Benjammin P. Bryant & Robert J. Lempert
- **Shaping Tomorrow Today: Near-Term Steps Toward Long-Term Goals** Robert J. Lempert, Steven W. Popper, Endy M. Daehner, James A. Dewar, Paul C. Light, & Gregory F. Treverton
- **Managing the Risk of Uncertain Threshold Responses: Comparison of Robust, Optimum, and Precautionary Approaches** Robert J. Lempert and Myles T. Collins
- **Shaping the Next One Hundred Years: New Methods for Quantitative, Long-Term Policy Analysis** by Robert J. Lempert, Steven W. Popper, & Steven C. Bankes
- **Public Policy in an Uncertain World: Analysis and Decisions** Charles Manski

THANK YOU!

ITS TIME FOR YOUR
QUESTIONS AND COMMENTS



Contact me at mwachs@ucla.edu