

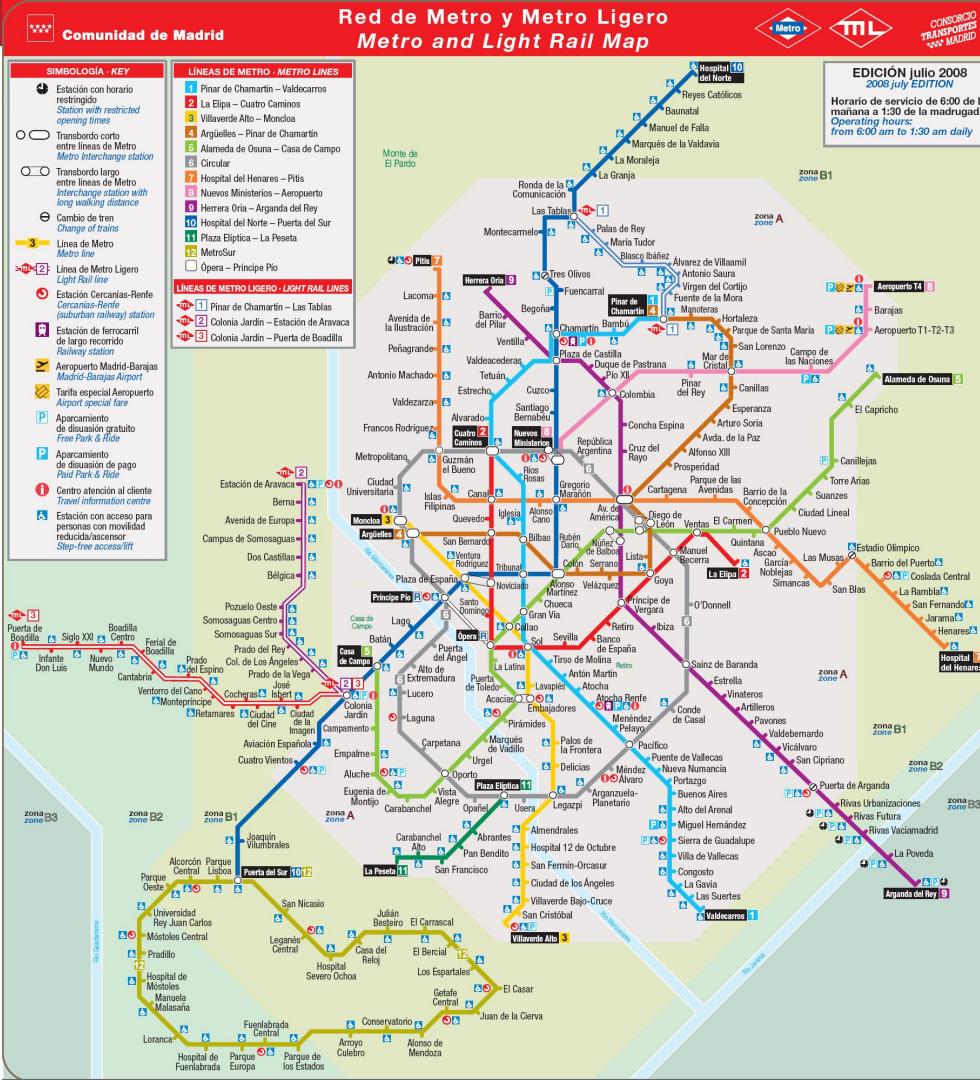


Emerging Systems in **Madrid, Spain**

Jaspreet Lal & Sean Lewis

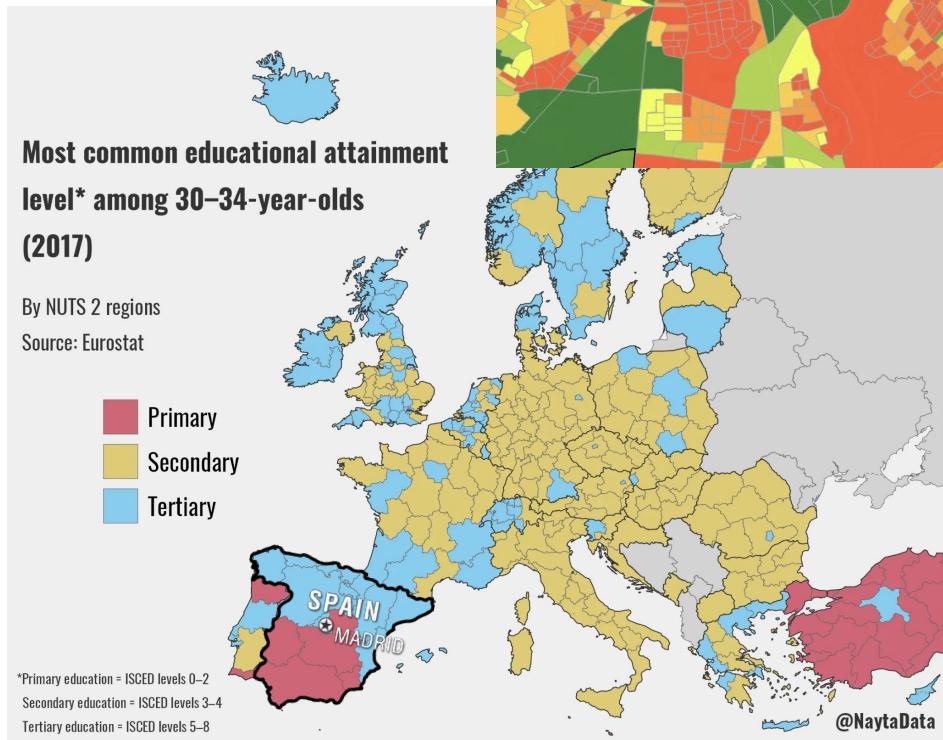
Recap of Hard Systems: Transportation

- Analysis of the transportation network in Madrid
 - Metro, Bus, Suburban, Light Rail, Eurail
- Some fun facts:
 - Average wait time for a metro is **2.5 minutes**
 - **69%** of trips in Madrid are not made by cars
 - **3.25 million** people in the city
- Madrid Nuevo Norte (2016—2024)



Recap of Soft Systems: Education & Economic

- Nearly **49%** of residents aged 25–34 hold a tertiary degree
- **28%** of 25-34 year-olds do not have an upper secondary degree in Spain, twice as much as the European average (14%)
- M-30 Ring Road Separation



Our Focus:

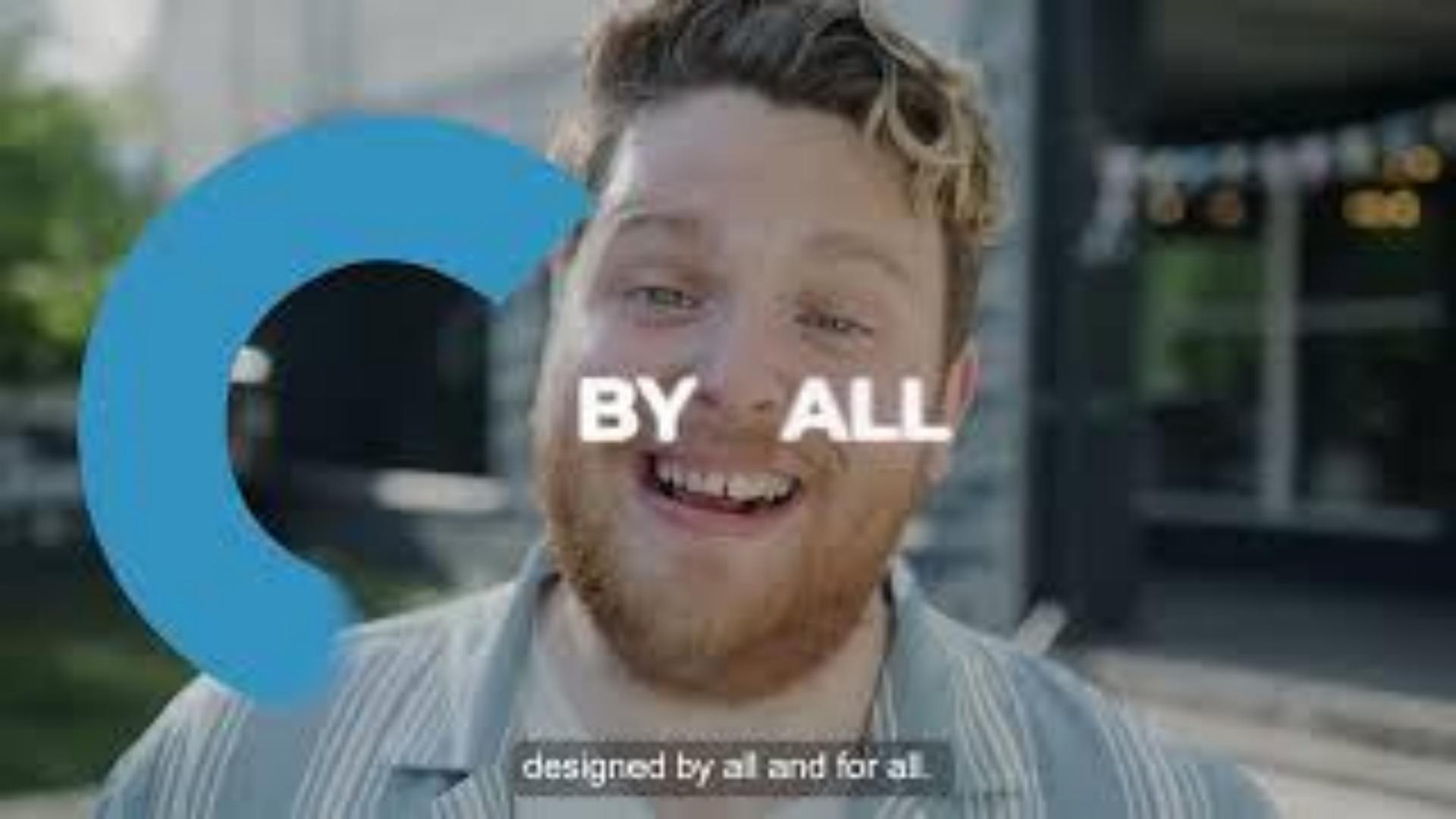
Madrid's Digital Transformation Strategy (2023 to 2027)

Key Aspects for the Digital Strategy:

- Digital transformation is transversal to all scenarios, European, national and with particular attention to cities
- Digitalisation is not an end, but rather a tool to improve public services for the City and for society in general
- It seeks to establish a connected Europe, enhancing Madrid as a hub that fosters linkages between the digital divide
- The digital inclusion and education of the entire population is a key goal to increase digital skills



Dedicated budget of €1 billion



BY ALL

designed by all and for all.

Safe, Resilient, and Capable City

Program 5. Sustainable and digital intelligence in management

- Intelligent management of Calle 30
- Intelligent transport systems
- Intelligent management of traffic and mobility
- Digital management of vehicle access and parking

Managed Based on Evidence and Data

Program 7. Data as energy for the City

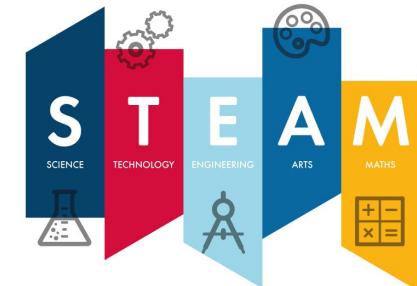
- Madrid Open Data program
- Madrid Data Lake

Program 8. Planning and management based on evidence

- **MetaMadrid**, Digital Twin of the City
- Madrid's Digital Brain

Digital Transformation Strategy: Madrid STEAM

- Establishment of a hub of STEAM vocations
- Develop programs aimed at building a skilled workforce in emerging digital sectors
- Strengthen collaboration between Madrid's public institutions, technology companies, and educational organizations
- Address urban challenges through STEAM-driven solutions in sustainability and infrastructure



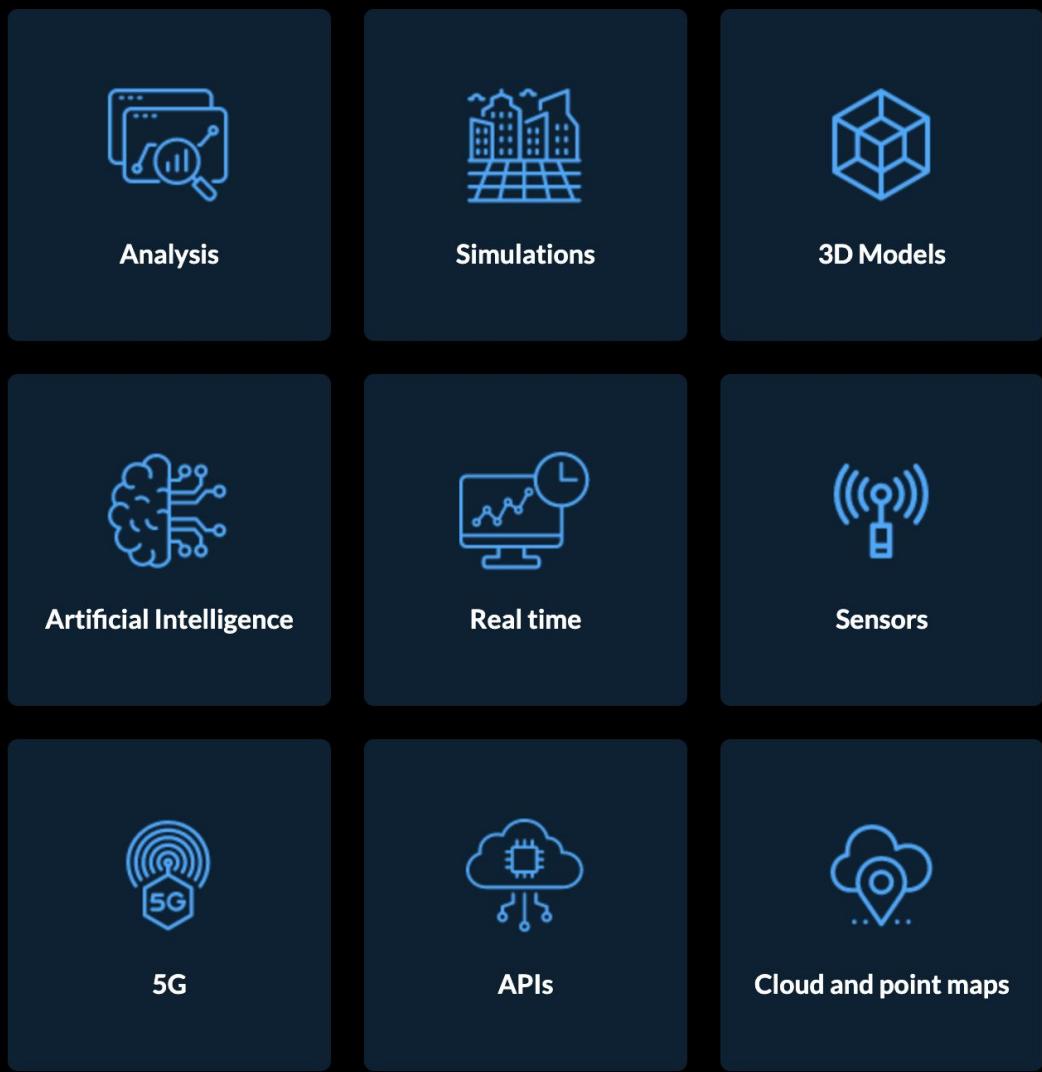
STEAM = Science, Technology, Engineering, Art and Mathematics

Madrid's Digital Twin

- **Urban Planning and Development:** The digital twin provides a 3D model of the city, allowing planners and architects to visualize and test new infrastructure projects. This helps streamline the development process, enabling better decision-making and reducing the risk of costly errors.
- **Virtual Space Demonstrator (VSD):** presents, through different solutions, how the aggregation of information from multiple sources (IoT sensors, historical data, synthetic data, etc.) allows to have an advanced, holistic and updated vision of the city and to simulate and model different urban scenarios and evaluate how different factors can affect the city.
- Provides:
 - Evidence-based policy design
 - Simulation, planning and management of actions
 - Monitoring and maintenance of infrastructures, facilities and assets
 - Citizen information

Digital Twin for Education

- Optimization of School Infrastructure & Campus Safety
- Efficient Route Planning
 - improving transportation and mobility for students
- Data-Driven Decision Making for Education Policy
 - improve analysis on analyzing education distribution, preventing infrastructure-related issues (such as the M-30 Ring Road Separation) in the future that manifests in social systems



Transit Deserts

- Ability to visualize areas with limited transportation availability
- Unique insights into correlations or why transit might be limited
 - analyzing transportation distribution,

Transit desert

Article Talk

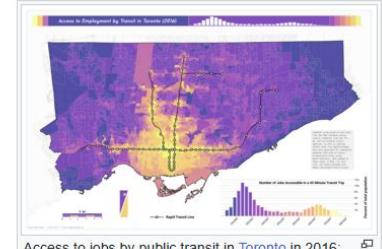
Read Edit View history Tools

From Wikipedia, the free encyclopedia

A **transit desert** is an area with limited [transportation](#) supply.^{[1][2]} Developed from the concept of [food deserts](#), various methods have been proposed to measure transit deserts. Transit deserts are generally characterized by poor [public transportation](#) options and possibly poor bike, sidewalk, or road infrastructure.^[3] The lack of transportation options present in transit deserts may have negative effects of people's health, job prospects, and [economic mobility](#).^{[4][5][6][7]}

History [edit]

The term 'desert' has been variously applied to areas that lack key services like [banks](#), [food access](#), or even [books](#).^{[8][9][10]} The idea of transit deserts was coined by Junfeng Jiao and Maxwell Dillivan, first appearing in print in 2013.^[1] Since that time, the concept of transit deserts has been expanded upon and competing definitions and measurement techniques have emerged.



Access to jobs by public transit in Toronto in 2016; note that the map does not include the extension of the western leg of Line 1 Yonge–University to the suburban municipality of Vaughan to the north-northwest, which opened in late 2017

Transit Desert: The Gap between Demand and Supply



Transit Deserts: The Gap between Demand and Supply

Junfeng Jiao, University of Texas at Austin
Maxwell Dillivan, Ball State University

Abstract

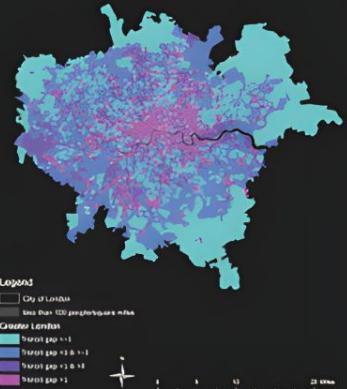
The term "transit desert" is a new concept that looks at the gap between level of transit service (supply) and needs of a particular population (demand). These populations are often referred to as "transit dependent," people that are old, young, too sick, disabled, or live in rural areas where transit is not available. Transit deserts are defined as areas that lack adequate public transit service given areas containing populations that are deemed transit-dependent. This study aims to analyze and compare transit access across the United States by race and ethnicity using demand and supply using Geographic Information Systems (GIS). The study looks at four major U.S. cities: Charlotte, North Carolina; Chicago, Illinois; Cincinnati, Ohio; and Portland, Oregon. Transit deserts often occur in neighborhoods surrounding historic downtowns, however, sometimes occur in very isolated rural areas.

Introduction

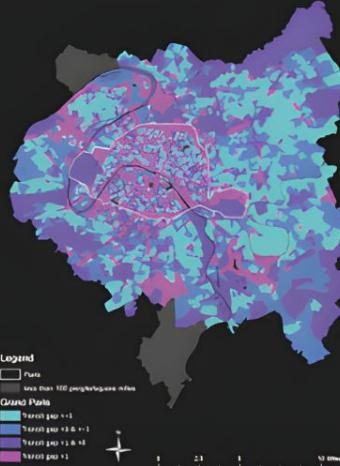
The concept of "transit deserts" introduced in this study is similar to the increasingly popular concept of "food deserts". (Clark et al. 2002; Whelan et al. 2002; Wing et al. 2002; Wilcoxen et al. 2002; Wilcoxen et al. 2003) The concept of food deserts refers to low-income and/or minority areas that lack access to healthy food environments through planning efforts to achieve equitable access to high-quality, affordable food for everyone. Food desert analysis can be applied to both food and transit deserts. In addition to lack access to healthy food exists in the urban landscape. Similar analysis can be applied to mass transportation systems as well. While access to healthy, affordable foods

Comparison between Spatial Distributions of Transit Deserts

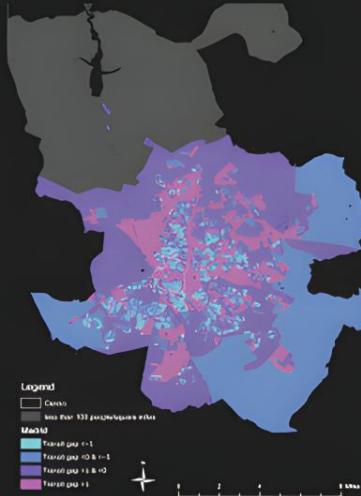
Transit Deserts



Greater London



Grand Paris



Madrid



Milan

Are There Transit Deserts in Europe? A Study Focusing on Four European Cases through Publicly Available Data

October 2022 - Sustainability 14(20):13182

DOI:10.3390/su142013182

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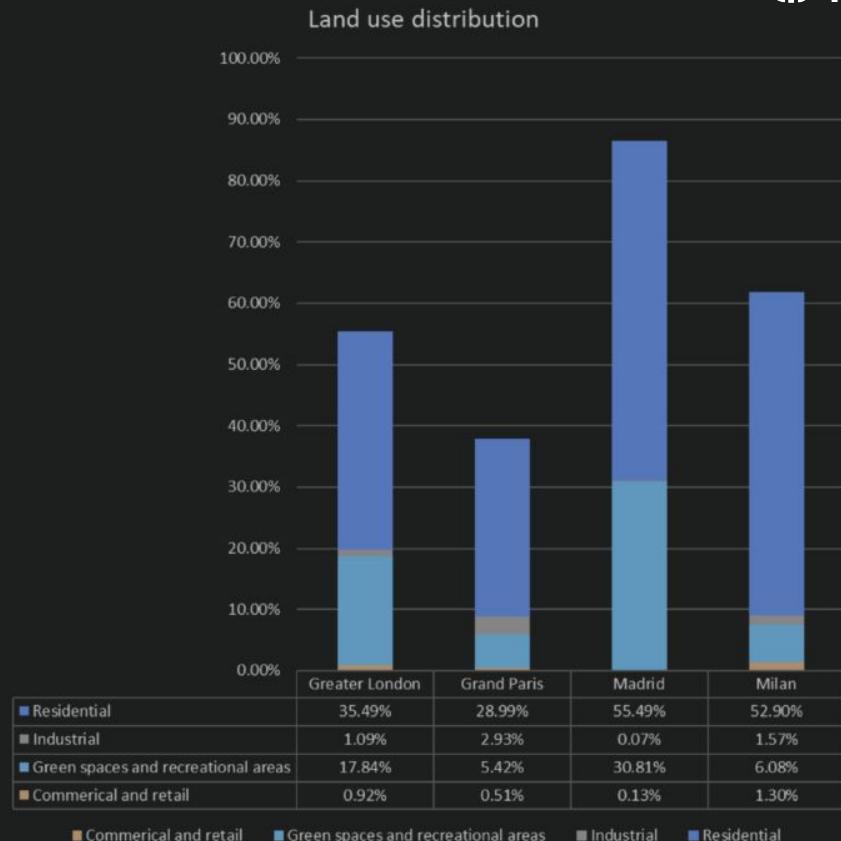
Authors:

 Yefu Chen
University of Texas at Austin

 Junfeng Jiao
University of Texas at Austin

Land use distributions in the study area.

presents the land-use factors in the transit desert. We noticed that residential areas are the most dominant land-use factors in transit deserts across the study area, followed by green spaces and recreational areas, which indicates that public transit access to and from these areas can be a general problem in European cases. Specifically, this result proves that it could be challenging for residents to travel from home to green spaces through public transit.



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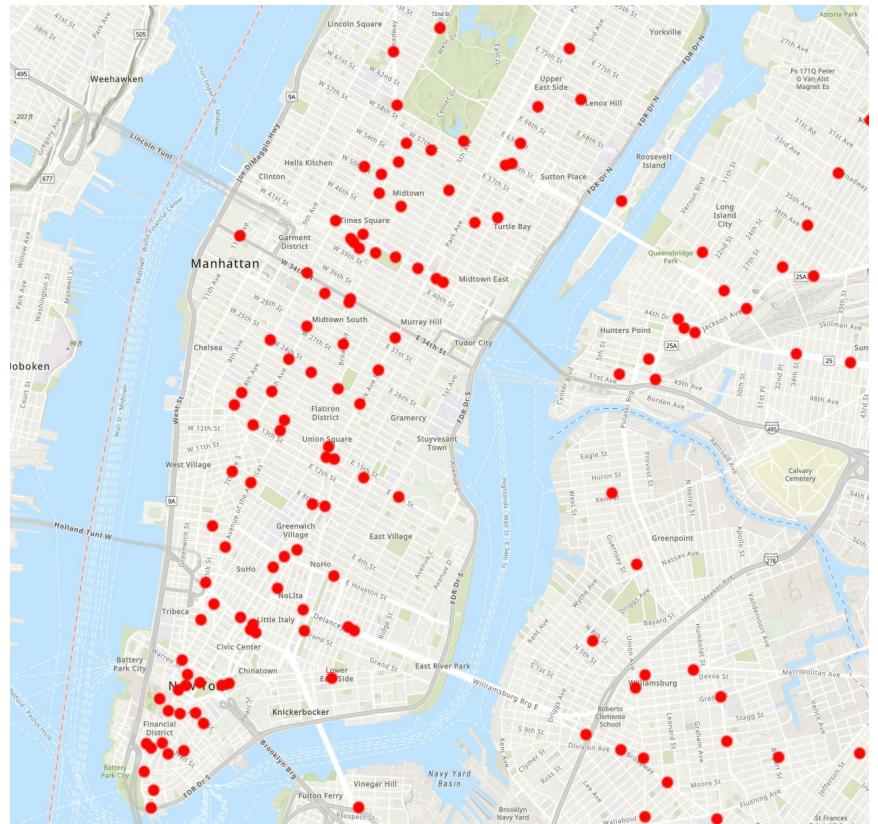
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Authors:

Closer to Home Examples / Relevancy

- Think about your past commutes to/from your educational institutions
- Think about areas of towns/cities you've lived in where transit might be limited in some areas
- Previous lectures have referred to the transit gap that is easily apparent in East Village, NYC
- (Audio) Dr. Samuelian indicating relevant aspects of transit deserts are important to consider
(on next page)



Audio Transcript

That's this one!

"I happen to teach a course here called Urban Systems, so we look very much at the interrelatedness of systems.

One of the benefits of technology, and specifically digital technology, is that we have access to information like we never had before.

One of the issues we talk a lot about in my course is measuring the city and measuring the metabolism of the city.

What roads are used more often, what roads are used less often, like where is there a leaky pipe in terms of infrastructure, what subway stations and subway lines are overwhelmed with people which are underutilized.

Optimizing systems is a whole new world that I don't think we've really tapped into in terms of understanding how urban systems work and affect people."



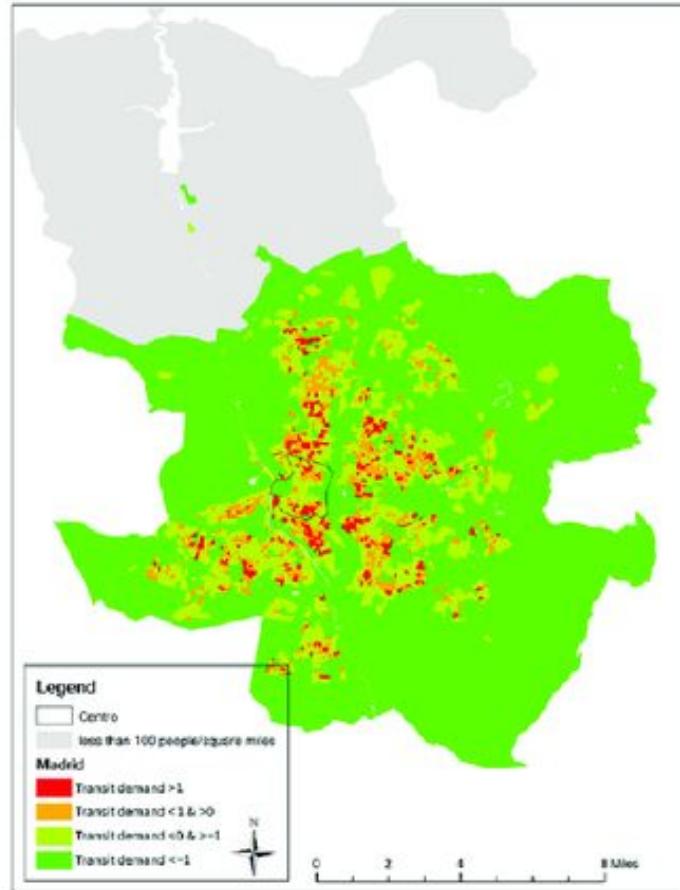
SRC: YouTube, Michael Samuelian: Urban Technology and Infrastructure

Prof. Michael Samuelian -- Founding Director of the Cornell Tech Urban Tech Hub, an urban planner, real estate developer, and the President and CEO of the Trust for Governors Island -- talks about managing cities and how we can optimize urban system by using the current data and technology.

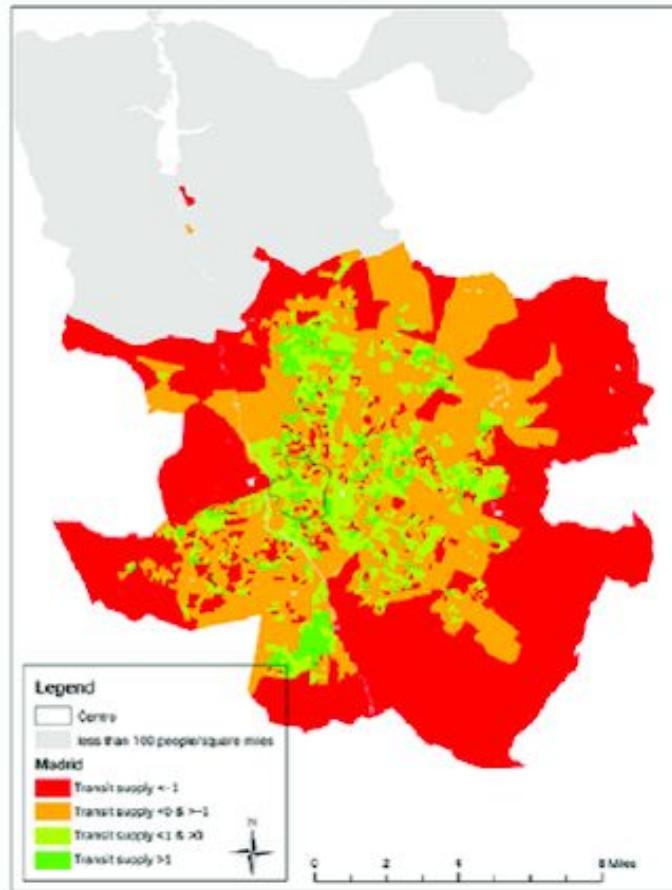
April 18, 2022

Madrid

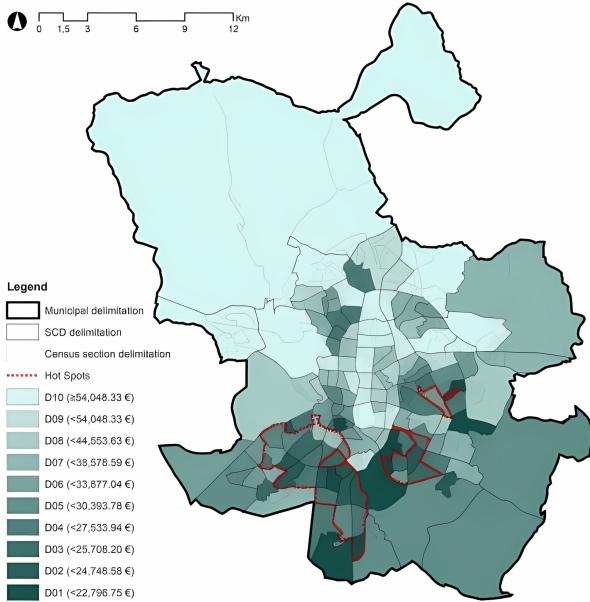
Transit demand



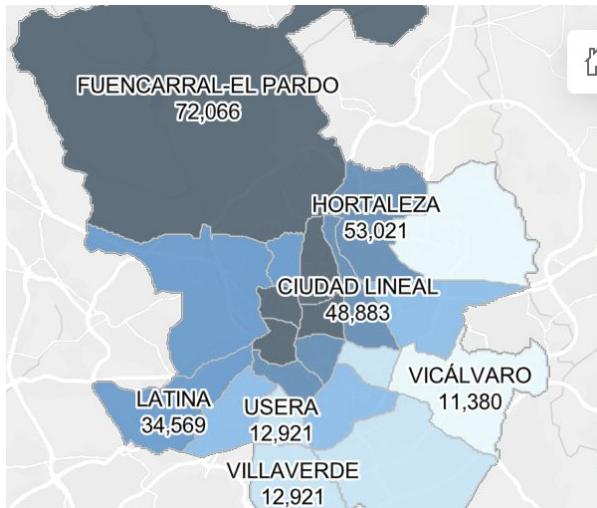
Transit supply



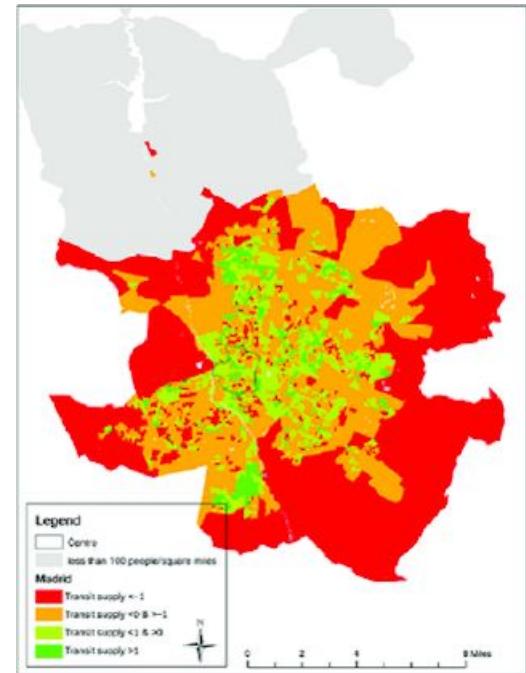
Comparisons Between Our Hard and Soft Systems



Economic
(income)



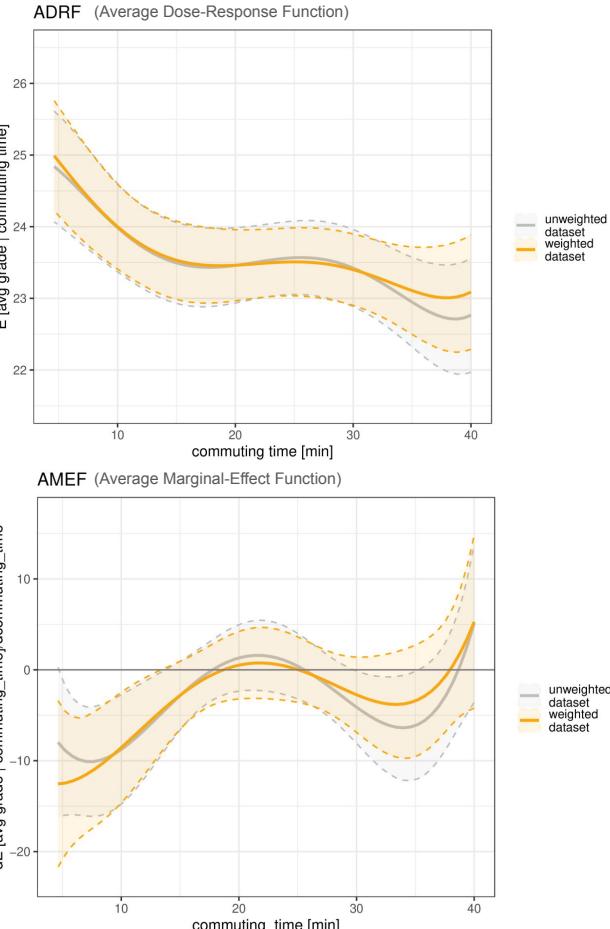
Education
(by tertiary degree)



Transit Supply

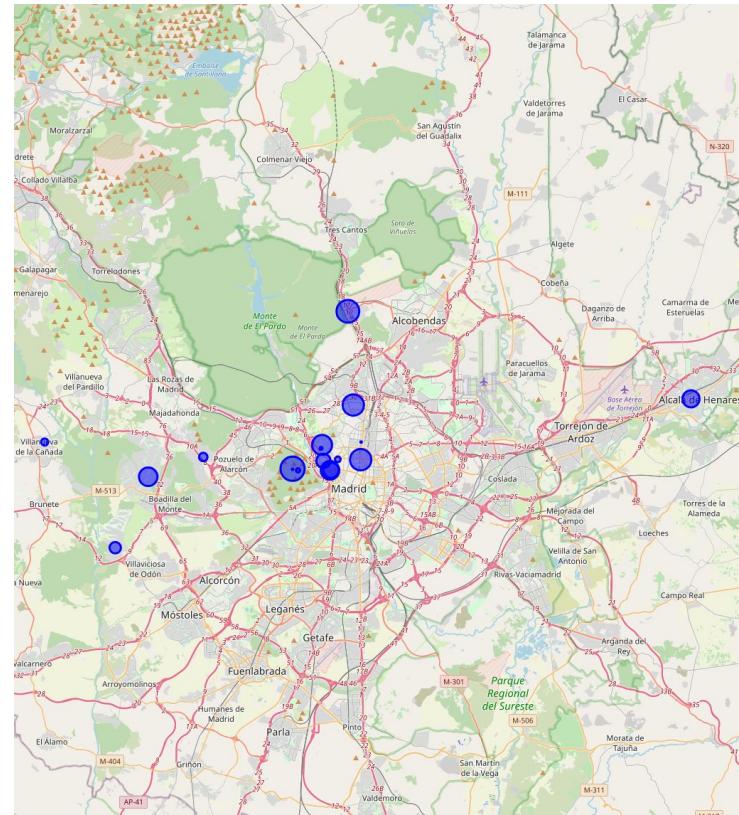
Is There Actually Any Correlation?

- Researchers looked into the correlation between influence of commuting time on students' GPA on university students focusing in the metropolitan area of Milan and the students of the Politecnico di Milano
- They found statistically significant figures showcasing that commute time can have an effect on GPA after accounting for other factors (sex, major, family income)
- TLDR (of entire paper): The study finds that **short commuting times of less than 15 minutes significantly impact students' academic performance, with average grades decreasing almost linearly from 25/30 to 23.5/30 as travel time increases up to nearly 15 minutes.** However, commuting times longer than 15 minutes show no significant effect on grades. This pattern is consistent across both balanced and unbalanced datasets



Data Analysis: Top 20 Universities in Madrid

- We scraped the **latitudes, longitudes, and ranks** of the top 20 universities in Madrid and mapped them
- The size of the “blue circle” represents the rank, the bigger the circle is, the higher the rank
(biggest circle is #1 university, smallest circle is #20 university)
- Rank was used in place of average income after graduation as specific numbers couldn't be found for all universities. We can assume that higher ranked universities will provide higher salaries for the purpose of this visualization.
- “The most prestigious university pays about a **13% premium** relative to unranked institutions and the least prestigious university” National Bureau of Economic Research, Cambridge, MA
- According to Glassdoor, the average annual salary for a graduate student in Madrid is approximately **€30,000**
- Additionally, a study by the Valencian Institute of Economic Research and the BBVA Foundation indicates that **only a select few degree programs in Spain guarantee** newly graduated students a monthly salary equal or greater than **€1,500** upon leaving university



M30 Renewal Project

- Addressing Congestion, Pollution, and Connectivity
 - digitalization of the M30
- Enhancing Mobility, Economy, and Education
- 5G, IoT, AI, edge computing integration
 - improved traffic flow & safety
 - broadband services in tunnels
- Fostering Long-Term Economic Growth
- Digital twin for education optimization



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