The National Academies of
SCIENCES • ENGINEERING • MEDICINE

TRANSPORTATION RESEARCH BOARD

Retrospective, Perspective, & Prospective of Transit-Oriented Development

February 25, 2021

@NASEMTRB
#TRBwebinar

PDH Certification Information:

- 1.5 Professional Development Hour (PDH) – see follow-up email for instructions
- You must attend the entire webinar to be eligible to receive PDH credits
- Questions? Contact Reggie Gillum at RGillum@nas.edu

The Transportation Research Board has met the standards and requirements of the Registered Continuing Education Providers Program. Credit earned on completion of this program will be reported to RCEP. A certificate of completion will be issued to participants that have registered and attended the entire session. As such, it does not include content that may be deemed or construed to be an approval or endorsement by RCEP.

RCEP

REGISTERED CONTINUING EDUCATION PROGRAM

#TRBwebinar

APA credits

- This webinar is eligible for 1.5 AICP credits
- Log into the APA website after this webinar to claim your credits

Learning Objectives

1. Identify impacts of TOD on travel behavior, real estate prices, residential location, urban form, and community life

2. Discuss how to further develop TOD policies

#TRBwebinar

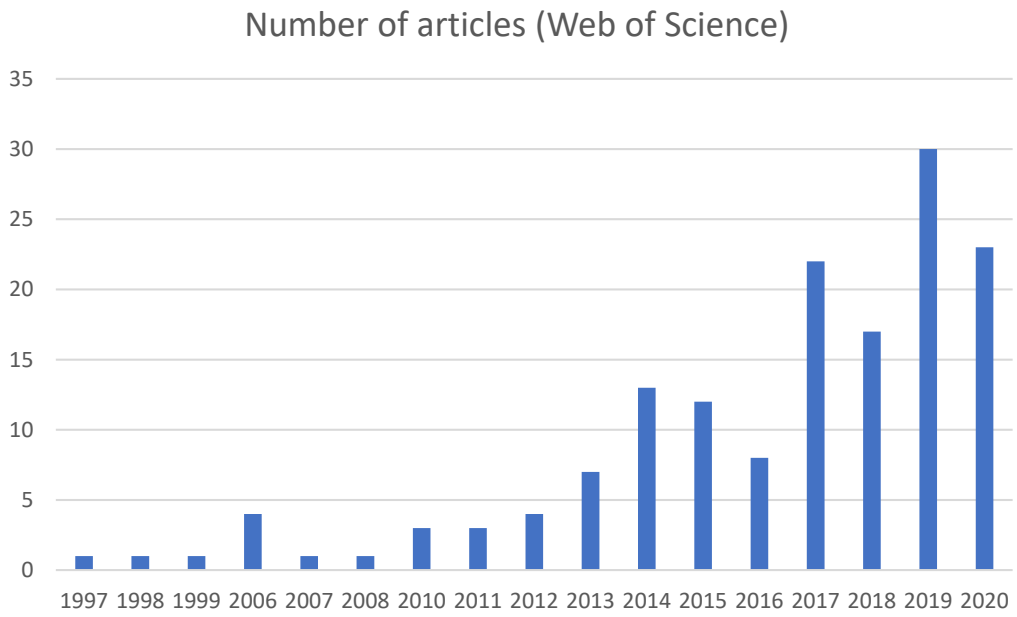
Review of TOD research achievements, planning tools, and challenges

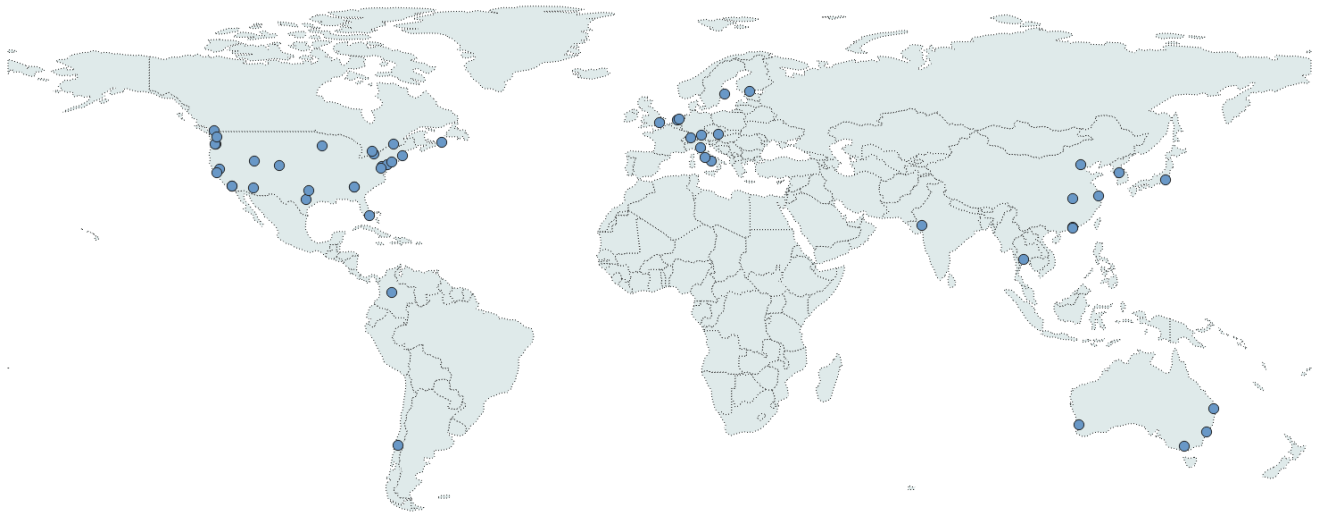
Anna Ibraeva, CITTA research center,
University of Coimbra (Portugal)

Contents

- TOD and Travel Behavior
- TOD and Self-selection
- TOD and Real Estate prices
- TOD and Gentrification
- TOD and Urban Form
- TOD and Urban Planning

TOD: RELEVANCE

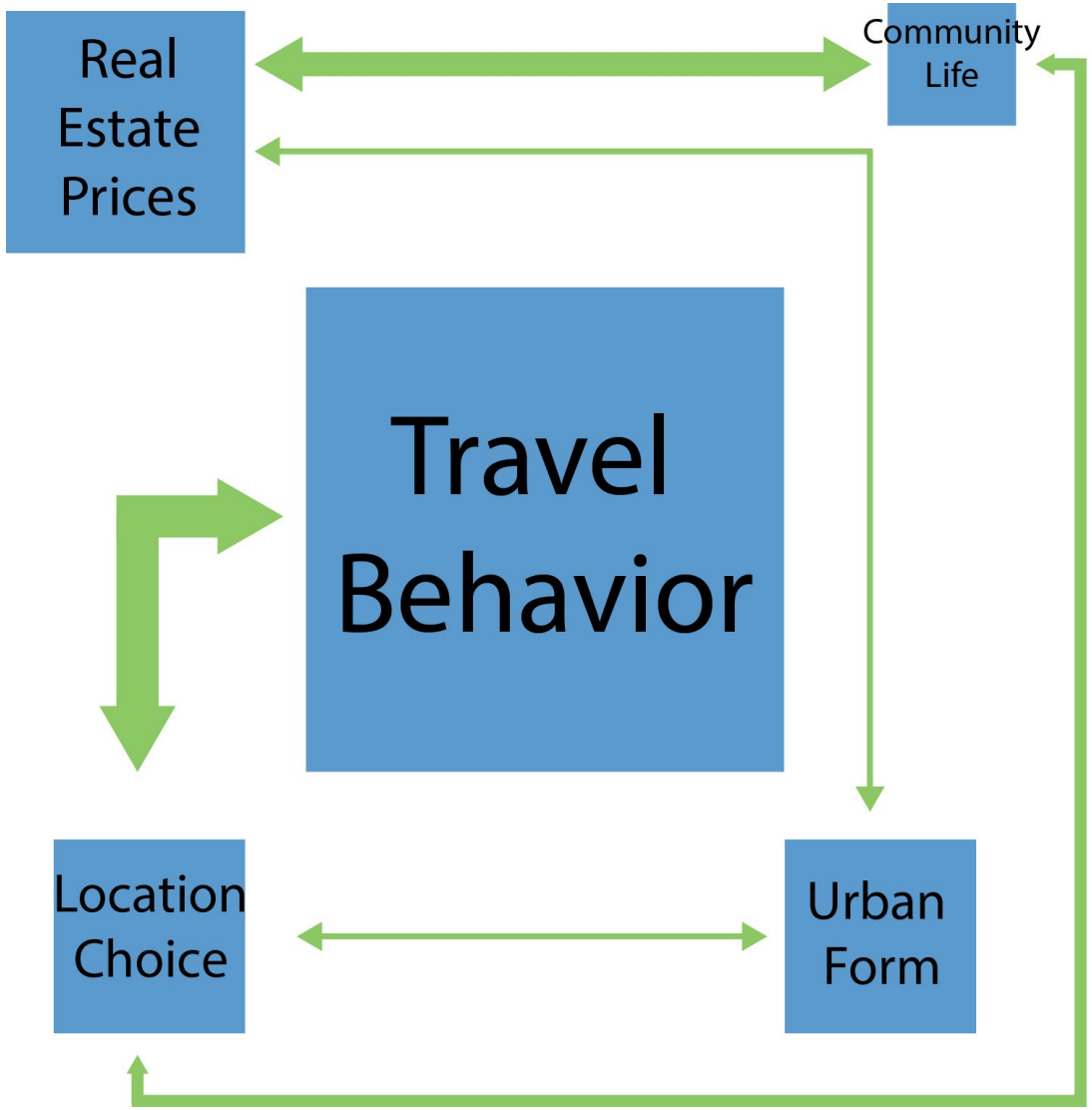




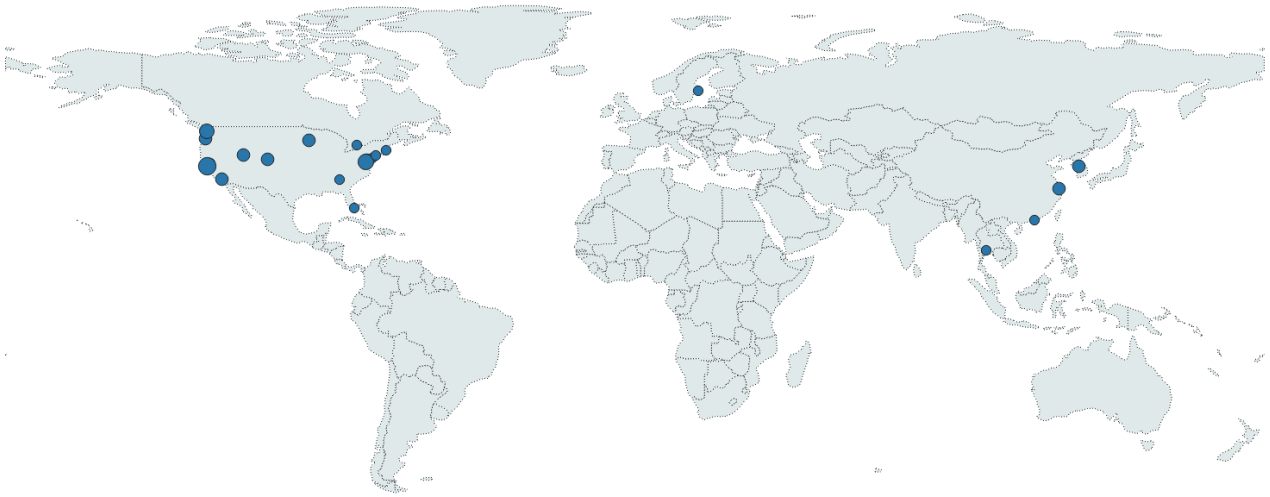
- Growing number of publications
- Growing number of TOD projects worldwide
- Urbanization trends that urge cities to implement sustainable growth strategies

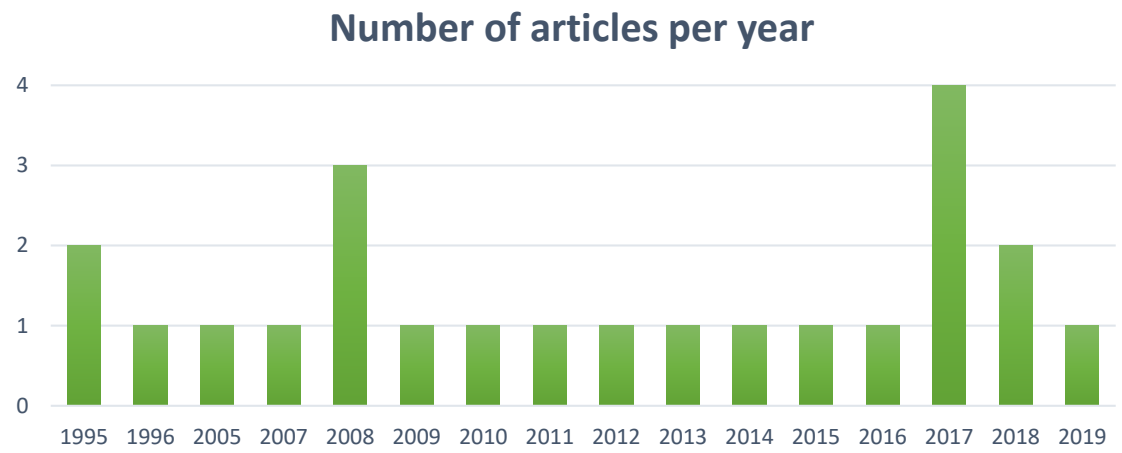
TOD: COMPLEXITY

- Various TOD issues are interconnected
- TOD is a place that allows people to reach various destinations, ideally being a destination itself (place for work, relax and living)
- A place that can easily be reached by various sustainable modes (PT, walking, cycling), multimodal node
- An affluent place with high land value, but with affordable housing and low levels or car ownership/car use
- "The ideal TOD is inviting and attractive to many types of users, acknowledging that people have different standards and different reasons for using the same space." (Jacobson and Forsyth, 2008)



TOD and TRAVEL BEHAVIOR: article selection

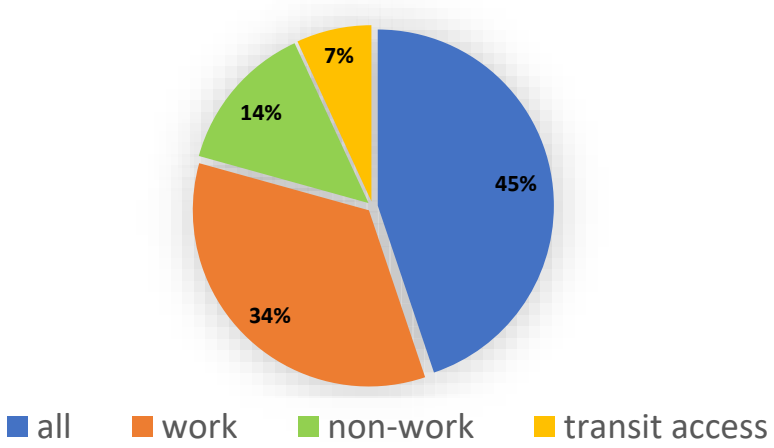


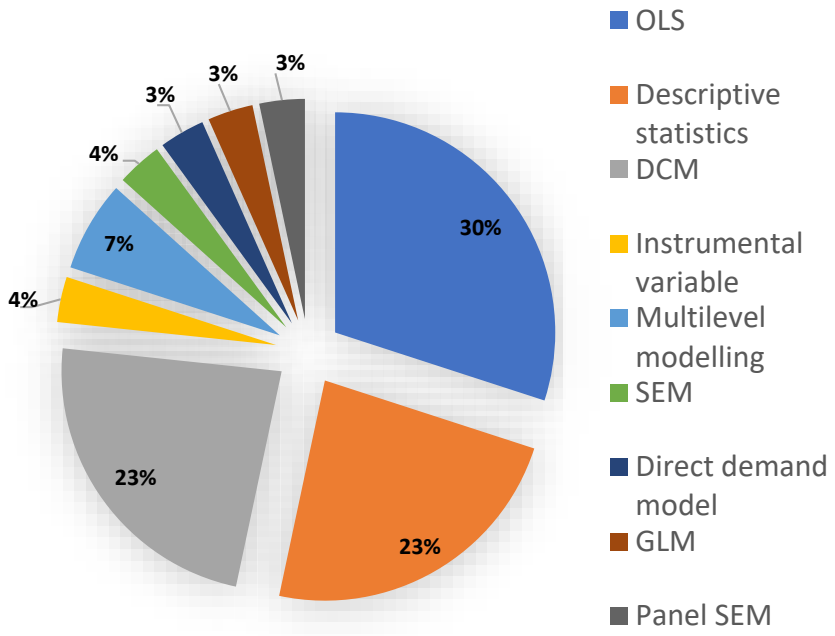


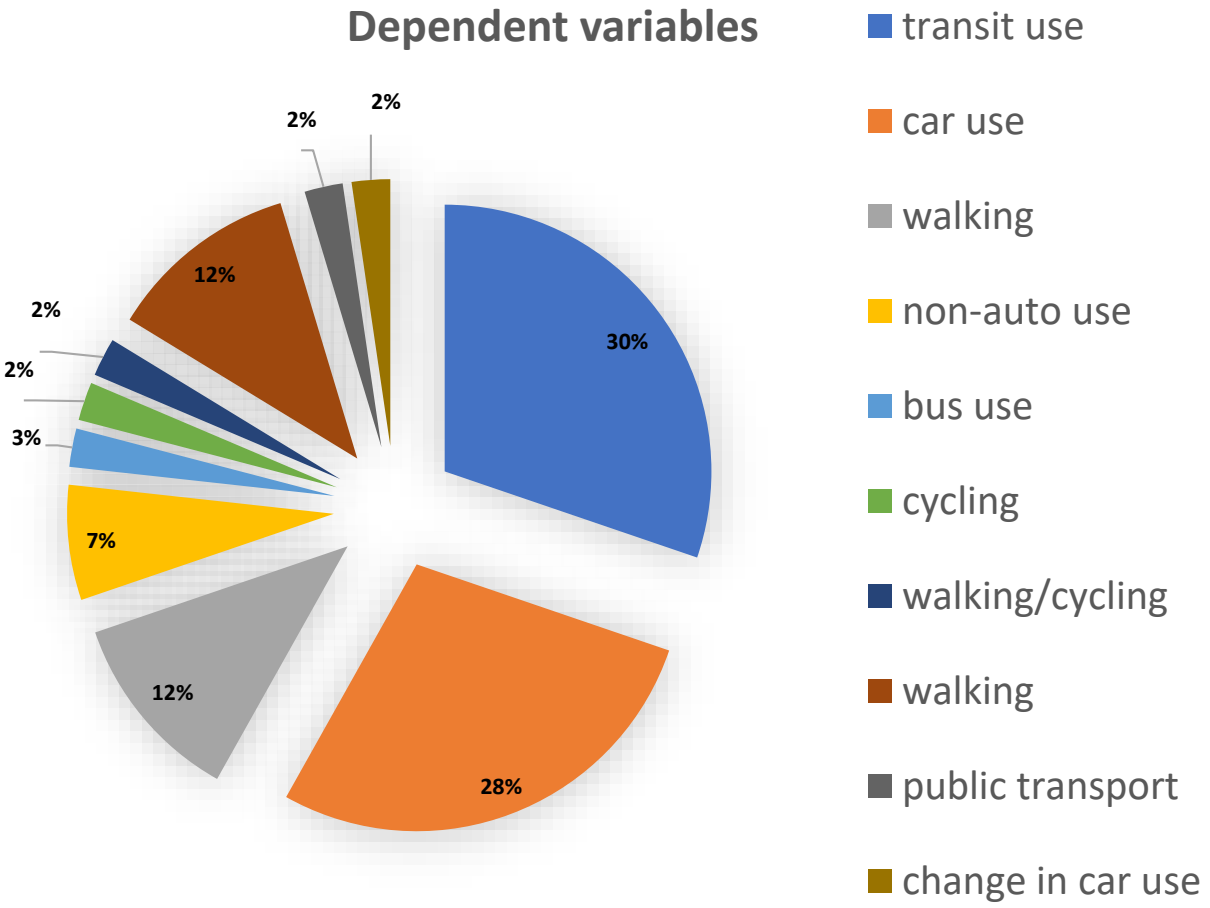
Total of 23 articles selected by:

- Keywords: TOD, travel behavior, mode choice
- Number of citations
- Attempting to widen the geographic scope
- Varied methodology
- Publication year to provide a comprehensive storyline

TOD and TRAVEL BEHAVIOR







TOD and TRAVEL BEHAVIOR

*(D) – destination
*TTR – travel time ratio
*nb – neighborhood
*ST - station
*HH - household
*Activity density - № of residents + № of jobs/area)

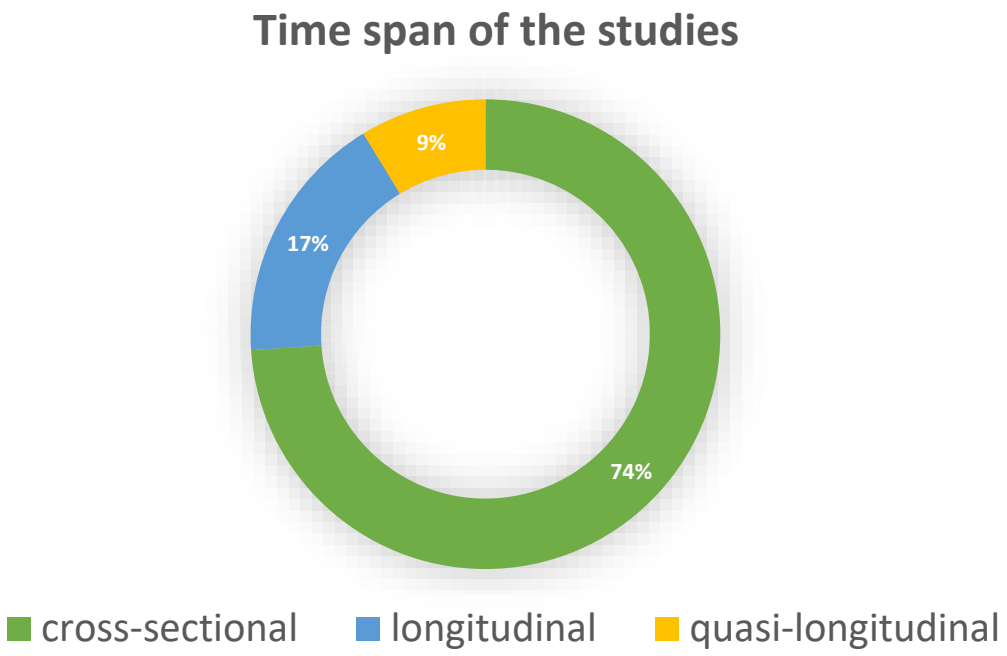
statistically significant at $p \leq 0,05$

TOD and TRAVEL BEHAVIOR

*ST - station
*HH - household
*Activity density - № of residents + № of jobs/area)

statistically significant at $p \leq 0,05$

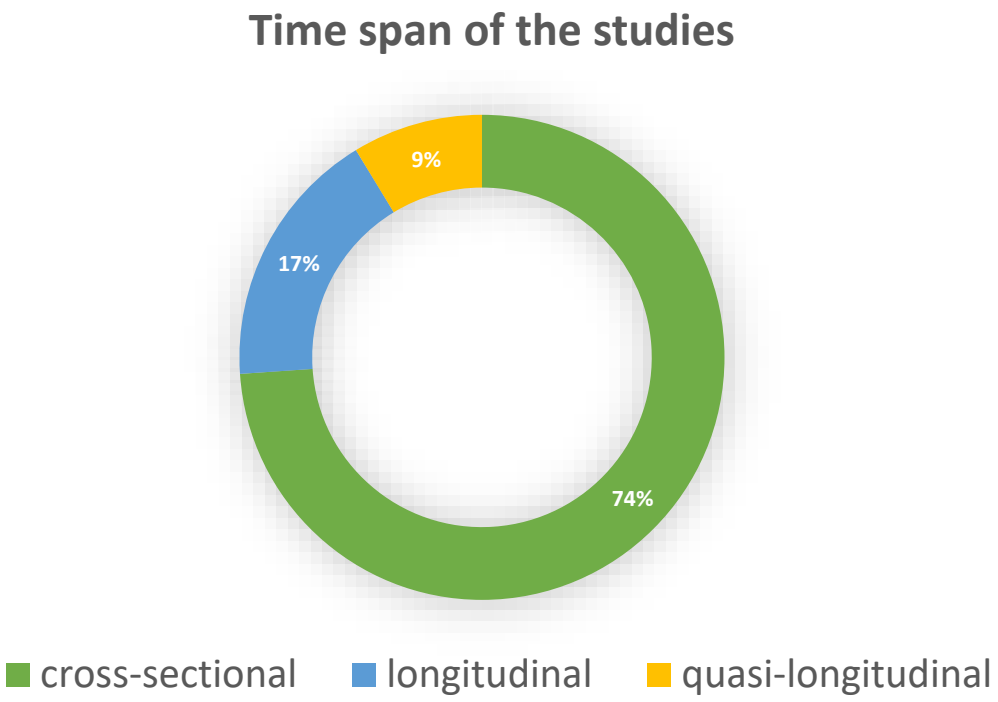
TOD and TRAVEL BEHAVIOR: longitudinal approach



Highlights:

- **Built environment is important** even after accounting for travel attitudes and socio-demographic controls (Handy et al., 2005, Cao et al., 2007)
- an **increase in accessibility** and **increase in safety** are associated with either **a smaller increase or a larger decrease in driving** (Handy et al., 2005)
- **attractiveness, safety, physical activity options, and socializing** are associated with **increase in walking** (Cao et al., 2007)
- **"supportive attitudes have limited power in the face of an unsupportive environment"** (Brown and Werner, 2008)
- Travel behavior is quite **stable over time**: past values largely explain current values. Moving away from a station is associated with ever greater car use (Van de Coevering et al., 2016)

TOD and TRAVEL BEHAVIOR: longitudinal approach



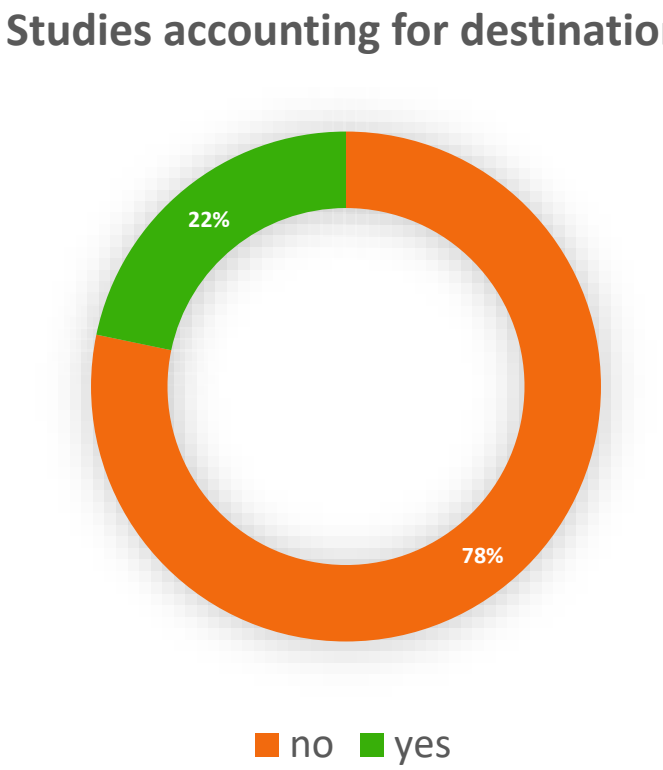
Benefits:

- Under certain assumptions, can reveal **causality**
- Demonstrates the **evolution over time** of travel attitudes and habits (that normally do not change easily or quickly)
- Accounts for **previous mode share** distribution

Drawbacks:

- **Data availability**: hard to find, especially panel data, especially for longer time intervals with same variables/same units of analysis
- **Self-selection** is hard to address at a census tract level (people relocate, frequently we do not have information where they are coming from or where they go)
- **Anticipation problem**: easier when service did not exist before, but harder when dealing with an already mature network and new stations are coming
- **Station maturity**: differentiate between older and newer stations
- **"Natural experiment" setting is rare** since many cities already have abundant transit service

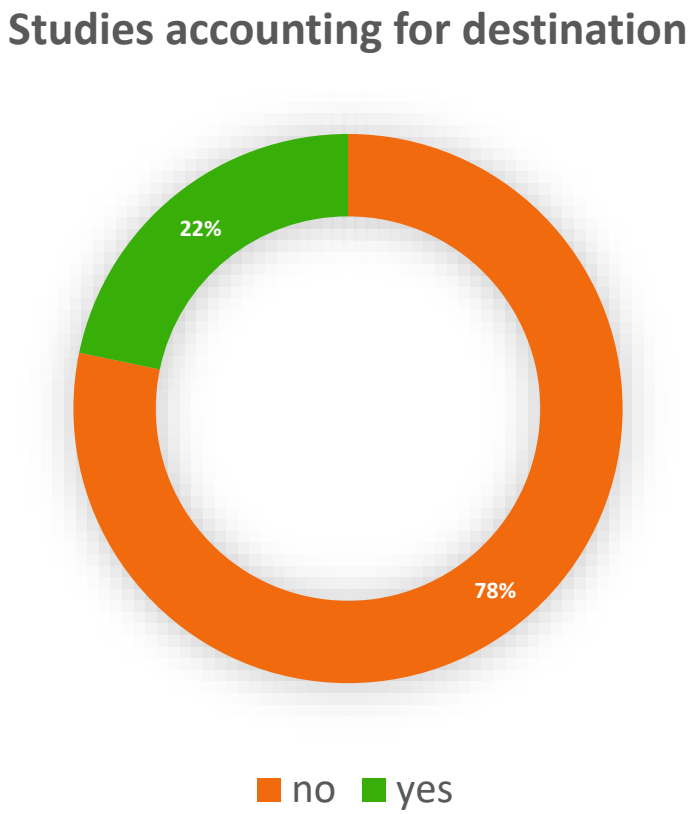
TOD and TRAVEL BEHAVIOR: origin-destination



Highlights:

- Trip with TOD at either origin or destination has higher probability of transit/walk/bike choice, but the **magnitude** of effect is greater for trips with TOD at destination (Nasri and Zhang, 2019)
- Links with **“university”** at one of the trip ends is positively associated with transit use (Cervero and Radisch, 1996; Choi et al., 2012)
- Presence of **large or medium shopping malls at a destination** is associated with an increase in transit ridership (Pan et al., 2017)

TOD and TRAVEL BEHAVIOR: origin-destination



Benefits:

- It is not only origin that matters, but also the **accessibility and characteristics of the destination**
- By differentiating between characteristics of the origin and destination we may know where interventions are more likely to produce desired result and which **links** are likely to benefit from TOD interventions
- Allows to determine **activity space**

Drawbacks:

- **Data availability**: hard to find, mobility surveys may be limited in terms of details for privacy considerations, cell phone data may not disclose trip mode and personal/HH characteristics, smart card data is limited to PT users, etc.

TOD and SELF-SELECTION

Highlights:

- **Built environment influences travel choices even after accounting for self-selection** (Mokhtarian and Cao, 2008; Cao et al., 2009)
- **Not only the travel attitudes influence** residential location, but **also residential location influences** travel choices (Van de Coevering et al., 2016; Brown and Werner, 2008; Kamruzzaman et al., 2021)
- **Destination matters**: workplace within a mile of a rail station induces HH to reside near transit (Cervero, 2007). Moreover, LU characteristics of workplace and residential location are often similar (Gang and Wang, 2020)
- **The interaction between residential location, travel attitudes and long-term choices (like kids or car ownership) is simultaneous and very complex** (Gang and Wang, 2020)
- Over time, **TOD dissonants become consonants at a faster rate** than vice versa (Kamruzzaman et al., 2021)

Gaps:

- Account for the reciprocal influences between BE and travel attitudes
- Longitudinal research design, before/after studies
- Anticipation problem: can people relocate to a place, anticipating a job relocation?
- Why some people become TOD consonants faster than others? Why some TOD consonants become TOD dissonants?

TOD and REAL ESTATE PRICES

Approach:

- Hedonic price analysis
- Stated preference vs revealed preference (what respondent says vs what respondent does)
- Spatial spillover from a station

Highlights:

- Effects depend on the **type of transport infrastructure** (heavy rail or light rail)
- **Property type** (commercial or residential)
- Neighborhood **income level** (Bowes and Ihlanfeldt, 2001; Hess and Almeida, 2007)
- **Service** coverage and attainable **destinations** (Kay et al., 2014)

Even though higher densities often negatively affect home values, in station areas this is unlikely to happen; on the contrary, **property prices in station areas with permissive zoning tend to be higher** (Duncan, 2011)

TOD and COMMUNITY LIFE

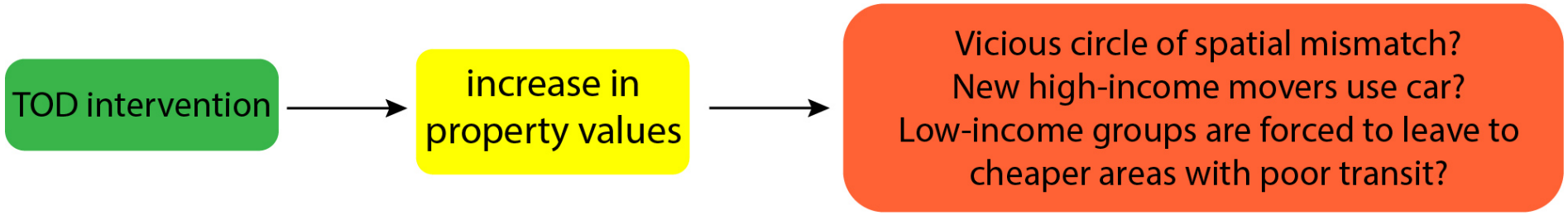
TOD initially aims to create **mixed-use, lively and safe neighborhoods**, so it is potentially helpful in creating/reinforcing community life and social networks.

However, as TOD is likely to provoke increase in property values, **gentrification** becomes a concern.

Highlights:

- Walkable, mixed-use neighborhoods are associated with higher levels of social capital and social interaction (Kamruzzaman et al., 2014), yet higher densities may compromise these interactions as social trust is negatively affected by higher densities. Mixed-use is essential to compensate for that.
- Kahn (2007) spotted uneven gentrification: manifested in some cities (Washington, D.C. and Boston) and near some stations (“walk & ride”) but was not noticeable in others.

TOD and COMMUNITY LIFE



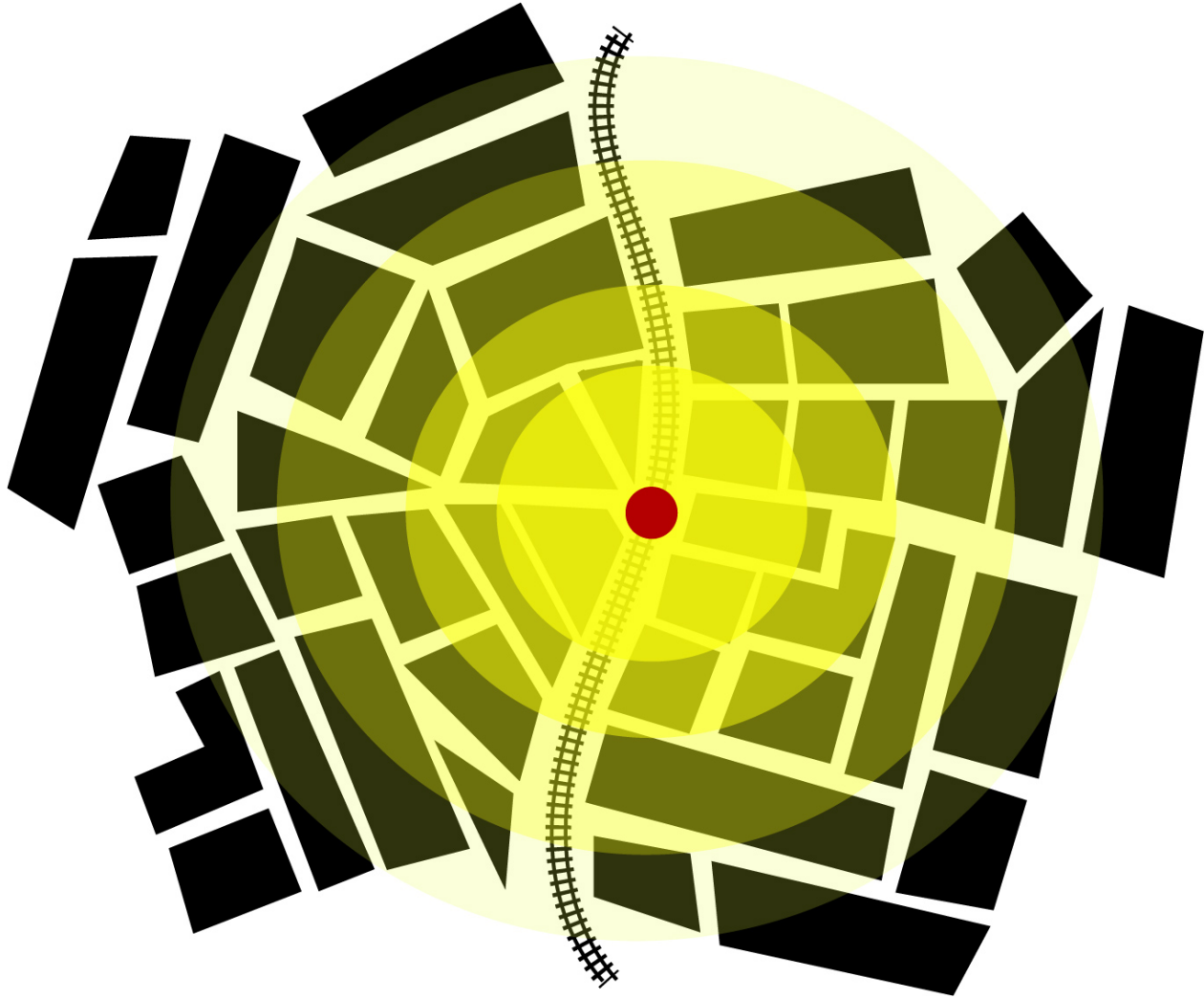
- Transit provides access to CBD during the day, while low-income groups often have different travel needs, will they actually benefit from transit? (Fan, 2012; Bardaka and Hersey, 2019)
- Shares of transit use in market-led neighborhoods are lower than in low-income areas (Bardaka and Hersey, 2019)
- Both gentrifiers and old residents favor metro use if their destination is within walking distance from the station (Chava et al., 2018)

Where is the balance between market-led and affordable housing that supports transit ridership?

TOD and SPATIAL SPILLOVER

- “The treatment effects increase as the percentage of directly treated neighbors rises” (Bardaka et al., 2018, about housing values and gentrification)
- TOD registered not only higher property prices than non-TOD station areas, but also showed significant spillover effect (beyond 800m walking distance), probably associated with commercial activity (Yu et al., 2018)

What determines the gradient length and intensity?



TOD and URBAN FORM

TOD as a way to:

- **Channel/organize urban growth** (Papa et al., 2008, Ratner and Goetz, 2013; Schuetz et al., 2015)
- Stimulate **infill development/urban regeneration** in urbanized areas
- Improve **regional accessibility** by promoting growth around transit-served areas and providing transit to dense areas

However:

- Developments in central areas risk to become mostly commercial/office, in suburbs they struggle to achieve mixed use
- In already dense central areas little land is available for development
- The balance requires multi-actor cooperation and participation

TOD and URBAN PLANNING

	Local authorities	Developers	Transit agencies	Residents
Expectations	Accomodate and organize urban growth; Promote an area; Better accessibility;	Satisfy market demand for mixed-use walkable environment; Benefit from higher property prices in station proximity;	Increase in transit patronage	Mixed
Risks	NIMBY; Reputational loss;	Density limitations; Green areas/walking infrastructure increase costs; Uncertain demand for office/commercial areas in some places; Affordable housing limitations; Risk that infrastructure project will be revised;	High initial investment costs (either service improvement, new lines or right-of-way acquisition); Uncertain demand;	Marginalisation of the station area; Densification; Parking limitations;

TOD and URBAN PLANNING: CHALLENGES

- How can local authorities **gain support** for the project from the residents?

Greenfield development, community engagement, introduction of public facilities like schools and parks in the plan, creating an identity for a project. Note: might increase project cost for developers.

- How can developers overcome **the high financial costs** of a project?

Adaptive reuse and higher densities. Note: adaptive reuse might be costly and density increase may provoke local opposition.

- How can transit agencies compensate for **high investment costs**?

R&P mechanism, ground lease, tax exemptions, using station parking lots as “land banks”. Note: might not work in cities with low transit ridership levels.


THANK YOU

References

Bardaka, E., Delgado, M. S., Florax, R. J. G. M., 2018. Causal identification of transit-induced gentrification and spatial spillover effects: The case of the Denver light rail. Journal of Transport Geography, 71, 15-31.

Bardaka, E., Hersey, J., 2019. Comparing the travel behavior of affordable and market-rate housing residents in the transit-rich neighborhoods of Denver, CO. Travel Behaviour and Society, 15, 74-87.

Bowes, D.R., Ihlanfeldt, K.R., 2001. Identifying the impacts of rail transit stations on residential property values. J. Urban Econ. 50 (1), 1–25.

Brown, B.B., Werner, C. M., 2008. Before and After a New Light Rail Stop: Resident Attitudes, Travel Behavior, and Obesity. Journal of the American Planning Association, 75(1), 5-12.

Cao, X., Mokhtarian, P.L., Handy, S.L., 2007. Do changes in neighborhood characteristics lead to changes in travel behavior? A structural equations modeling approach. Transportation, 34, 535-556.

Cao, X., Mokhtarian, P.L., Handy, S.L., 2009. Examining the Impacts of Residential Self-Selection on Travel Behaviour: A Focus on Empirical Findings. Transport Reviews, 29(3), 359-395.

Cervero, R., 2007. Transit-oriented development's ridership bonus: a product of self-selection and public policies. Environment and Planning A, 39, 2068-2085.

Cervero, R., Radisch, C., 1996. Travel choices in pedestrian versus automobile oriented neighborhoods. Transport Policy, 3(3), 127-141.

Chava, J., Newman, P., Tiwari, R., 2018. Gentrification of station areas and its impact on transit ridership. Case Studies on Transport Policy, 6.

Chava, J., Newman, P., Tiwari, R., 2018. Gentrification of station areas and its impact on transit ridership. Case Studies on Transport Policy, 6, 1-10.

Choi, J., Lee, Y. J., Kim, T., Sohn, K., 2012. An analysis of Metro ridership at the station-to-station level in Seoul. Transportation, 39, 705-722.

Duncan, M., 2011b. The synergistic influence of light rail stations and zoning on home prices. Environ. Plan. A 43 (9), 2125–2142.

Fan, Y., 2012. The Planners' War against Spatial Mismatch: Lessons Learned and Ways Forward. Journal of Planning Literature, 27(2), 153-169.

Fan, Y., 2012. The planner's War against Spatial Mismatch: Lessons Learned and Ways Forward. Journal of Planning Literature, 27(2).

Guan, X., Wang, D., 2020. The multiplicity of self-selection: What do travel attitudes influence first, residential location or work place? Journal of Transport Geography, 87.

References

Handy, S.L., Cao, X., Mokhtarian, P.L., 2005. Correlation or causality between the built environment and travel behavior? Evidence from Northern California. Transportation Research Part D, 10, 427-444.

Hess, D.B., Almeida, T.M., 2007. Impact of proximity to light rail rapid transit on station-area property values in Buffalo, New York. Urban Stud. 44 (5–6), 1041–1068.

Jacobson, J., Forsyth, A., 2008. Seven American TODs: Good practices for urban design in Transit-Oriented Development projects. Journal of Transportation and Land Use, 1(2), 51-88.

Kahn, M.E., 2007. Gentrification trends in new transit-oriented communities: evidence from 14 cities that expanded and built rail transit systems. Real Estate Econ. 35 (2), 155–182.

Kamruzzaman, Md., Giles-Corti, B., De Vos, J., Witlox, F., Shatu, F., Turrell, G., 2021. The life and death of residential dissonants in transit-oriented development: A discrete time survival analysis. Journal of Transport Geography, 90.

Kamruzzaman, Md., Wood, L., Hine, J., Currie, G., Giles-Corti, B., Turrell, G., 2014b. Patterns of social capital associated with transit oriented development. J. Transp.Geogr. 35, 144–155.

Kay, A.I., Noland, R.B., DiPetrillo, S., 2014. Residential property valuations near transit stations with transit-oriented development. J. Transp. Geogr. 39, 131–140.

Mokhtarian, P.L., Cao, X., 2008. Examining the impacts of residential self-selection on travel behavior: A focus on methodologies. Transportation Research Part B, 42, 208-228.

Nasri, A., Zhang, L. 2019. How Urban Form Characteristics at Both Trip Ends Influence Mode Choice: Evidence from TOD vs. Non-TOD Zones of the Washington, D.C. Metropolitan Area. Sustainability, 11, 3403.

Pan, H., Li, J., Shen, Q., Shi, C., 2017. What determines rail transit passenger volume? Implications for transit oriented development planning. Transportation Research Part D, 57, 52-63.

Papa, E., Pagliara, F., Bertolini, L., 2008. Rail system development and urban transformations: towards a spatial decision support system. In: Bruinsma, F., Pels, E., Priemus, H., Rietved, P., Van Wee, B. (Eds.), Railway Development: Impacts on Urban Dynamics. Physica-Verlag, Heidelberg, pp. 337–357.

Ratner, K.A., Goetz, A.R., 2013. The reshaping of land use and urban form in Denver through transit-oriented development. Cities 30 (1), 31–46.

Schuetz, J., Giuliano, G., Shin, E.J., 2018. Does zoning help or hinder transit-oriented (re)development? Urban Studies, 55(8), 1672-1689.

Van de Coevering, P., Maat, K., Kroesen, M., Van Wee, B., 2016. Causal effects of built environment characteristics on travel behaviour: a longitudinal approach. EJTIR, 16(4), 674-697.

Yu, H., Pang, H., Zhang, M., 2018. Value-added effects of transit-oriented development: The impact of urban rail on commercial property values with consideration of spatial heterogeneity. Papers in Regional Science, 97(4), 1375-1396.

Review of transit's role in urban development & best practice recommendations for TOD in the 21st century

Professor Richard D. Knowles

University of Salford, Manchester, UK &
University of Huddersfield, UK

TRB Webinar on Transit-Oriented Development
25th February 2021

TOD Research Team

This TOD research was undertaken by:

- **Professor Richard Knowles** [1&3]
- **Dr Fiona Ferbrache** [2]
- **Dr Alexandros Nikitas** [3]

[1] University of Salford, Manchester, UK; [2] University of Oxford, UK;
[3] University of Huddersfield, UK

TOD Research Method

- Synopsis of the systematic literature review
- Empirical evidence approach outlined in Knowles et al. 2020

Reference:

Knowles R.D, Ferbrache F. & Nikitas A. (2020) Transport's historical, contemporary and future role in shaping urban development: Re-evaluating transit oriented development. *Cities*, 99, 102607

Transport Shaping Space

- Transport plays a key role in ‘shaping space’ (Knowles 2006)
- Seismic change during the industrial revolution from small compact walking towns to expanded star-shaped cities following horse-drawn, steam-powered and electrified transit routes
- Transport is ‘a maker and breaker of cities’
  (Clark 1958; Hall 1992)
- Strong relationship between transport and both urban development & post-industrial urban regeneration

Transit-Oriented Development (TOD)

- TOD is the process of focusing housing, employment, retail & leisure activities, education facilities & public services around rapid transit stations or stops: *rail, light rail (LRT), or bus (BRT)*

- TOD was first defined by Calthorpe (1993), but the process has existed since the mid 19th century

Three Eras of TOD

Historic suburbanisation: mid C19th to early C20th
: captive transit traffic

Planned suburbanisation: mid C20th
: low car ownership & largely captive transit traffic

Contemporary: Urban Development or Regeneration

(Knowles et al. 2020)

Historic TOD

Private sector urban development along railway (*suburban, metro* or *subway*) and tram (*streetcar*) routes: mainly in Europe and North America

- **Streetcar suburbs**: e.g. Boston, Copenhagen, Glasgow, Leeds & Melbourne
- **Railway suburbs**: e.g. New York (North Manhattan, Brooklyn & Bronx); Manchester to Altrincham UK from 1849
- **Star shaped city**: Chicago - classic example
- **Metroland**: London 1920s/1930s

Growth of Manchester

Manchester: world's first industrial city

- **Pre 1845**: compact 'walking city': Manchester & Salford
- **1845-1905**: joined up along tram and railway routes with small neighbouring towns: Altrincham, Stockport, Ashton, Oldham etc
- **1905-1950**: infilling between radial routes

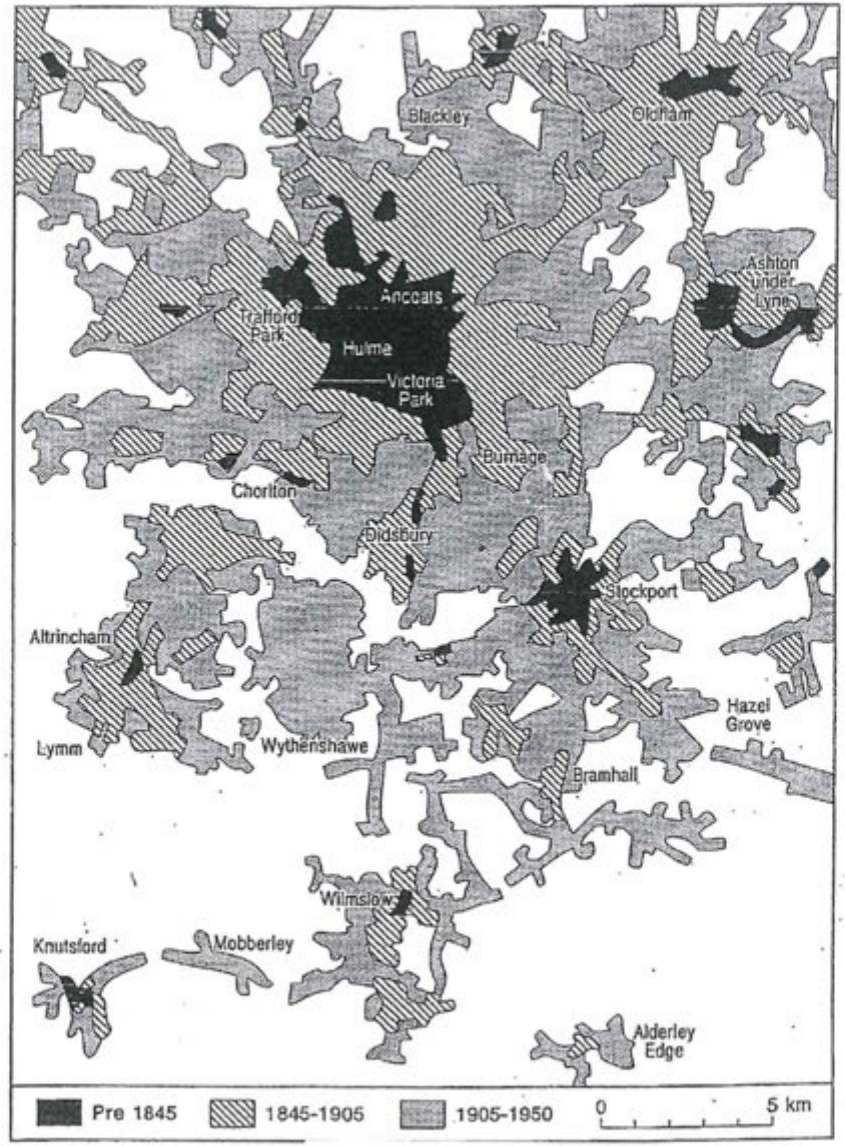


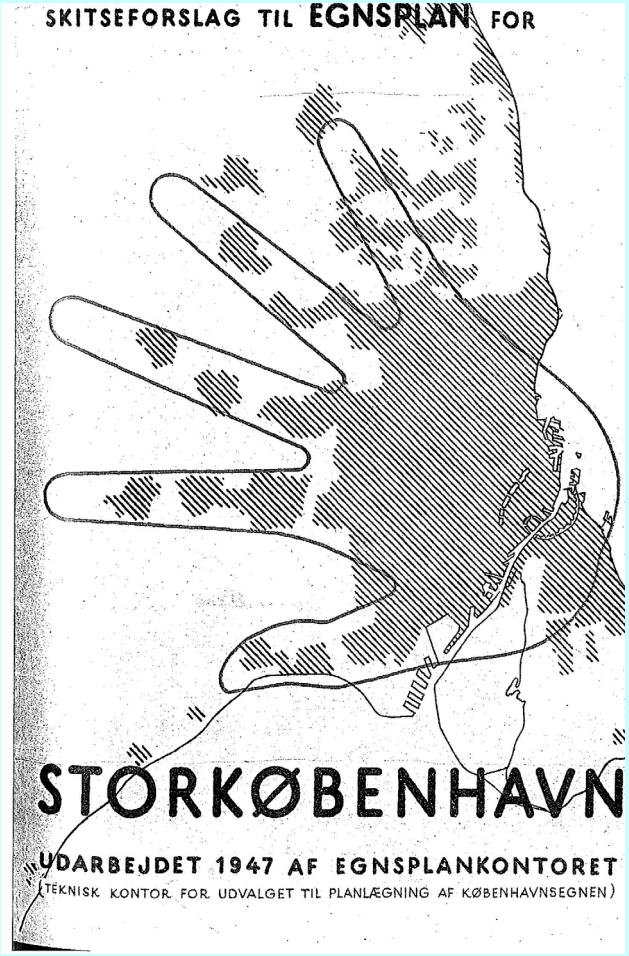
Figure 1 Manchester's development context

Planned TOD

- Copenhagen 1947 Finger Plan
- Oslo 1950 Comprehensive Plan
- Stockholm 1952 General Plan
- Paris 1965 Regional Masterplan
- Singapore’s 1971 Concept Plan

(Knowles 2012; Knowles et al. 2020)

Copenhagen Finger Plan 1947



Contemporary TOD: 6 ‘D’s & High Frequency

- **Density**: high density – dwellings, population, jobs & activity sites
- **Diversity**: multiple forms of land use
- **Design**: dense urban grids & pedestrian friendly

  (Cervero & Kockleman 1997)

- **Distance** to transit
- **Destination** accessibility
- **Demand** management

  (Ewing & Cervero 2010)

- **High Frequency Transit**: rail, light rail or bus (BRT)

  (Knowles 2012; Knowles et al 2020)

Contemporary TOD..

- requires supportive planning policies designed to create a relatively high density, compact and mixed urban form
- can create a distinct ‘sense of place’ and make an iconic impact on the urban landscape: ‘Grenoble Effect’
- accessed by sustainable transport: rail, light rail or bus transit; cycling & bike-sharing; walking
- a very important part of a broader ‘Smart Growth’ approach to urban development and regeneration

(Ferbrache & Knowles 2017; Knowles et al 2020)

Contemporary TOD...

- **Minority of captive traffic** in Europe, North America etc.
- **Majority of captive traffic** in city states, East Asia & Less Developed Countries
- **Higher transit frequencies** & capacity to compete with cars
- **Speed**: wider catchment area for Rail than for Light Rail or BRT
- **Displacement**: increased accessibility raises house prices & rents – can force lower income residents out

Contemporary TOD: REGENERATION

- Canary Wharf, London [1&2]
- Grenoble, Nice & Bordeaux [1]
- Portland (O) & Denver [1]
- Salford Quays & Media City UK [1]
- Vancouver [1]

1 Light Rail (LRT); 2 Heavy Rail

MediaCityUK: Salford Quays

Contemporary TOD:
NEW URBAN DEVELOPMENT

- Brisbane, Australia [1]
- Delhi [2&3]
- Dubai [2]
- Curitiba, Brazil [1]
- Hong Kong [2]
- Ørestad, Copenhagen [3]
- Ottawa, Canada [1]
- Seoul, South Korea [2]
- Singapore [2]

1 Light Rail (LRT); 2 Heavy Rail; 3 Bus Rapid Transit (BRT)

Ørestad New Town, Copenhagen

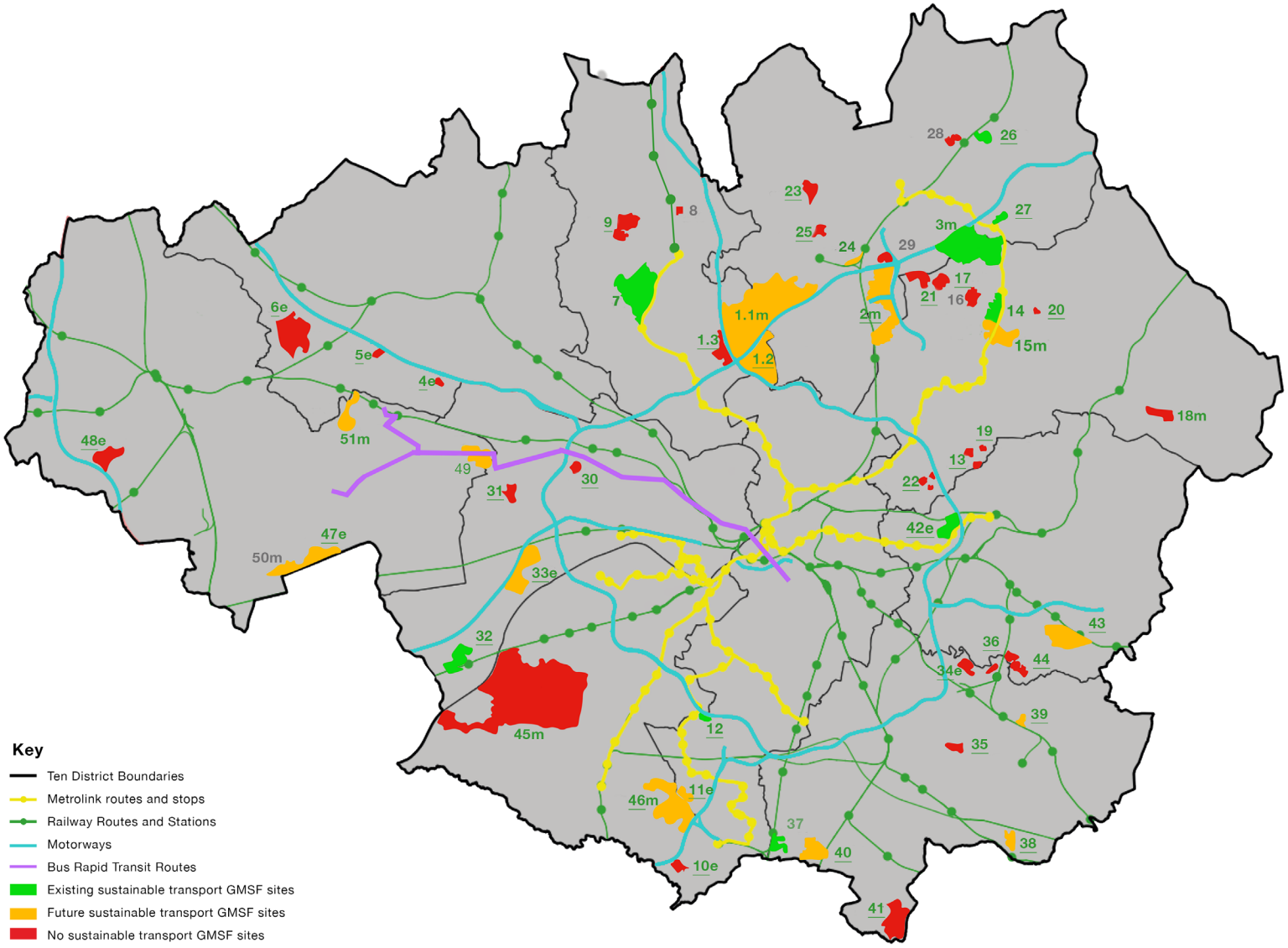
Mismatch between Regional Planning and Sustainable Transport: GMSF2019

Greater Manchester's 2019 Spatial Framework: environmental, sustainability & TOD objectives

53 strategic development sites:

- 9 (*green*) currently served by LRT or rail
- 16 more (*orange*) if transit investments are made in LRT, rail & BRT
- 26 remain dependent on cars (*red*) & 2 with low frequency transit

(Knowles 2021)


Key
Ten District Boundaries
Metrolink routes and stops
Railway Routes and Stations
Motorways
Bus Rapid Transit Routes
Existing sustainable transport GMSF sites
Future sustainable transport GMSF sites
No sustainable transport GMSF sites
1m Mixed use sites denoted by "m" after the site Number
1e Sites for employment only denoted by "e" after the site number
1 Green site numbers underlined indicate Wholly Green Belt sites
1 Green site numbers indicate mainly Green Belt sites
1 Black site Numbers indicate non Green Belt sites
0 4 8 12 16km
0 3 6 9 12 mi
N

Future TOD for the 21st century

Closer integration with strategic planning

Promote the 15 minute city concept

Infrastructure financing: capture increase in land & property value created by higher accessibility

Future TOD for the 21st century ..

‘Smart Growth’ ICT-led approach will develop & diversify – more remote working/telecommuting

Technical innovations may include:

- Car, ride & bike sharing
- Mobility-as-a-Service
- Autonomous Vehicles: driverless cars & transit
- Electrification of transport
- Hyperloop & unmanned aerial vehicle concepts

(Knowles et al. 2020; Nikitas et al. 2017)

Best Practice Recommendations

- Supportive planning policies are essential to maximise the positive economic and urban (re)development impacts of urban transit investment
- Mixed land use to integrate homes with jobs, retail & leisure and minimise longer travel
- Boost City Image: liveable cities - open, green & attractive

Best Practice Recommendations ..

- Mechanisms should be adopted to capture increase in land and property values
- Cost Benefit Analysis of transit investment proposals should be modified to place more emphasis on environmental, social and wider economic effects

References

Calthorpe P. (1993) *The Next American Metropolis: Ecology, Community and the American Dream*. Princeton Architectural Press, USA

Cervero R. & Kockleman K. (1997*)* Travel demand and the 3 Ds: density, diversity and design. *Transportation Research Part D: Transport and Environment*, 2, 199-219

Clark C. (1958) Transport – maker and breaker of cities. *The Town Planning Review,* 28(4), 237-250

Ewing R. & Cervero R. (2010) Travel and the Built Environment: A Meta-Analysis*.* *Journal of the American Planning Association*, 76(3), 265-294

Ferbrache F. & Knowles R.D. (2017) City boosterism and place-making with light rail transit. *Geoforum*, 80, 103-113

Hall P. (1992) Transport: Maker and Breaker of Cities. In Mannion A.M.& Bowlby S.R. (eds) *Environmental Issues in the 1990s*, 265-276. John Wiley: Chichester, UK

Knowles R.D. (2006) Transport shaping space: differential collapse in time-space. *Journal of Transport Geography*, 13, 407-425

References ..

Knowles R.D. (2012) Transit Oriented Development in Copenhagen, Denmark: from the Finger Plan to Ørestad. *Journal of Transport Geography*, 22(1), 251-261

Knowles R.D. (2021) The mismatch between strategic planning and sustainable transport: The case of Greater Manchester's Spatial Framework 2019. *Journal of Transport Geography*

Knowles R.D. & Ferbrache F. (2016) Evaluation of the wider economic impacts of light rail investment on cities. *Journal of Transport Geography*, 54, 430-439

Knowles R.D, Ferbrache F. & Nikitas A. (2020) Transport's historical, contemporary and future role in shaping urban development: Re-evaluating transit oriented development. *Cities*, 99, 102607

Nikitas A., Kouglas L.,Alyavina E. & Njoya Tchouamou E. (2017) How can autonomous and connected vehicles, electromobility, BRT, hyperloop, shared use mobility and mobility-as-a-service shape transport futures for the context of smart cities? *Urban Science*, 194, 36

THANK YOU!

Professor Richard D. Knowles

r.d.knowles@salford.ac.uk

ANY QUESTIONS?

Today's Panelists

#TRBWebinar

- Anna Ibraeva, *University of Coimbra (Portugal)*
- Richard Knowles, *University of Salford (UK)*

Moderator: John Renne,

Florida Atlantic University

Get Involved with TRB

Receive emails about upcoming TRB webinars
https://bit.ly/TRBemails

#TRBwebinar

Find upcoming conferences
http://www.trb.org/Calendar

@NASEMTRB
@NASEMTRB
Transportation Research Board

Get Involved with TRB

#TRBwebinar

@NASEMTRB

@NASEMTRB

Transportation Research Board

Getting involved is free!

Be a Friend of a Committee bit.ly/TRBcommittees

- Networking opportunities
- May provide a path to Standing Committee membership

Join a Standing Committee bit.ly/TRBstandingcommittee

Work with CRP https://bit.ly/TRB-crp

Update your information www.mytrb.org