

# Participatory system dynamics modelling to support integrated transport decisions

## Critical reflections and lessons



**ALEX MACMILLAN**

**Senior Research Fellow**

**The Bartlett School of Graduate Studies, UCL  
School of Population Health, University of Auckland**



# Theory and practice



Theory is when you know everything but nothing works.

Practice is when everything works but no one knows why.

In our lab, theory and practice are combined: nothing works and no one knows why.



Alistair Woodward, School of Population Health, UoA

Jennie Connor, Preventive & Social Medicine, Otago

Karen Witten, SHORE, Massey

Robin Kearns, School of Environment, UoA

David Rees, Synergia Ltd, Auckland



# Decision-making for healthy, fair sustainable transport



1. Policy, community and academic knowledge
2. Participatory action research – collective learning
3. System understanding (complexity, uncertainty)
4. Quantifiable and non-quantifiable outcomes
5. Environmental sustainability and social equity

# Participation in transport planning



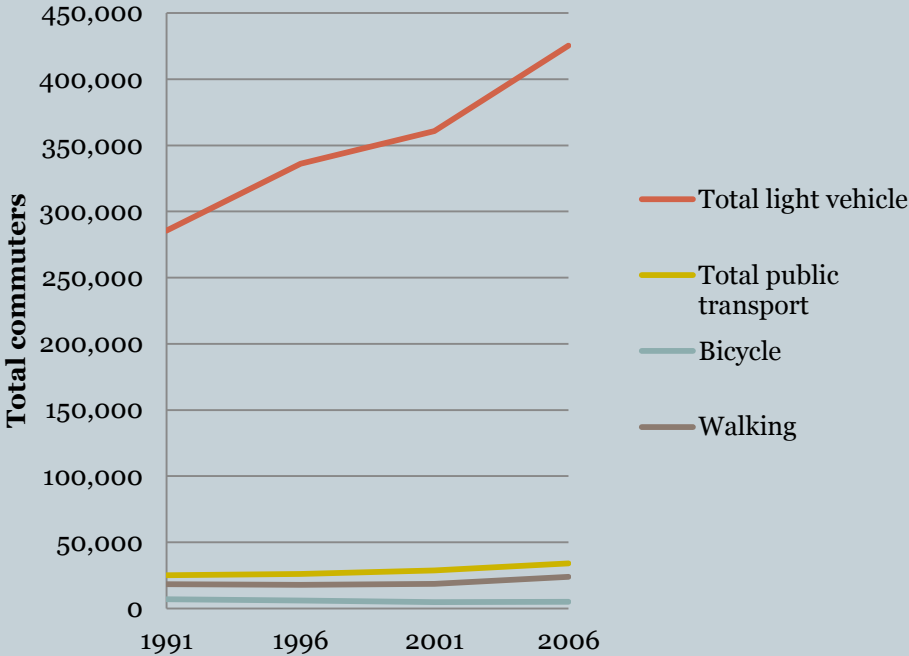
- Too complex *Booth & Richardson 2001*
- Lack of skills *Sanchez & Wolf 2005*
- Sustainable transport “lacks publics” *Burby 2003*
  
- Focus on neighbourhood level change *Innes & Booher 2004*
- OR limited to post hoc consultation *Booth & Richardson 2001*
- Limited success with innovative methods *Lowry 2010*

# Leaping off Arnstein's ladder



1. Provision of information
2. Offering options, listening to feedback
3. Deciding together
4. Acting together
5. Supporting independent community initiatives

# Intervening in the trip to work project





# System dynamics (SD) modelling



1. Many interacting variables
2. Behaviour governed by structure
3. Feedbacks
4. Accumulation (stocks)
5. Time important
6. Endogeneity



# Reflection v prediction



SD modelling as relativist, constructivist and holistic

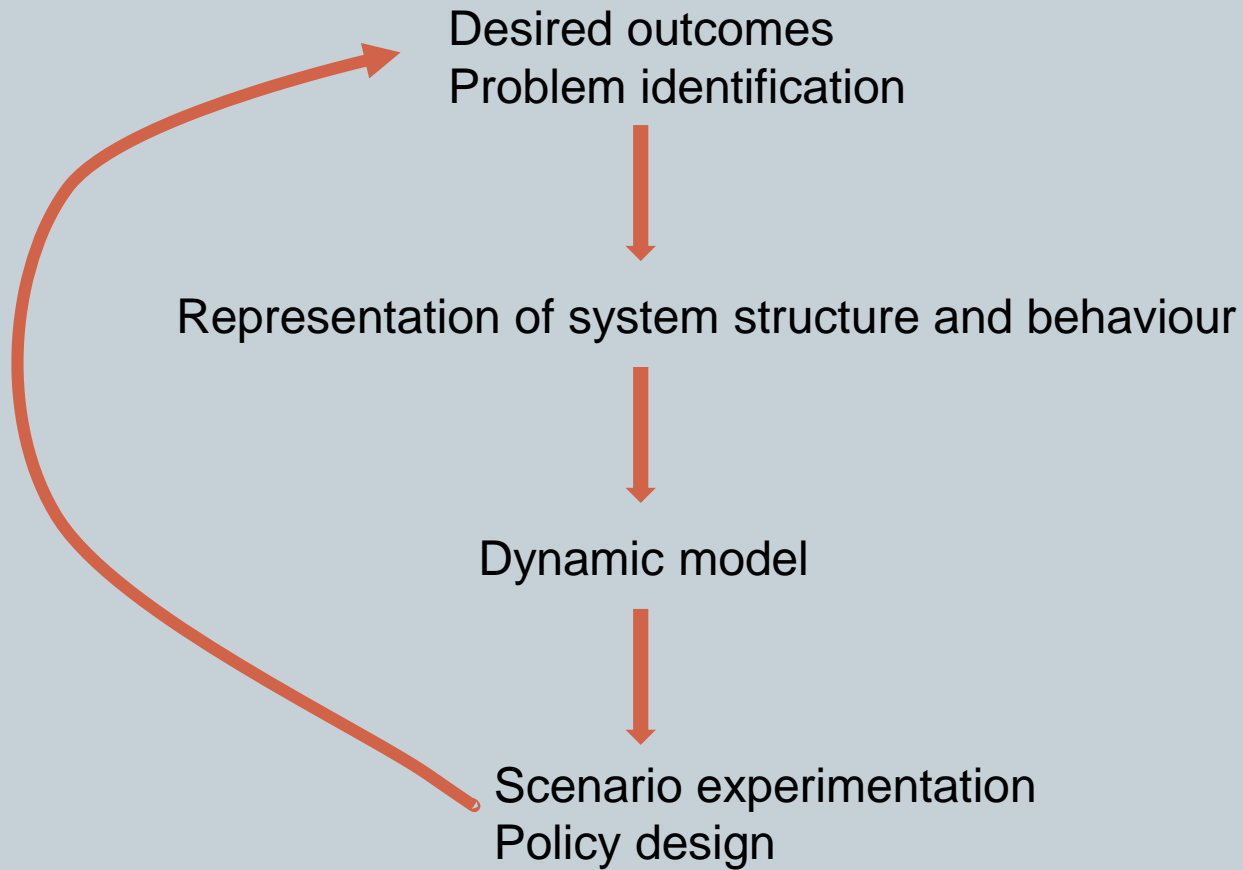
Usefully reflective models rather than point prediction

# Places to intervene in a system



5. Numbers, constants and rates of flow
4. Feedback loops, time and information delays
3. The system rules
2. Capacity of actors to change and evolve
1. Paradigms and ideological constraints

# Process



# Participatory SD process



- Define communities of interest
- Identify and recruit the “right” stakeholders
- Elicit collective understanding of the “system”
- Triangulate collective theory with data and literature
- Simulation modelling
- Policy levers
- More simulation modelling
- Policy insights

# Participants



<i>Groups represented</i>	<i>Participants representing each group</i>
People with disabilities	1
Māori communities	5
Pacific communities	3
Low income families	3
Young people	2
Regional transport policy makers	2
National transport agency	1
Public health	2
Local business association	1
Local tertiary institution	2
Local government	2
Regional government	2
Academics	3

M.W. interview 8 September 2008

people who don't have confidence about driving

people with disabilities

reliance on public transport

people without their driver's license maintenance

ALL costs of car

repairs insurance income

employment

can't afford to run a car

comparative cost of PT versus car

taking a stand about climate change / environmental issues

awareness of environment

orientation cues to know where you are

visually impaired people

busy city requires assertiveness & confidence

old buses

accessibility

crowded buses

frequency of service

disabilities accessibility

public transport take car.

safe crossings

in touch with community

knowledge about community

More likely to take action in comm.

getting to know people in the community

exercise

walk to/from bus stop

mentally prepare

space to think about what to do in the day

independence

having to deal with parking

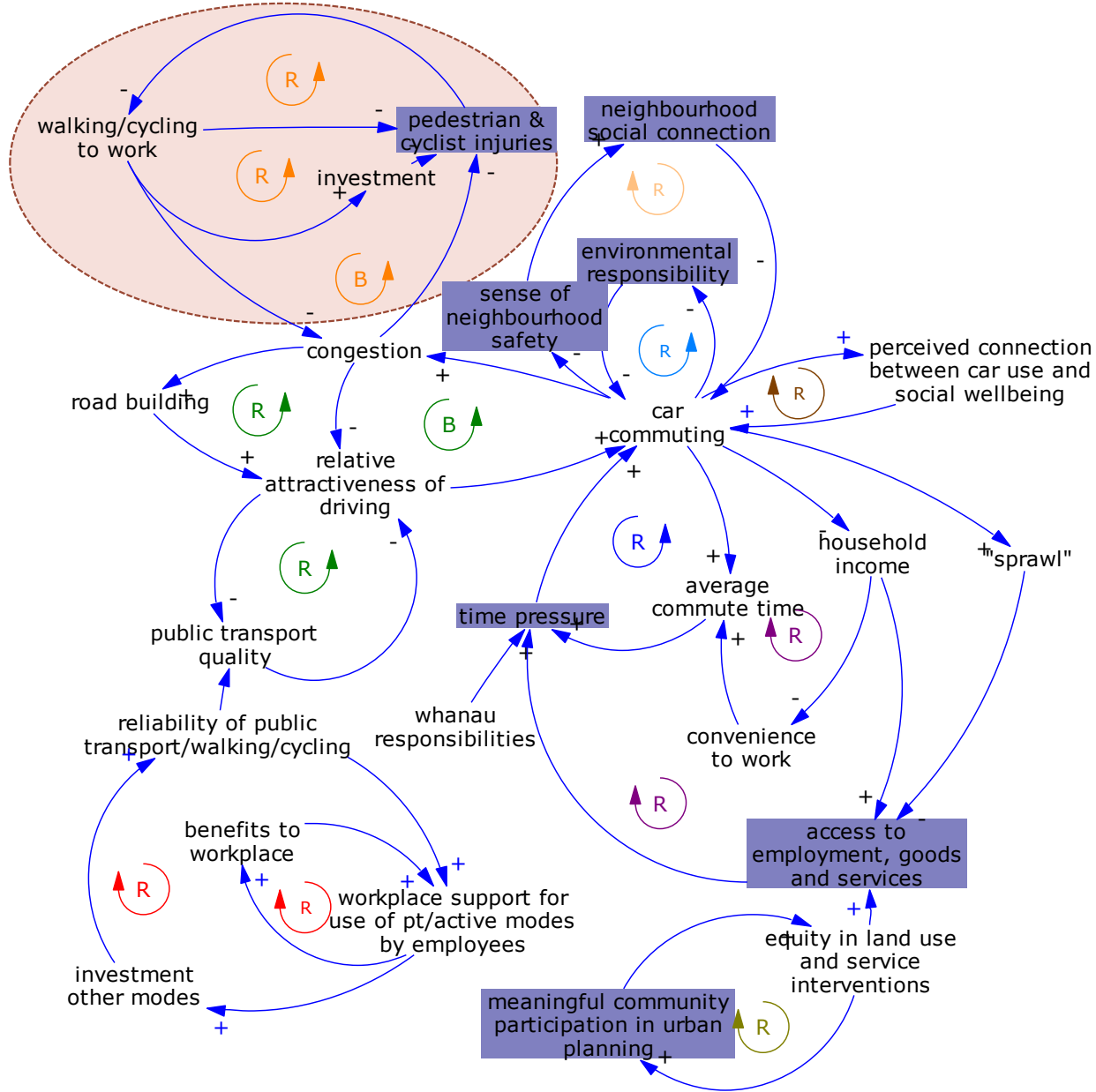
interested in public transport issues

taking part.

stress

ability to listen to music in car

GPS systems at bus stops and on buses





# Transport Patterns and Whānau Ora

Research Report  
2012



Raerino K, Macmillan AK and Jones RG. Indigenous Māori perspectives on urban transport patterns linked to health and wellbeing. *Health & Place*. 2013; 23: 54-62

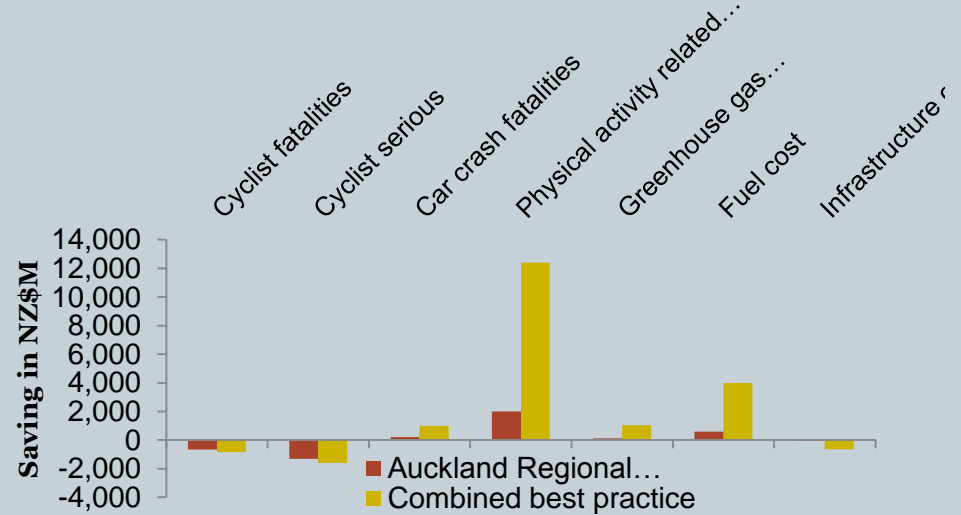
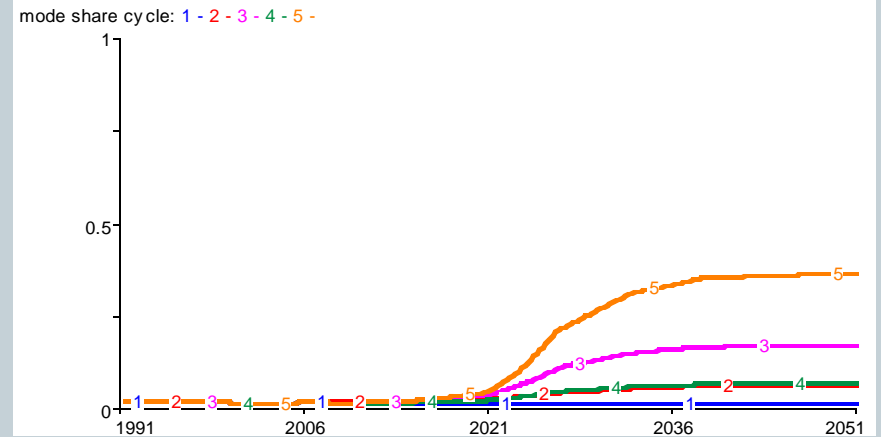
Then what happened when  
we tried to...

- Move from qualitative to simulation
- Shift from local to regional focus

In the context of...

- Significant governance upheaval

# Cycle commuting simulation model



# What did participation achieve in this project?



- Shaped included outcomes
- Germinated and governed new research
- Developed agreed collective causal theory linking transport, energy and wellbeing
- Divergent issues of interest:  
policy/academy/community
- Shared policy levers to increase cycling

# SDM – how participatory?



- Developed in particular citizenship contexts
- Time consuming!
- Language and symbols OK
- Able to incorporate different knowledge
- Flexible to shifts in focus and participation
- Meaningfulness of regional transport policy
- Community familiarity with computer simulation
- Tensions of timing
- Assumptions of spatial homogeneity

# Ingredients for success?



1. Policy champions/embedded in government
2. Active participation of policy makers
3. Stable governance (huh!)
4. 2 steps forward, 1 back
5. Flexibility of process and involvement
6. Facilitated practice sessions for participants ++
7. Being prepared to listen to and fund new questions
8. Introducing small simulations early

- Andersen, D. F., Richardson, G. P., & Vennix, J. A. M. (1997). Group model building: adding more science to the craft. *System Dynamics Review*, 13(2), 187-201. doi: 10.1002/(sici)1099-1727(199722)13:2<187::aid-sdr124>3.0.co;2-o
- Barlas, Y. (1996). Formal aspects of model validity and validation in system dynamics. *System Dynamics Review*, 12(3), 183-210. doi: 10.1002/(sici)1099-1727(199623)
- Beall, A., & Ford, A. (2010). Reports from the field: Assessing the art and science of participatory environmental modeling. *International Journal of Information Systems and Social Change*, 1(2), 72-89.
- Booth, C., & Richardson, T. (2001). Placing the public in integrated transport planning. *Transport Policy*, 8, 141-149.
- Burby, R. J. (2003). Making plans that matter. *Journal of the American Planning Association*, 69(1), 33.
- Charmaz, K. (2005). Grounded Theory in the 21st Century. Applications for Advancing Social Justice Studies. In N. K. Collins, K., & Ison, R. (2006). *Dare we jump off Arnstein's ladder? Social learning as a new policy paradigm*. Paper presented at the PATH (Participatory Approaches in Science Technology) Conference, Edinburgh. Denzin & Y. S. Lincoln (Eds.), *Sage Handbook of Qualitative Research* (3rd ed., pp. 507-535). Thousand Oaks, California: Sage.
- Charron, D. F. (2012). Ecohealth: Origins and Approach. In D. F. Charron (Ed.), *Ecohealth Research in Practice: Innovative Applications*. Ottawa: International Development Research Centre.
- Healey, P. (2006). *Collaborative Planning. Shaping Places in Fragmented Societies* (2nd Edition ed.). Basingstoke: Palgrave Macmillan.
- Innes, J., & Booher, D. (2004). Reframing public participation: strategies for the 21st century. *Planning Theory & Practice*, 5(4), 419 - 436.
- Lowry, M. B. (2010). Online public deliberation for a regional transportation improvement decision. *Transportation*, 37, 39-58.
- Organisation for Economic Co-operation and Development. (1996, March 24-27). *Conference Highlights and Overview of Issues*. Paper presented at the Towards Sustainable Transportation. , Vancouver, British Columbia.
- Raerino, K., Macmillan, A. K., & Jones, R. G. (2013). Indigenous Māori perspectives on urban transport patterns linked to health and wellbeing. *Health & Place*, 23(0), 54-62. doi: <http://dx.doi.org/10.1016/j.healthplace.2013.04.007>
- Richardson, G. P. (2011). Reflections on the foundations of system dynamics. *System Dynamics Review*, 27(3), 219-243. doi: 10.1002/sdr.462
- Tritter, J. Q., & McCallum, A. (2006). The snakes and ladders of user involvement: Moving beyond Arnstein. *Health Policy*, 76(2), 156-168.
- Wilcox, D. (1994). *The Guide to Effective Participation*. Brighton: Delta Press.