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Review of “Forecasting Urban Travel: Past, Present and Future”, Edward Elgar Publishing, David Boyce and Huw Williams 2015, ISBN 978 1 84844 960 2, £117

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This book announced its arrival with a thud. The 600+ pages of *Urban Travel* are clearly the result of many years of research and experience. This shows in the design of the book. It is a chunky hardback written in academic prose, interspersed with detailed quotations for historical accuracy, high quality graphics (e.g. showing model output or schematic structure) and a smattering of mathematics, deliberately placed in each chapter's meticulous endnotes to increase readability. The chapters are ordered roughly chronologically, covering the entire gamut of computational transport forecasting models from the early developments in the US and UK (Chapters 2 and 3) through discrete choice modelling approaches (Chapters 4 and 5), activity-based and network equilibrium approaches (Chapters 6 and 7), the practice of travel forecasting (Chapters 8 and 9) to computational aspects of the field (Chapter 10) and prospects for the future (Chapter 11). All this content is neatly summarised in introductory and concluding chapters, which do a great job of synthesising these seemingly divergent strands of thought into a single narrative.

Before diving into this content, it's worth putting this review in context, in terms of the book's timing, the *rason d'etre* of transport modelling and the reviewer's worldview: as with transport modelling itself (as the authors readily acknowledge) this review is inevitably influenced by my position as an early career researcher entering a field undergoing rapid change. I am not a transport modeler by training, but I am moving into the field, starting a post in Transport and Big Data in the Leeds Institute for Transport Studies (ITS) in September 2016. (Coincidentally, this is where the book authors first met, back in 1973, 12 years before I was born and 43 years before I commence my position in ITS.) This means that I need to rapidly get up-to-speed with the history and concepts of the large and at times complex field. So from a career perspective the opportunity to review the work could not have come at a better time.

As the authors note, although transport forecasting may seem from a distance to be a 'scientific' and objective science, it is inevitably shaped by the personalities and politics of the time. The same applies to this review. My worldview is shaped by the overwhelming scientific evidence of a need to transition away from fossil fuels in the 21st Century to prevent catastrophic impacts of climate change such as dozens of metres of sea level rise (Clark et al. 2016), which would destroy shipping ports worldwide, not to mention low-lying roads, railway paths, subways and paths for active travel. Thus, inspired by previous work on the matter (e.g. Gilbert and Perl 2008), the priority for the discipline seems to be to create an evidence base that will enable rapid decarbonisation of the

transport sector. I am a strong believer in transition: transition away from proprietary software in transport planning (which prevents information sharing and public scrutiny of the decision making process); transition away from fossil fuels in all sectors of the economy including transport. Following this worldview and building on my skills learned in Quantitative Geography or 'Geocomputation', my work focusses on applied modelling of travel behaviour. My current role as Lead Developer of the Department for Transport (DfT) funded Propensity to Cycle Tool (PCT) (Lovelace et al. 2015) has awoken me to the importance of academic research for providing tools that will eventually lead to decisions affecting millions of lives. I this context the book is reviewed from a somewhat utilitarian perspective: how can it help researchers to create the evidence base needed to move out of the mess of car dominated and highly inefficient transport systems that have arisen since World War II? I will return to that important question at the end.

Chapter 2 in my view is the most important in the book. It illustrates the origins of computerised transport modelling in a very specific context: the explosive growth of car use in the increasingly sprawling urban settlements of 1950s USA. Planners were struggling to cope with the traffic. Swept by the expansionist assumptions of the time, the aim of transport planning essentially became an exercise in how to accommodate more cars. In many early models public transport, let alone active travel modes walking and cycling, simply did not exist. Based on the historical evidence one could argue that early transport models have played a major role in creating the car-dominated and highly energy inefficient transport system in place in the US today. One could argue that transport modellers were not to blame and that they simply provided more logical plans for new road locations than otherwise would have been selected. On the other hand, applications of the early methods of demand generation could easily have created scenarios in which eternal car growth was not preordained. But in the fervor of the time, in which the 'predict and provide' paradigm was born, it seems that the majority of transport modellers and planners saw no alternative.

Despite unveiling their narrow policy priorities, the chapter clearly shows that the early modellers were not deliberately trying to create a transport system that was damaging to both people and the planet. By contrast, they were intelligent and diligent workers, trying hard to contribute to a better future in which traffic flowed smoothly. Boyce and Williams lucidly trace how a new breed of planners set about applying the latest methods, mainframe computers and intelligence to the problem to better design the location of new roads and developments: “urban travel forecasting was definitely 'where the action was' for young transportation engineers and planners entering the field in the 1960s” (p. 67). In the 2010's by contrast, I would argue that with players such as Elon Musk entering the field, the question of how to transition away from fossil fuels in the transport system of the 21st Century is now where it's at.

The Chapter ends with two fascinating developments at the time. First was a clear description of Lowry's 'Model of Metropolis', something I had read much about but never fully grasped. The fundamentals of the model are described concisely as an essentially a couple of iteratively interactive gravity models, one for employment and one for retail location. The second insight was a description of perhaps the first major attack on transport modelling, by Lee (1973), which has reverberated throughout the field ever since.

The same detail of research and clarity of insight is present in every one of the proceeding 9 Chapters. Indeed, the book is worthy of 9 reviews, one for each of these dense chapters. Rather than

do justice to the breadth and depth of the content, I will attempt to summarise some of their key points in the following three paragraphs.

Chapter 3 was particularly interesting to me as a British researcher as it traces the importance of 'our' theoretical contribution to the field. Alan Wilson, a Cambridge-trained mathematician and theoretical nuclear physicist who subsequently turned his attention to the social sciences, had a vast (and often unacknowledged) impact on transport modelling. His seminal paper that generalised and extended the concept of spatial interaction models (Wilson 1967) had a huge impact on the field, providing a strong theoretical foundation for further mathematical development in the field of travel behaviour estimation and forecasting. What is fascinating about Wilson's intervention from the perspective of an early career research entering the field was that at the same time of his theoretical contributions, he was actively advising government, on the Mathematical Advisory Unit at the then Ministry of Transport (now DfT), between 1965 and 1968.

Chapters 4 and 5 both discuss discrete choice models, which have had a major impact on (if not dominated) the field since the mid 1970s. Discrete choice models use the concept of 'utility maximisation' to allocate probabilities to different behaviours. This framework allowed a more detailed and individualised approach to transport models which was linked to the use of 'microsimulation' for transport applications and studies exploring people's stated and revealed preferences for different transport options.

Chapters 6 and 7 trace the development and application in publicly funded transport models and studies of two approaches to modelling transport behaviour. The activity based approach (Chapter 6) was partly aimed at addressing the limitations of the discrete choice models outlined in the previous chapters. Although there seems to be no overiding theory of activity based models, the fundamental change was a shift in emphasis away from the individual and towards the trip as the main unit of analysis. The activity-based approach lives on, in trip-based models such as the open source transport land-use models MATSim. Chapter 7 explores the 'network equilibrium' approach to transport modelling. As with the previous chapter it seems the field was not built on theory but rather practical necesity: how to predict bottlenecks in the road system and then resolve them.

The next two chapters explore in great detail the tension between the desire to use 'traditional' approaches on the one hand against the need to innovate as political priorities shift on the other, for the US and the UK. In the USA, the Clean Air Act Amendments (1990) had a substantial impact on transport forecasting, by forcing modellers to consider 'peak hour' conditions. Moreover, such regulations led to the incorporation of externalities into transport models, which had for so long been ignored. In the UK, the drivers were more prosaic and included the need to model traffic flows in more detail, better account for goods vehicles and provide better evidence for long-term strategic planning.

Chapter 10 was in some ways the most interesting to me, tracing the development of technologies (software and hardware) that allowed the prolific growth in the resolution and scope of transport models to take place. These are the 'tools of the trade' and have a huge impact on what is possible. The implications are profound: if you are limited by technology, your vision of the future may be blinkered. Unfortunately for me, this was also the shortest chapter in the book. It is primarily historical, and discusses a number of software products which have now been superceded (the excellent description of VISUM and TransCAD, two proprietary software products used in industry,

are notable exceptions). Frustratingly for someone witnessing the open source revolution unleashed in the transport modelling field, there was no discussion of the new breed of open source tools for the trade, which are gradually replacing the bloated, slow-moving expensive and oligopolistic products. I would direct the interested reader not towards academic literature but towards the websites of MATSim (see http://www.matsim.org/), UrbanSIM (http://www.urbansim.com/) and the Propensity to Cycle Tool (http://pct.bike/) for more on these exciting developments in transport planning software that are not covered in the book. The omission of these developments does not detract greatly from the chapter if one is aware of them from other sources and is a minor oversight given the grandeur of the project that Boyce and Williams have undertaken.

The result of more than a decade of close collaboration by experienced researchers who know their field intimately, this is clearly a serious piece of work. It is the first unified account of the field of transport forecasting/modelling and, as the authors acknowledge in the Preface, was a 'daunting challenge' to take on. It quickly becomes clear that David Boyce and Huw Williams, both Emeritus Professors, are the right people to take on the challenge, not only because of their deep technical knowledge and experience as researchers and practitioners, but also because of their deep connection with the community that has built up around the subject area, their personal connection with some of its trail blazing personalities and their clear love of the field. A vital component of any field of research is the sense of community that builds up around it and this is illuminated brilliantly in this book, with input from a range of voices, each giving their views about the priorities and future of the field. If you thought that transport was a dry and lifeless field, this book will make you think again!

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