Forecasting Urban Travel
Past, Present and Future

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How did the Book come about?

- We first met at the Institute for Transport Studies at the University of Leeds in 1972, and compared notes on US and UK urban transportation studies.

- In 2003, we began to write on a comparison between model developments in US and UK.

- In 2007, we finalised a book outline on the history of ideas underpinning models and methods for forecasting.

- In 2014, the first draft was completed!
What were our Objectives?

- Write history of the development of the field in terms of influential ideas.

- Consider innovations in relation to existing knowledge and ‘spirit of the times.’

- Explore how innovation was transferred over time and space.

- Draw in contributions from mathematics, statistics, physics, engineering, operational research, economics, geography and psychology.

- Establish a literature which we hoped would be useful to the field.

- Hoped to make a contribution that was widely accessible to academics, professional planners, students and the interested citizen.
What were our Methods?

• Drew on our own experience in particular areas.

• Consulted national and international literature, read/reread major papers and reports produced over the last 60 years.

• Wrote to many key figures in the development of the field.

• Consulted many current theoreticians and practitioners about the current states of the art in particular areas.

• Circulated chapters widely to check their accuracy and integrity.
The style of the book

To fulfil our ‘accessibility’ objective:

• No mathematics in the text (Hawking’s Law).

• Technical details and further reading in the chapter end notes.
Models and their uses

• Representations of the behavior of a system
  - changes over time
  - changes in response to policies

• Policies very wide ranging

• Generate information of interest to planners and policy makers
Establish themes of development and innovation

Within a broadly chronological approach, we considered the following themes:

• Role of institutions in developing, sponsoring and promoting models
• Planning contexts, information requirements
• Nature and relevance of theory
• Data requirements of models and methods
• Solution of models
• Validation and performance of models
• Practical compromises in model development
Chapter 2: Emergence of the traditional approach

- Impetus for urban transportation studies.
- Role of forecasting and plan testing in the Detroit and Chicago areas.
- Major advances in zone-based land use, generation, distribution and assignment models.
- Urban transit and inter-zonal modal split models.
- Consolidation of the three-step and four-step approaches.
- Role of the Bureau of Public Roads and US HUD.
- Land use - transportation studies and the development of land use models.
- Rise and fall of ‘large scale’ models?
Chapter 3: Early developments in the UK

- Early 1960s: Transfer of the technology of forecasting from North America
- 1965-7: zone-based to household class-based models.
- 1967-9: generalised costs and VoT expressions.
- 1967-9: Entropy maximising models introduced
- Empirical to analytic forms for location, mode and route splits.
- Much improved representation of public transit systems
- 1969 SELNEC Study: incorporates all major developments
Chapter 4: Developments in discrete choice models, 1970-1976

- Disaggregate models and methods based on rational choice.

- Major progress in forecasting approach based on specification, estimation, aggregation, and validation of discrete choice models.

- Wide application of multinomial logit (MNL) models particularly to modal choice and related problems.

- Early exploration of model structure (e.g., to combined choices).

- Increasing application of ‘disaggregate behavioural’ approach in the US, UK and Netherlands.

- Contrasts between ‘new’ and ‘traditional’ approaches emphasized
Chapter 5: Further developments in discrete choice models, 1976

- Major theoretical efforts in US and UK to address the problem of similarities between alternative choices

- Nested Logit and GEV family extensions established

- Traditional forecasting model reinvented in behavioural clothes. Anomalies found in forecasts!

- Numerical methods applied to address more complex choice processes. Micro-simulation methods used more widely.

- Stated preference methods developed and officially supported.

- Testing of ‘disaggregate behavioural’ approach (USA and Netherlands).

- 1980s onwards. Major theoretical and empirical work on choice processes.
Chapter 6: Activity-based travel analysis and forecasting

• Late 1970s / early 1980s: broad critique of economic models as a basis for explanation and forecasting of travel behaviour.

• Empirical studies on complexity of choice processes and organisation of activities and travel in space and time.

• Early 1990s: ‘Towards a new generation of travel demand models’.

• Tour-based and schedule-based approaches to activity-travel analysis.

• Econometric and ‘computational process’ models approach operational status.

Chapter 7: Transportation network equilibrium models

• 1952: Wardrop’s two criteria established.

• 1956: Beckmann-McGuire-Winsten network equilibrium model formulated.

• Exploration of combined model as an alternative to the traditional four-step procedure.

• Classification of problems on basis of demand function (fixed/variable) and cost functions (symmetric / asymmetric).

• Solution algorithms proposed and convergence properties examined for various combined models. Rigorous solution procedures replaced four-step heuristics. ‘Feedback’ examined in detail.

• Challenges remain for multi-modal, multi-time period models with more realistic link cost functions.
Chapter 8: Tradition and Innovation in US practice

- Evolving requirements for urban travel forecasting (Clean Air Act Amendments, 1990).

- Responses of the MPOs limited and main tradition of practice unchallenged.

- Applications of tour-based and activity-based models.

- New travel forecasting initiatives – TRANSIMS a work in progress (??).

- Major developments of applied land use - transportation models.

- Weaknesses of traditional urban goods movement models widely recognised: vehicle-based, commodity-based and agent-based approaches
Chapter 9: Tradition and innovation in UK practice

- Few comprehensive tour-based or activity-based models (e.g., PRISM).
- Incremental (pivot-point) models widely used and officially supported.
- Major studies on significant responses to policies and corresponding elasticities.
- Journey timing decision increasingly modelled.
- G/D/M/A no longer used as default → G/M/D/A increasingly supported.
- Stated preference approaches widely adopted and officially supported.
- More network detail in space and time (e.g., SATURN, micro-simulation)
- Major advances in Integrated LU-T models
Chapter 10: Computing environment and travel forecasting software

• Our field and digital computing for civilian use grew up together.

• Development in hardware allowed innovations in models and software products.

• Developments of hardware for mainframe, mini- and micro-computers reviewed.

• Comparisons of computing speed, memory and cost.

• Travel forecasting software for mainframe, mini- and micro-computers examined.

• Travel forecasting software developers and products reviewed.
Chapter 11: Achievements, current challenges and future prospects

- Summarised progress in five stages.
- Challenges of behavioural modelling abound
- Still searching for internal consistency of complex models in practice.
- Assumptions underpinning forecasts and performance of models increasingly seen to be subject to challenge.
• Conflicts and compromises between ‘practice’ and ‘research’

• The role of the critic is vital for constructive innovation.

• Major challenges related to modeling new technological initiatives, innovative policies, etc.

• How will the field develop in an age of ‘big data’ and new means of data collection?
Chapter 12: Conclusion

• How was progress achieved?
  - Progress through a series of paradigm changes?
  - Where do/did ‘good’ ideas come from?

• Handing on the experience and learning in the process
  - How will future progress be judged?
  - Need to make our field more transparent to everyone, including interested citizens.
What happened next?

• We tried to consult widely on individual topics:
  – Approximately 100 people approached for advice, and read selected passages
  – 10 people read several chapters

• Draft of final manuscript submitted in June 2014
  – Published in UK in April 2015
  – Published in US and Rest of World in June 2015

• Paperback edition will appear by mid-2016.

• We welcome comments / critiques on omissions / inaccuracies and biases
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