

# The virtual lab: data-led decision-making to optimise economic growth and development



Richard Marsham - RMG Photography

## Modelling for future planning options

CSIC Investigator Dr Ying Jin from the Martin Centre for Architectural and Urban Studies, Department of Architecture at the University of Cambridge, heads the Cities and Transport Research Group. He is currently leading a three-year 'Cambridge Futures 3' modelling study, funded by Cambridgeshire and Peterborough Combined Authority and Cambridge Ahead, to design and examine alternative scenarios of workplaces, housing and transport to 2031 and 2051. The model is helping to foresee the effects of future planning options for Greater Cambridge and the project will continue to support the local land use and transport plan for a further three years.

Areas of economic growth, where enterprise and employment are flourishing, often find housing and infrastructure unable to keep pace. Disparity between these elements can lead to high house prices, congested roads from in-commuting and social inequality. Sustainable growth can be strategically supported by a long-term development plan that brings balance to business growth, the natural environment and quality of life.

## Greater Cambridge case study

Greater Cambridge is an economic hot spot where growth has outpaced the rest of the UK throughout the past decade; the proliferation of high-tech businesses, innovation networks, start-ups and entrepreneurs has led to an expansion in jobs and businesses in the region. Currently around 60,000 people work in 4,700 knowledge-intensive companies in Greater Cambridge, particularly in computer and software, life sciences, hi-tech manufacturing and AI.

This economic success story is not without cost: house prices have soared – the city's average house price is now 16 times the median salary – and the think tank Centre for Cities reports Cambridge as the least equal small city in the UK. If employment continues to rise at the current rate the resulting increase in commuting will put untenable pressure on already-congested roads. The Cambridgeshire and Peterborough Independent Economic Review (CPIER) Final Report (Dr Jin was on the Technical Board for the CPIER), published in September 2018, presented its findings to the Cambridgeshire and Peterborough Combined Authority responsible for local strategic transport and infrastructure. It warns that Cambridge is at a critical point in its development and must choose between reshaping for growth or stagnating and losing its economic dynamism.

---

“Modelling by LUISA shows how jobs, housing demand and travel connect together, and this helps local communities make sense of what interventions will work well.

Dr Ying Jin, Lead of the Cities and Transport Research Group and CSIC Investigator

### Data-led decision-making

The Cambridge Futures 3 model uses data on buildings, green spaces, housing, jobs, businesses, shops, services, schools, means of transport, congestion, crowding on trains, rents, wages, prices and perceptions of wellbeing. Threading all the different strands of information together, the computer model, LUISA, provides a new 'lens' that is otherwise unavailable to look at future working, living and travelling in and around Greater Cambridge.

### Coordinated interventions

LUISA has the ability to process developments in housing, transport and jobs as one integral system and has been tested using three decades of data and knowledge on business and consumer behaviour. It models different trajectories for the region which comprises cities, market towns and Fenland villages with growing connections to Cambridge. These scenarios provide opportunities to explore long-term consequences of decisions made now around building houses, location of housing in relation to places of work and how this affects transport and commuting, living costs, rents, prosperity of companies and wellbeing of citizens. This detailed modelling provides a big picture of how jobs, housing demand and travel connect together which helps decision-makers understand what interventions will work best and how to coordinate them.

### Modelling uncertainties

LUISA addresses the challenge of forecasting despite uncertainties such as politics, the economy, disruptive technology, migration and climate change by separating out what is hard to predict from the highly predictable elements. The uncertainties are then examined using a wide range of possible scenarios. When there is a balance between jobs, transport and housing, then business productivity and wellbeing of residents go up. When the balance is lost businesses recoil from thoughts of further investment costs and residents face a higher cost of living.

### Balancing outcomes

The research team started LUISA modelling with a 'business as usual' case where the region develops according to current trends in employment growth and local plans for housing. This scenario showed that even a small rise in jobs would lead to considerable wage pressure in Cambridge and South Cambridgeshire and an unmanageable amount of in-commuting which would choke growth. Potentially businesses may respond to high wages and increased prices by reassessing plans for new investment or moving out of the UK to other knowledge-intensive areas overseas, resulting in a significant loss of jobs and output for the UK.

LUISA was then used to consider alternative courses of action to achieve the optimum potential for the region. Instead of asking the mathematical model what the best solutions are, which is, by definition not a question that a model can answer, LUISA is used to test scenarios that represent a full range of different courses of action, and investigate the potential effects, both positive and negative:

- **Densification** – inserting new sites of employment and housing within the city boundaries: this can accommodate the largest amount of jobs and people around existing and new rail hubs, but could risk worsening congestion and air quality in spite of convenient public transport access
- **Fringe growth** – extending urban areas around the edges of the city: this brings the highest financial returns with more modest building construction costs, but needs to use Green Belt land and will increase car use
- **Dispersal** – encouraging growth to go to market towns or newly created settlements beyond the Green Belt: this could spread the growth and gain social and environmental benefits, but would rely on companies that are willing to move away from current centres of high business productivity
- **Transport corridors** – developing new sites for jobs and housing along existing and new fast public transit services that emanate from Cambridge: this offers space for continued growth of existing business clusters while unlocking potential of new sites that could attract growth, but this requires the highest financial investment in transport infrastructure and services.

### Improved decision-making

The main benefit of studying the four scenarios above is the opportunity for all stakeholders to be clear about their strengths and weaknesses, negotiate the difficult trade-offs, and coordinate a blended approach that addresses the concerns of the local communities. How to make that blend would be subject to a democratic process in which all residents as well as businesses and local governments take part. The model's findings would also help the local communities develop a robust case for new investments in housing, infrastructure and nature conservation from central government and private investors.

The results from LUISA are shaping the district councils' new land use plans and the Combined Authority's local transport plan. Used well, LUISA can help support a novel local strategy developed to improve quality of life across the region. The techniques developed for LUISA can be applied to other regions. Currently Dr Jin's team is also working for the UK2070 Commission examining scenarios to rebalance the UK growth in jobs, housing and transport among all areas in the UK, including the devolved countries of Wales, Scotland, and Northern Ireland as well as the English regions.



**Principal Investigator:** Dr Ying Jin

**Modelling and analytics:** Dr Li Wan, Dr Kaveh Jahanshahi, Dr Jamil Nur, Dr Tim Hillel, Tianren Yang

**Data and GIS:** Steve Denman, Dr Xihe Jiao

**Land use and transport data:** Dr Mingfei Ma, Kelly C Wang

**3D Modelling:** Stephanie Veanca Ho, Zhou Fang, Ying Yue, Shanshan Xie

**Advisers:** Professor Marcial Echenique, Professor Peter Carolin