MANCHESTER 1824
The University of Manchester

UK-Ireland Planning Research Conference
September 5th – 7th, 2022

casa UCL University College London

Manchester, Computation & the Emergent Digital Transformation of Cities & City Planning

Michael Batty
Centre for Advanced Spatial Analysis
CASA-UCL

m.batty@ucl.ac.uk
@jmichaelbatty

I have put this on my web site as a PDF and you can get it from

http://spatialcomplexity.blogweb.casa.ucl.ac.uk/files/2022/09/Manchester.pdf

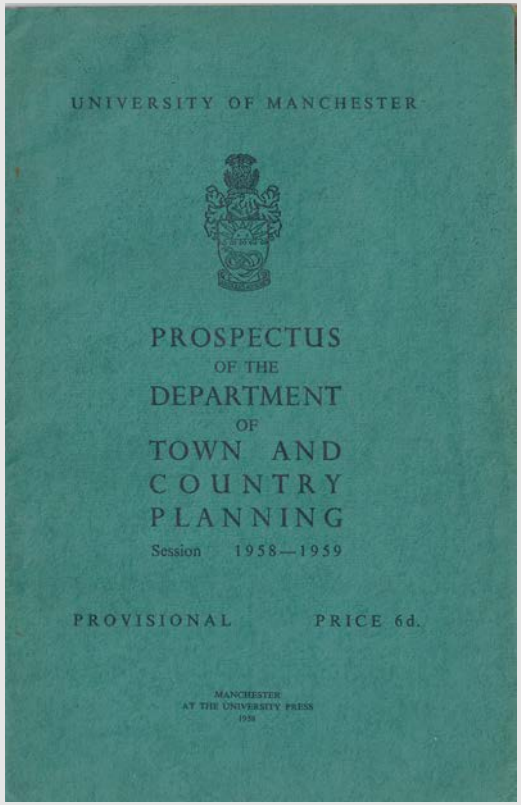
Or in short form *tinyurl*

https://tinyurl.com/2p9v38t2

Outline

- Just After the Beginning: An Indulgence About the Past
- Manchester in the 1960s: The Systems Approach
- The First Computers and Planning Applications
- Three Recurrent Themes
    - *Land Use Transportation Interaction Models*
    - *Modelling the Planning Process: Design Methods*
    - *Urban Design: The 3D City and Visualisation*
- The Emergence of the Smart City and the Platform Economy
- The Digital World: Using Models in Everyday Life
- The Digital Transformation of Planning: The Recent Taskforce

Just After the Beginning: An Indulgence About the Past







December 1962



July 1966



DEPARTMENT OF TOWN AND COUNTRY PLANNING

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Lecturers in Town and Country Planning,

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G. F. CHADWICK, M.A., B.Sc.Tech., Dip. T.P. (Manchester), A.M.T.P.I., A.I.L.A.

J. N. JACKSON, B.A. (Birmingham).

D. F. MEDHURST, D.F.C., A.R.I.B.A., A.M.T.P.I.

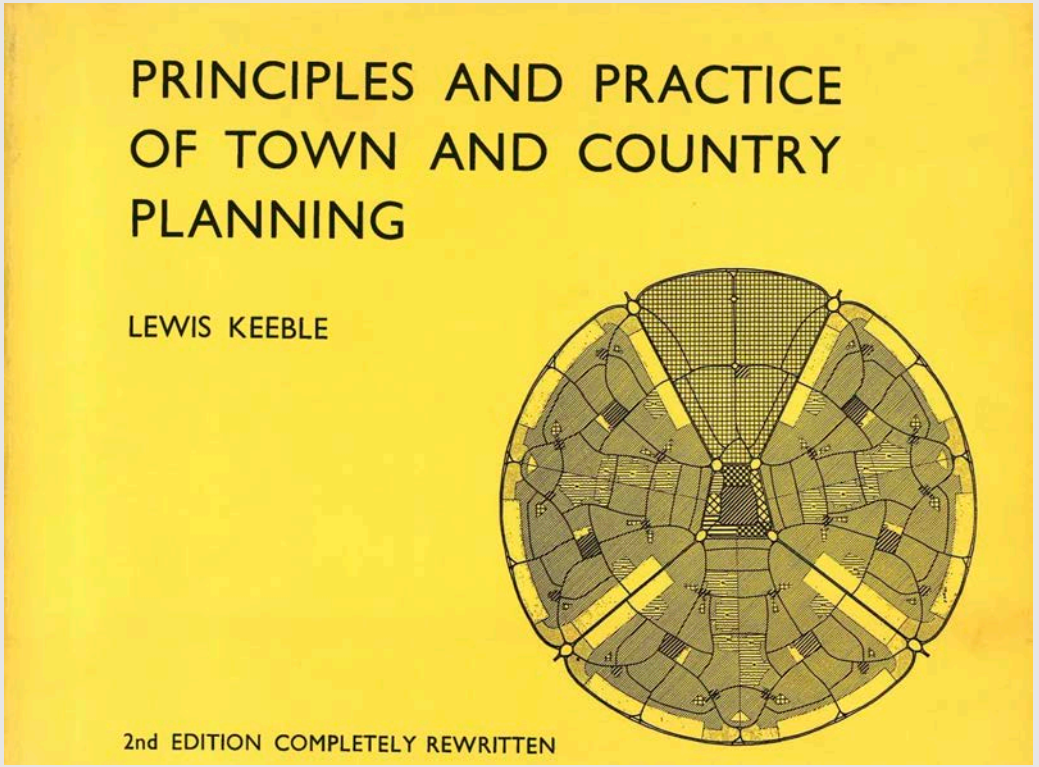
D. H. TOMKINSON, B.Arch., M.C.D. (Liverpool), A.R.I.B.A. A.M.T.P.I.

Lecturer in Town Planning Law, H. C. EASTON, T.D., M.A. (Oxford), LL.B. (Manchester), of Lincoln's Inn, Barrister-at-Law.

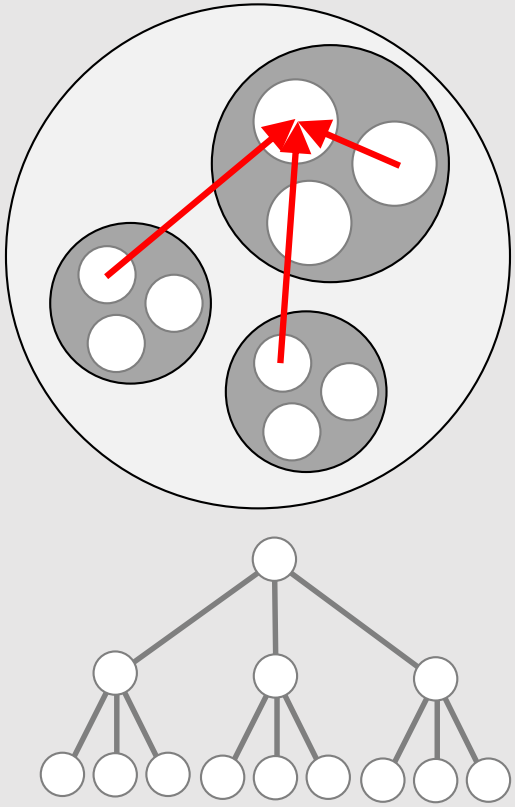
Lecturer in Architecture for Town Planning, R. B. TURNER, Dip. Arch., Dip. T.P. (Manchester), A.R.I.B.A., A.M.T.P.I.

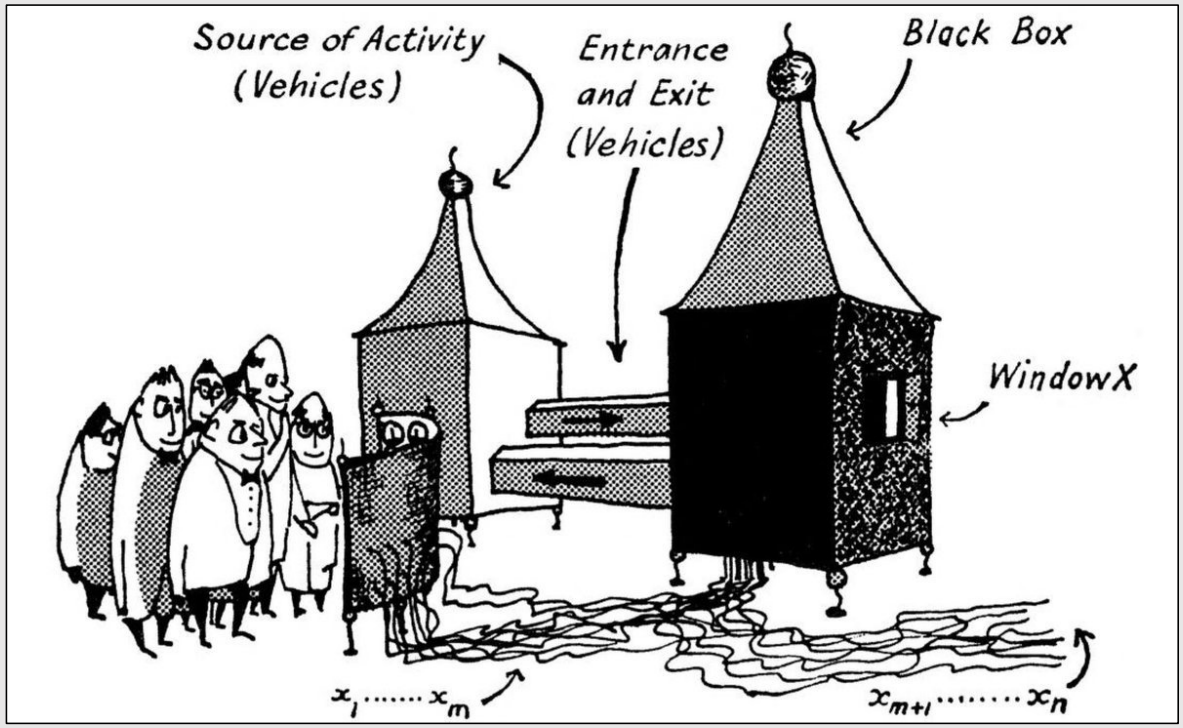
Lecturer in Engineering for Town Planning, ALBERT JOHNSON, M.Sc. (Durham), A.M.I.C.E., F.R.S.H., M.I.Mun.E., F.I.P.H.E., of Gray's Inn, Barrister-at-Law.

Also the Professors and Lecturers in the subjects of Architecture, Geography, Economics, Languages and Law in the University.



Manchester in the 1960s: The Systems Approach

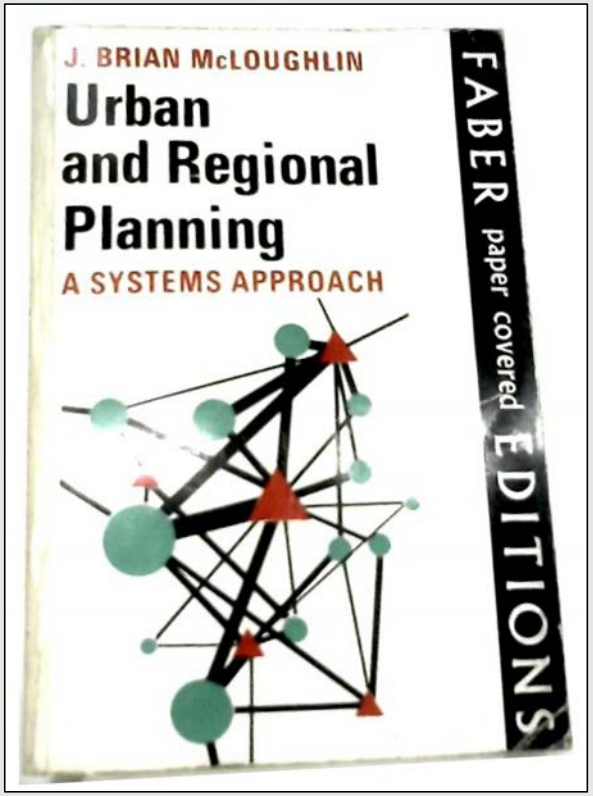


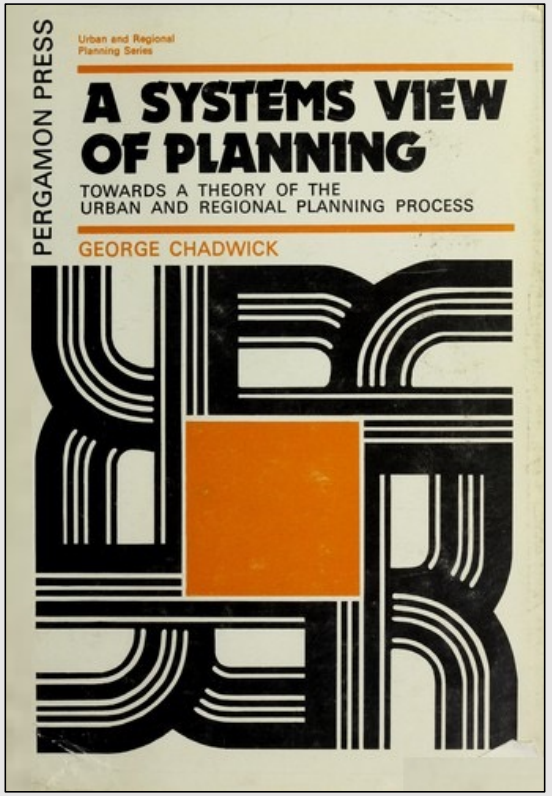


Gordon Pask (1961) **An Approach to Cybernetics**, Radius Books, London

Manchester in the 1960s: The Systems Approach





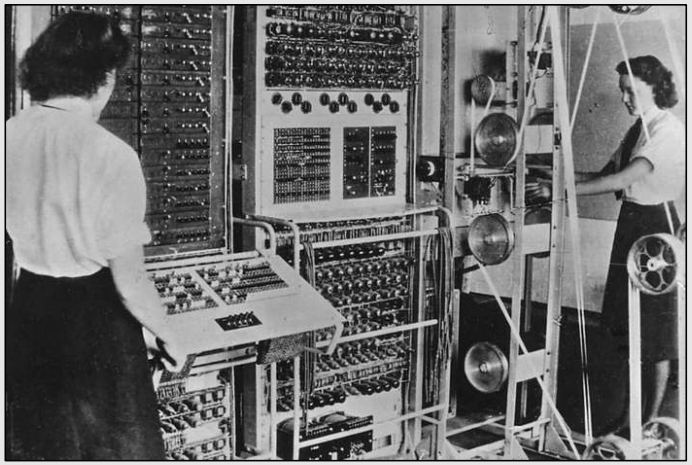


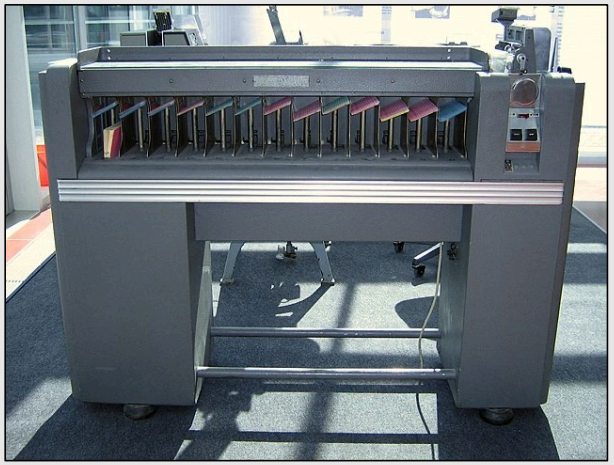


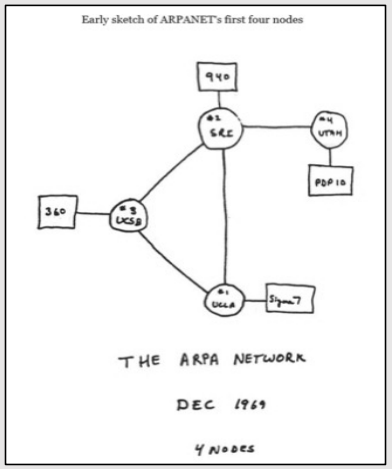
The First Computers and Planning Applications

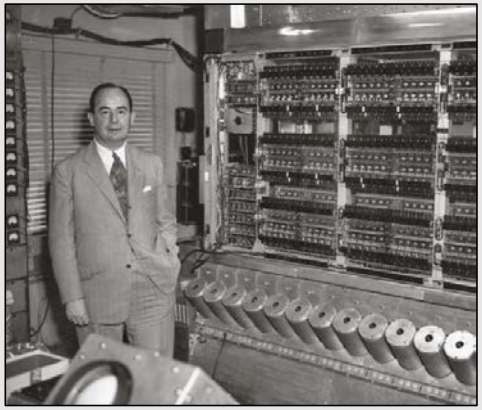
The digital computer was invented between 1938 and 1945 and the key developments associated with Turing and von Neuman argued that the computer was a universal machine. Anything that could be reduced to 0 or 1, yes or no, red or green etc could be computable.

The first machines were enormous electro mechanical devices and access to hem involved programming offline and the machine processing the program and its data remotely. Manchester housed one of he biggest machine world wide in the form of the Atlas 1. I used it from 1966 to 1969.





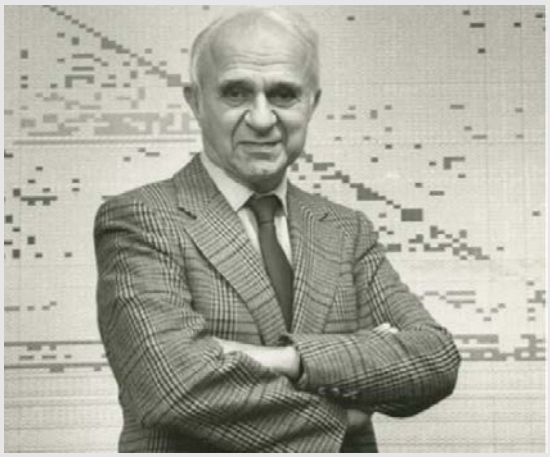

Early sketch of ARPANET's first four nodes
940
SRI
UTAH
PDP 10
360
UCSB
UCLA
Sigma 7
THE ARPA NETWORK
DEC 1969
4 NODES



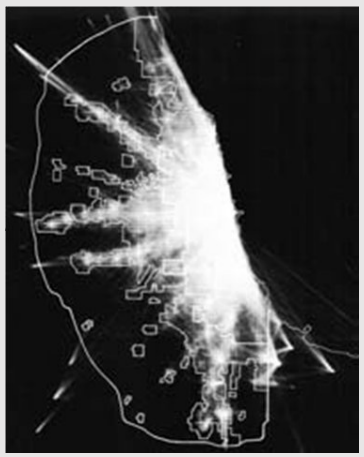

Alan Mathison Turing
1912-1954
Father of Computer Science
Mathematician, Logician
Wartime Codebreaker
Victim of Prejudice




CORAL 66
ON ARPANET











And then onto the world of the PC, the workstation and computer graphics





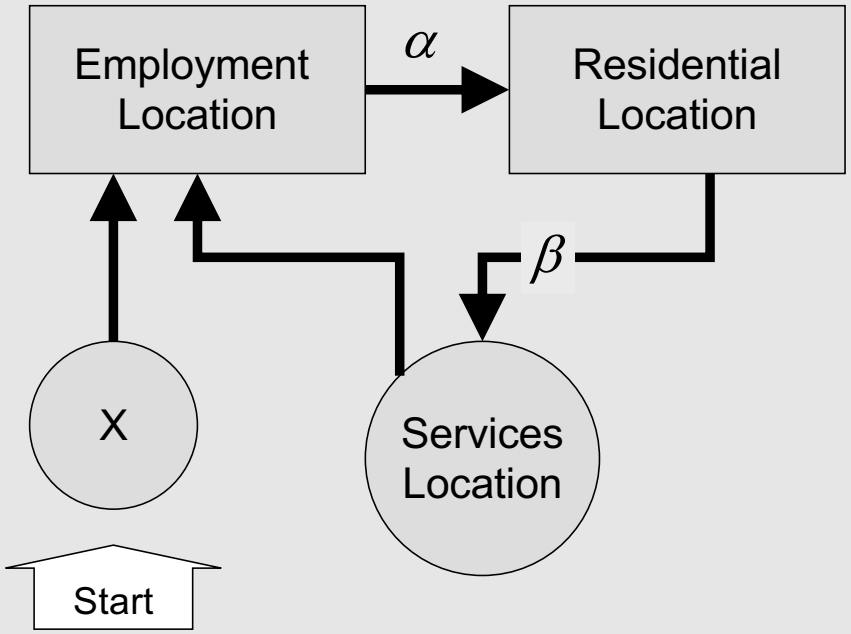
Three Recurrent Themes

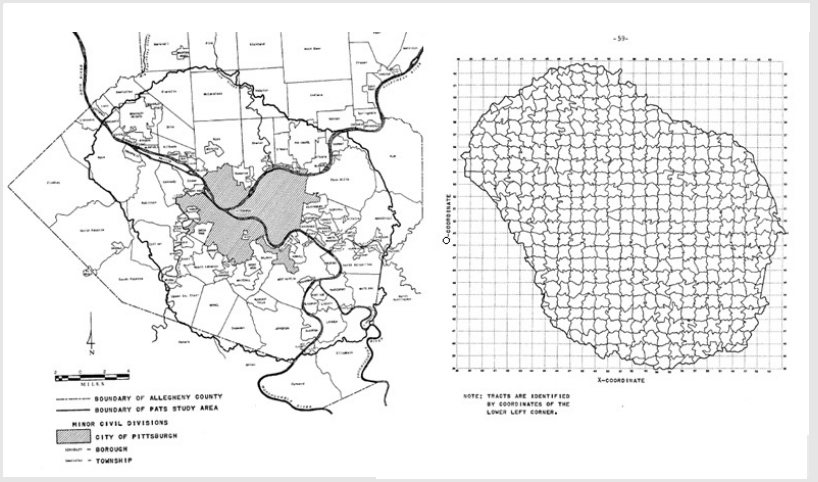
Land Use Transportation Interaction Models – *they began in 1955 and have continued to be developed. The problems that beset them are that the ways cities are organised have changed but mobility still lies at the core of how cities are structured. Agent-based activity models focussing on travel lie at the current cutting edge*

Modelling the Planning Process: Design Methods – *these have never really been developed in earnest but they began in the early 1950s and there are links to AI. Planning support systems – collections of models and tools – now form the cutting edge; and there are slow but sure links into decision theory.*

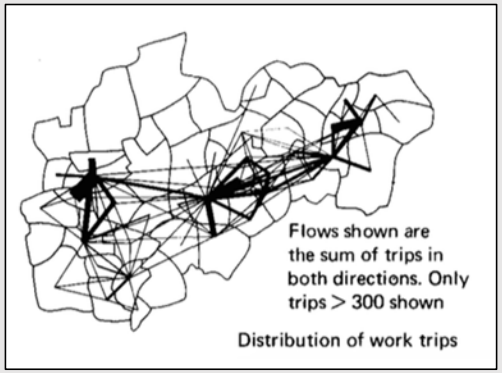
Urban Design: The 3D City and Visualisation – *To an exent, these represent the least controversial of computers in planning for the focus is on description. These have taken the longest time to develop and the first large scale models emerged around 1980. CAD has also been used from that time for architectural modelling*

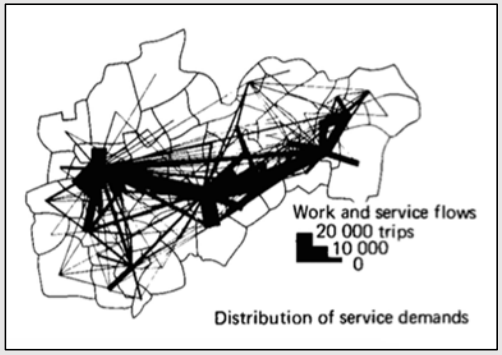
Land Use Transportation Interaction Models



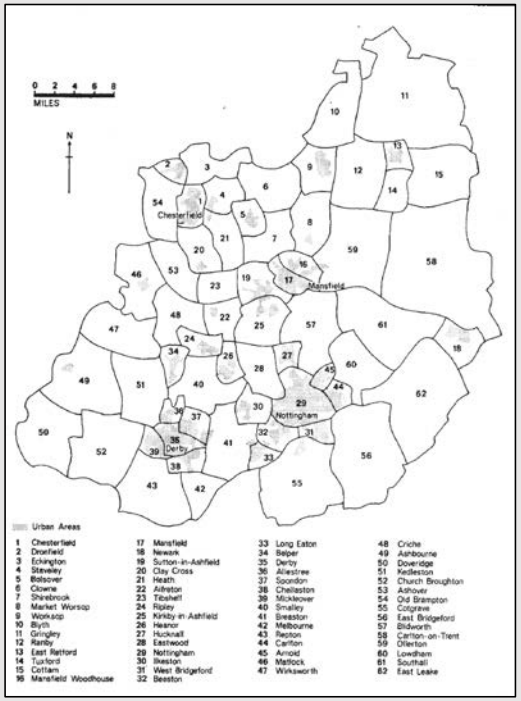


Ira S. Lowry (1964) **A Model of Metropolis**, RM-4035, The Rand Corporation, Santa Monica, CA





Central and North East Lancashire



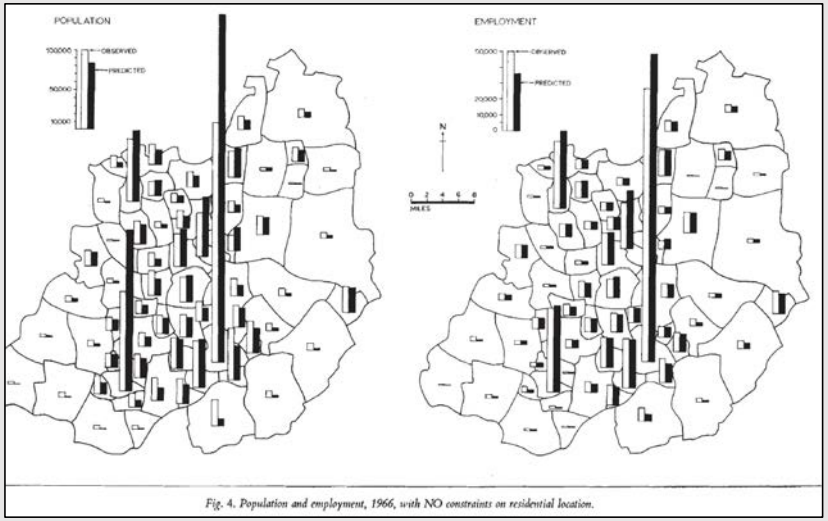


Fig. 4. Population and employment, 1966, with NO constraints on residential location.

Semantic Scholar

Corpus ID: 60396202

The Impact of a New Town

M. Batty · Published 1969 · Computer Science

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Regional Studies. Vol. 4, pp. 307–332. Pergamon Press 1970. Printed in Great Britain.

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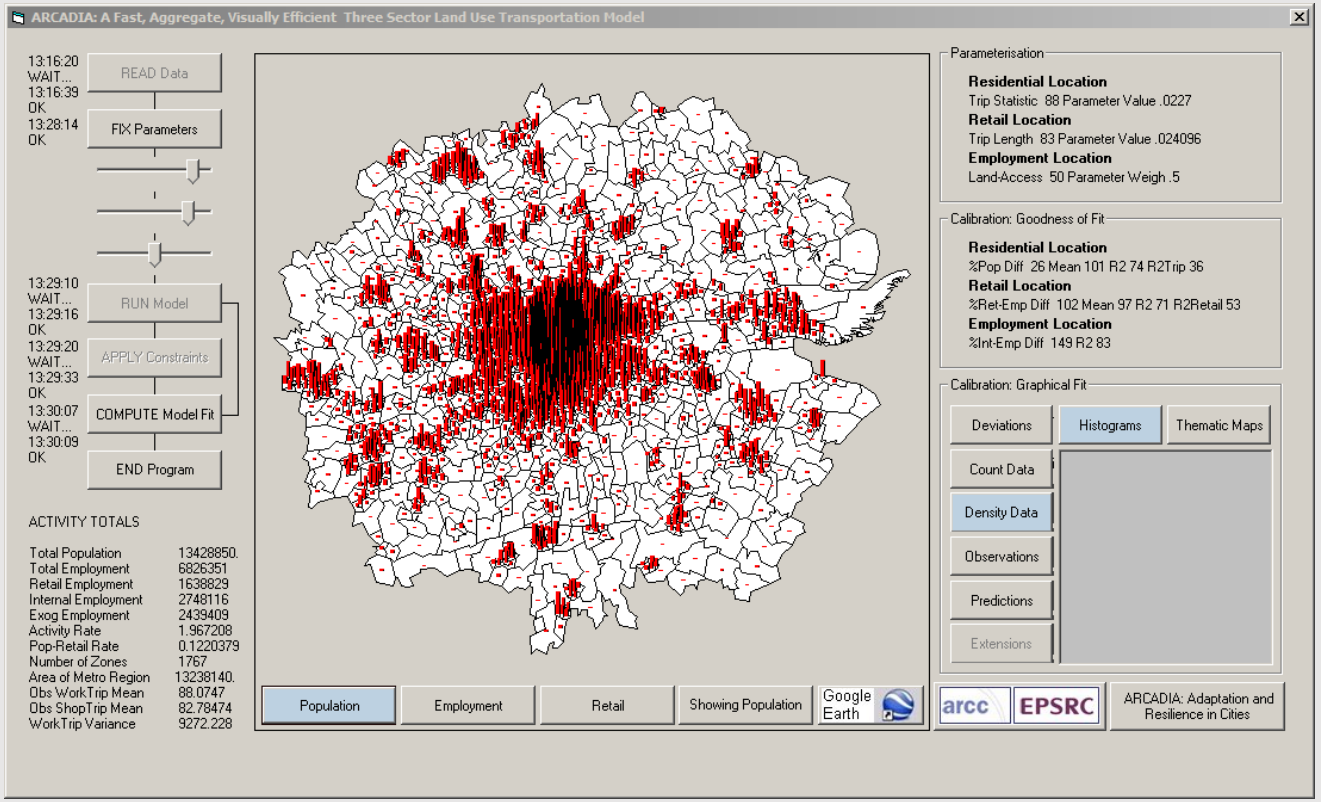
An Activity Allocation Model for the Nottinghamshire-Derbyshire Subregion

M. BATTY

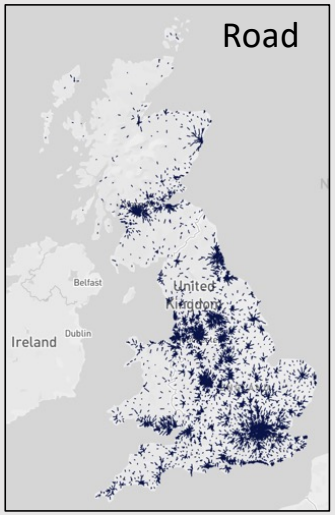
Senior Research Assistant, Urban Systems Research Unit, Department of Geography, University of Reading

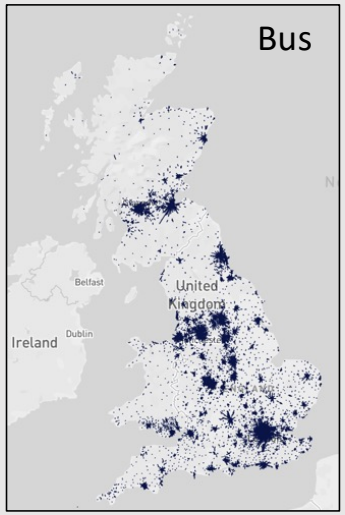
(Received 9 January 1970)

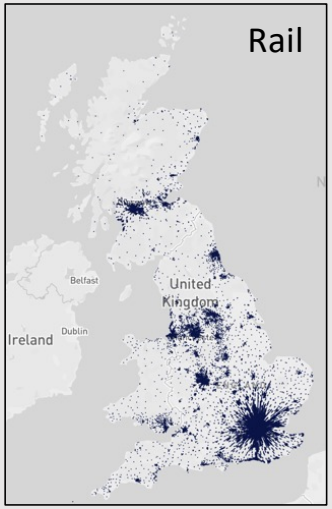
Fast Forward 40 years: Urban Models on the Desktop

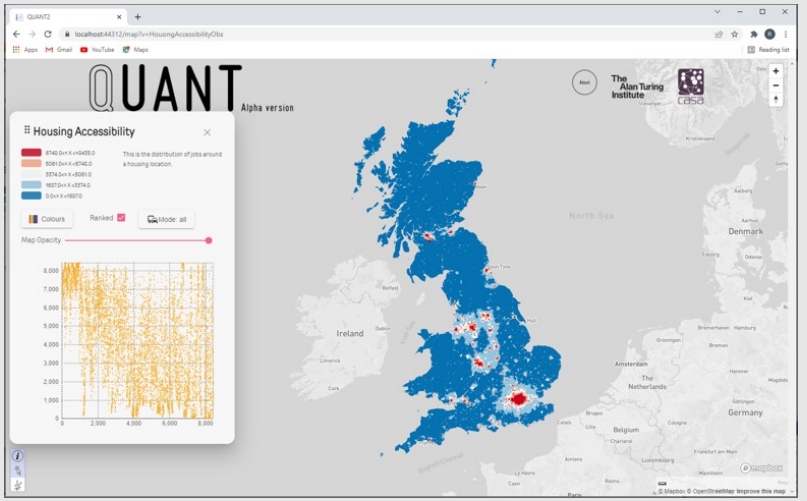


Another 20 years: Models Everywhere, on the Web, on your Phone







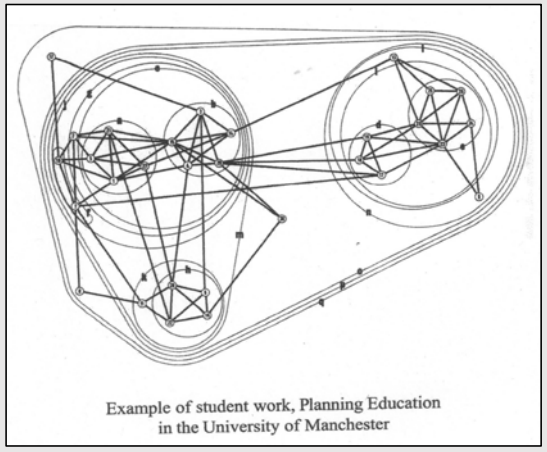


Our **QUANT** model is web-based and for the whole UK, funded first by FCC and now by ATI. I will show it to you later but you can get it at http://quant.casa.ucl.ac.uk/quant2/

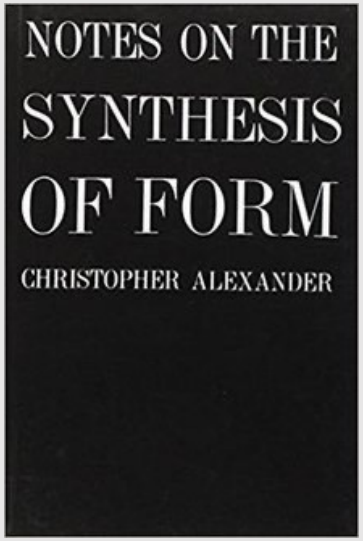
Modelling the Planning Process: Design Methods

Back to Manchester and to the division between models of cities and models of planning. George Chadwick introduced us all to design methods, to Chris Alexander's **Notes on the Synthesis of Form**

This is based on the deep seated idea that any problem had a systematic structure, that could be divided into a hierarchy and one could exploit that hierarchy to achieve a good solution to the problem



Example of student work, Planning Education in the University of Manchester



Let me quickly show you what I started to do in Manchester back then – I couldn't really decide whether to work on models of cities or models of planning so I worked on both.

In fact, I was a lone wolf on all this, still am really, as models of cities have been in the ascendency but latterly some of the work on design methods has begun to converge with complexity theory. In fact I worked on a problem of urban expansion in Macclesfield and only very recently have we begun to resurrect this in modelling land development processes in our city models

This is another theme – different models have begun to converge on each other as the world has become digital.

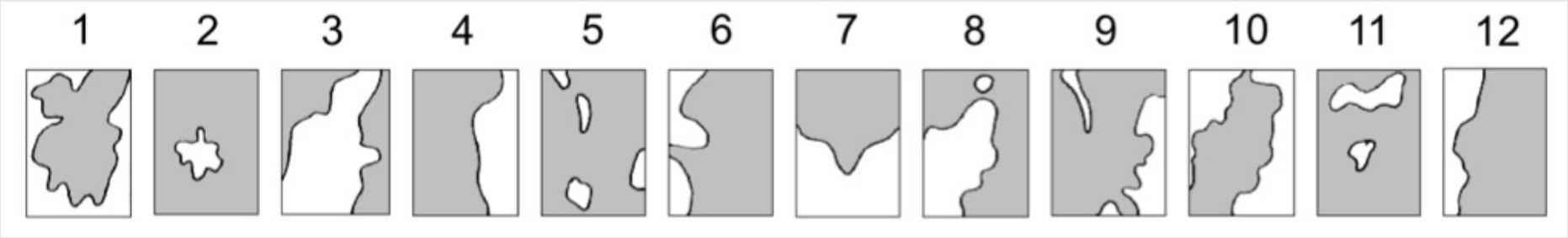
The core of these methods it is quite simple. In planning and design we often use a method of compromising – reducing conflict between different factors that need to be resolved to produce a solution.

The most obvious and perhaps the simplest of these is where we are searching for a solution which ‘optimizes’ with respect to different conflicting factors.

We can of course add these factors together and produce an average but this does not take account of their relative important given to them. This is a kind of overlay analysis, what we called ‘sieve mapping’ back in the day, or now ‘geodesign’. Marketta will talk about PP-GIS tomorrow.

Let me illustrate an example where we have 12 factors that we can map spatially and each of these factors indicates the best location for a housing development or any facility. The method works as follows:

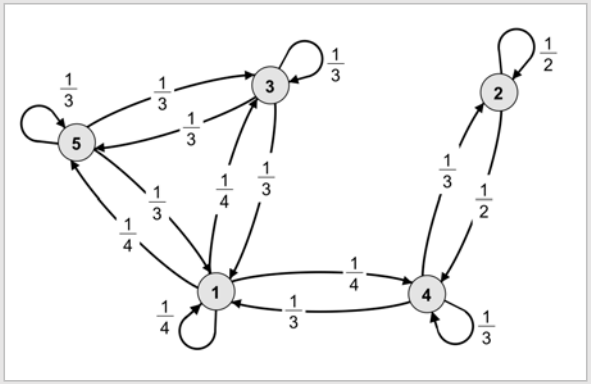
Key Factors Affecting Residential Development

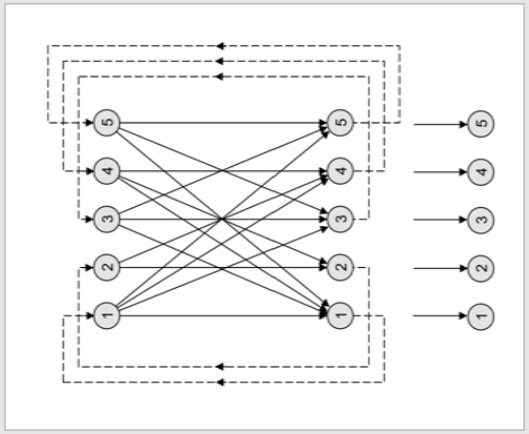


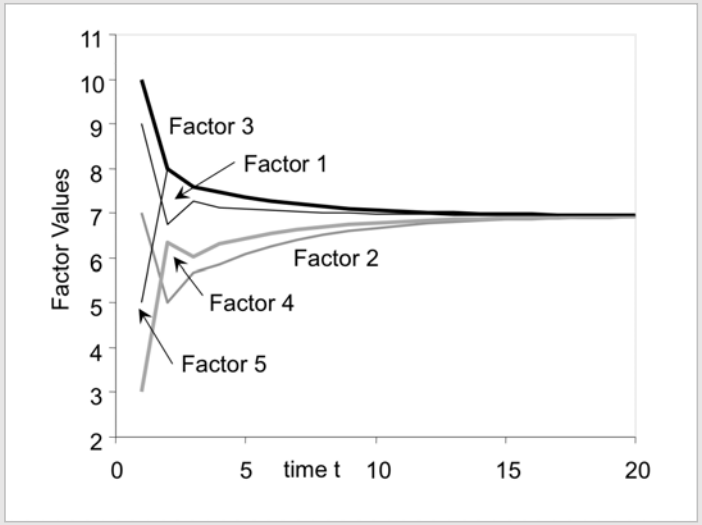
1. Accessibility to Existing Urban Services
2. Costs of Spatial Congestion
3. Accessibility to Recreational Amenities
4. Areas of Acceptable Micro-Climate
5. Areas of Water Catchment and Poor Drainage
6. Institutional Constraints Imposed by Government
7. Accessibility to External Urban Markets
8. Subsidence and Extensive Industrial Pollution
9. Areas of Suitable Topography
10. Rural Amenity Areas
11. Historic Urban Areas
12. Conservation of High Quality Agricultural Quality



- A set of factors showing the desirability of land development –our opinions expressed as maps. These conflict with one another
- We form a network showing the strongest conflicts We make sure the network is connected - this implies weights. We perform the averaging:





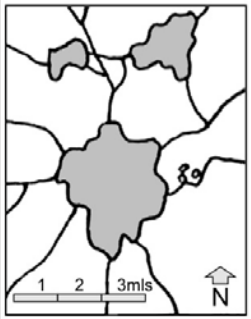


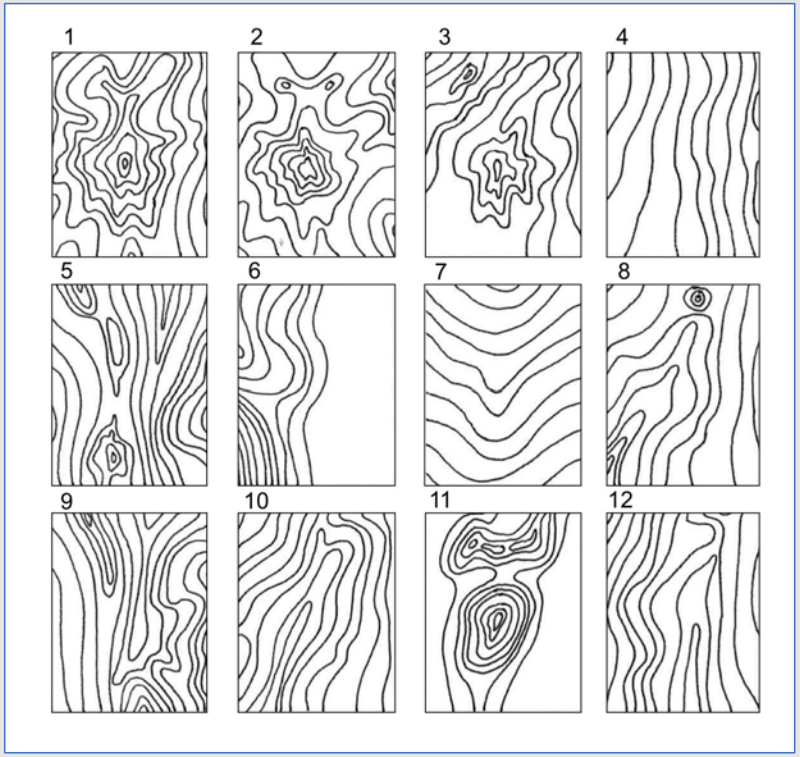
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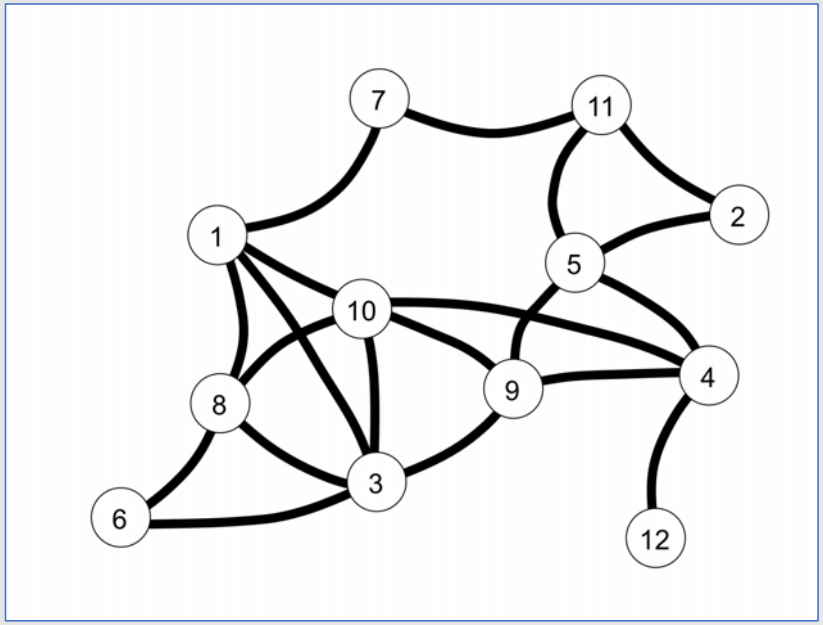
1/4	0	1/4	1/4	1/4
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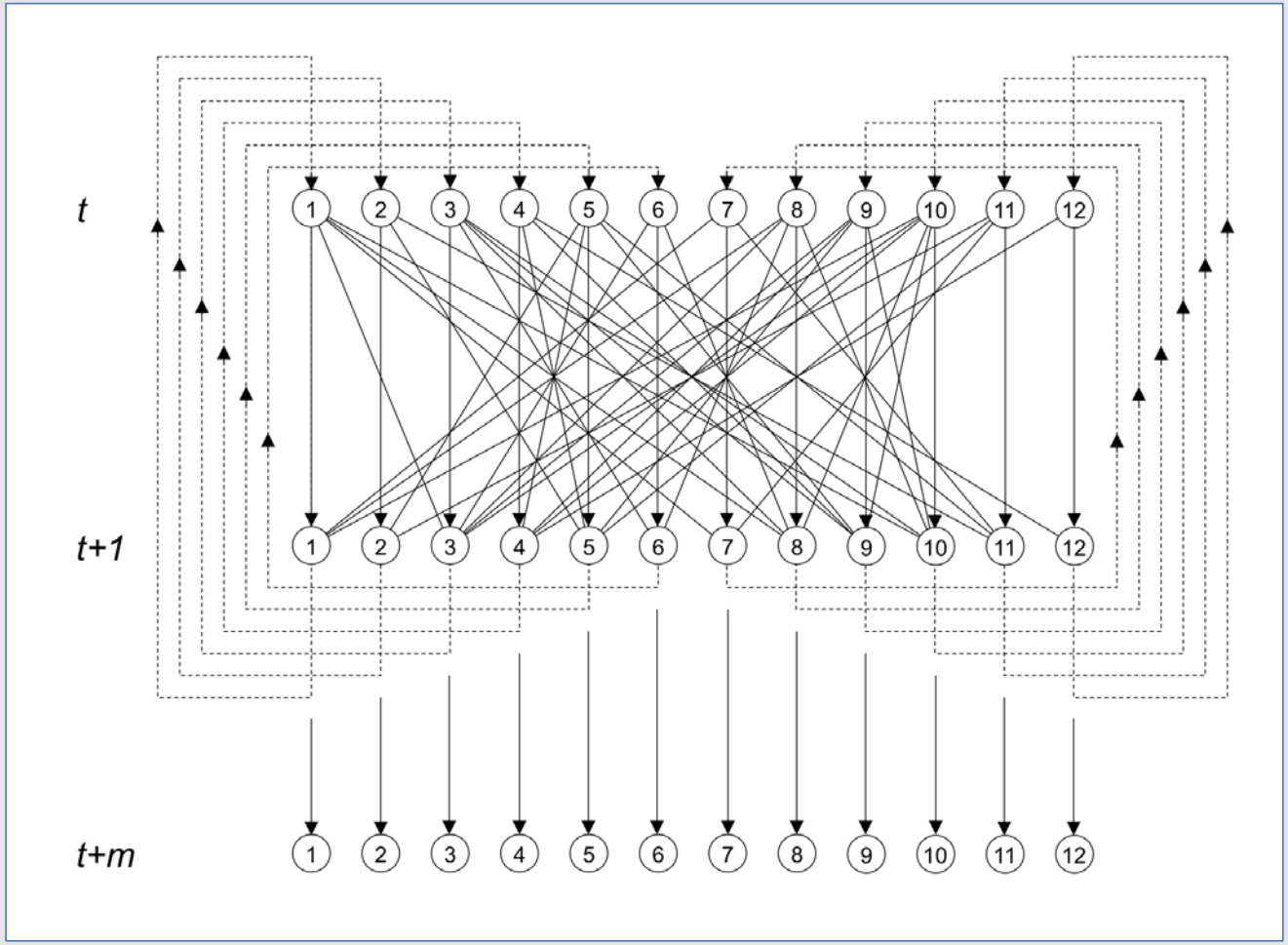
$$a_i(t+1) = \sum_{j=1}^{n} W_{ij} a_j(t)$$

$$a_i(t+1) = b_i(t) + \sum_{j=1}^{n} W_{ij} a_j(t)$$


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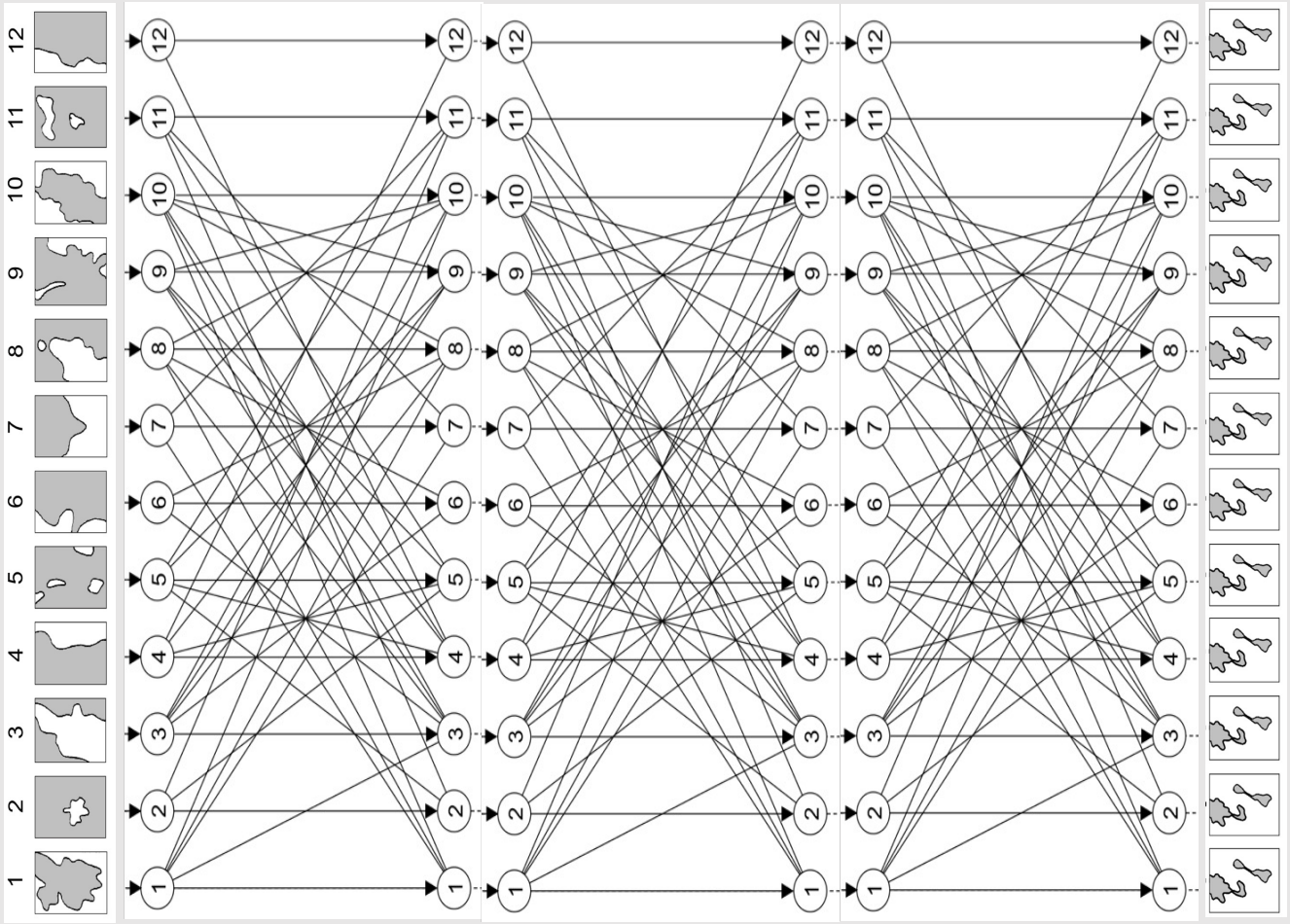

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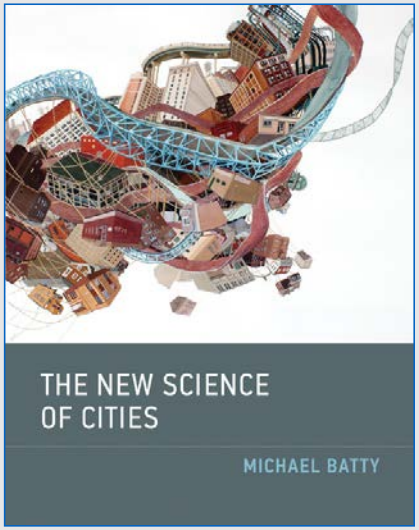

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Key Factors Affecting Residential Development

- Accessibility to Existing Urban Services
- Costs of Spatial Congestion
- Accessibility to Recreational Amenities
- Areas of Acceptable Micro-Climate
- Areas of Water Catchment and Poor Drainage
- Institutional Constraints Imposed by Government
- Accessibility to External Urban Markets
- Subsidence and Extensive Industrial Pollution
- Areas of Suitable Topography
- Rural Amenity Areas
- Historic Urban Areas
- Conservation of High Quality Agricultural Quality







My first paper on this was in Architectural Design in 1970, and I have written more recently in various edited books but there is hardly anyone working on this and most of my time is spent doing other things

Manchester, Computation and the Emergent Digital Transformation of Cities and City Planning

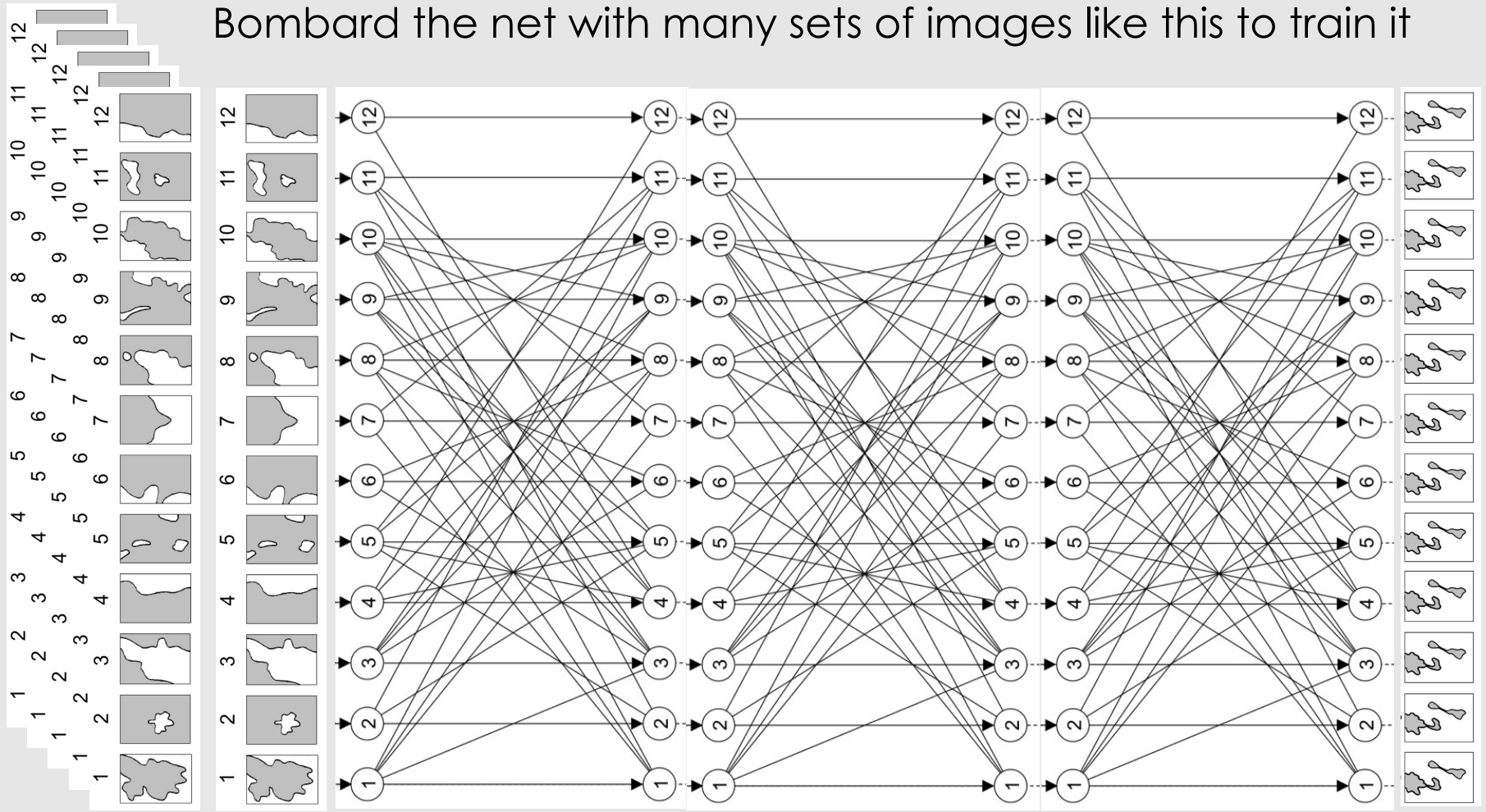
Now fast forward 50 years or more.

Imagine there were only 12 factors that determined all urban development, things like accessibility, topography etc..

If we had many, many towns and relevant sets of 12 factors for each, these factors are images, and we could throw them at our **neural net** and we could train the net to produce a unique set of weights that would produce the most relevant combination of factors that would determine the most likely town form.

Next is example of how this might work. And there is also glimpse of convergence with city models, cf deep gravity models

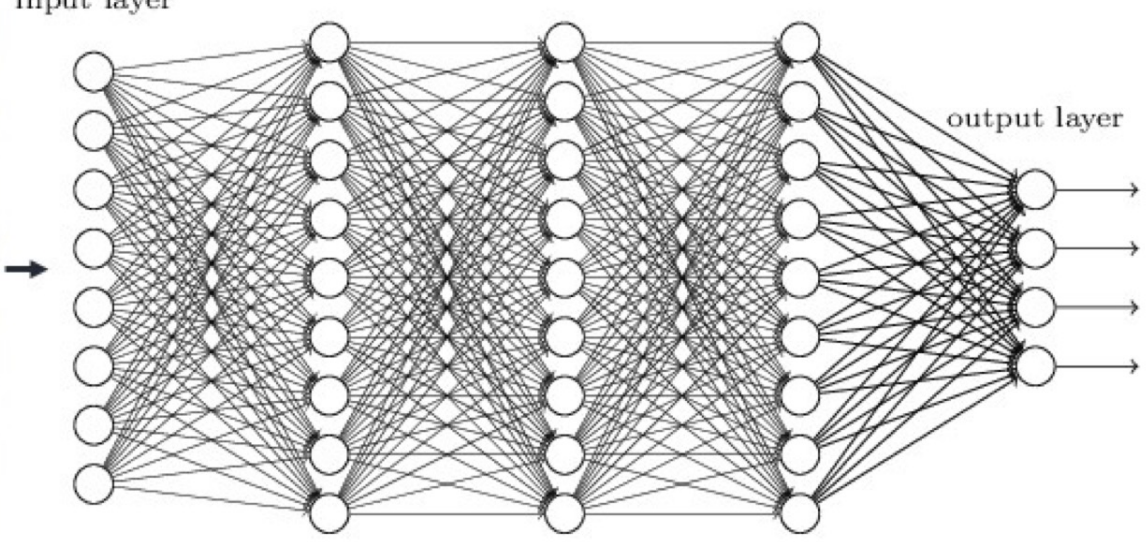
Bombard the net with many sets of images like this to train it



Deep neural networks learn hierarchical feature representations







Urban Design: The 3D City and Visualisation

Again back to Manchester. The degree I did was remarkable. We were taught a lot of what I have described. Systems of course and we were much influenced by what was happening on the other side of the Atlantic where simulation models came from

But we had a lot of design – 80% of our time was spent in the studios – in the Whitworth Art Gallery where the dinner will be held tomorrow night. Here are two sketches of our 2016 Reunion by Duncan Thomas – God rest his soul -

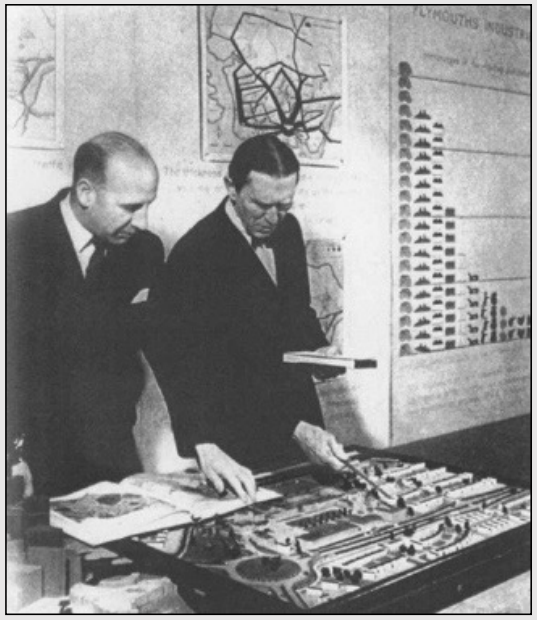




We did a lot of urban design – a lot – and all the lecturers – especially those like Chadwick and Mcloughlin – actually did design. I have many stories. The high water mark was of course Kantorowich (below) who taught Civic Design in year 3 and that was all about ancient Greek Temple complexes. He designed the Humanities Bridgford Street Bldg.

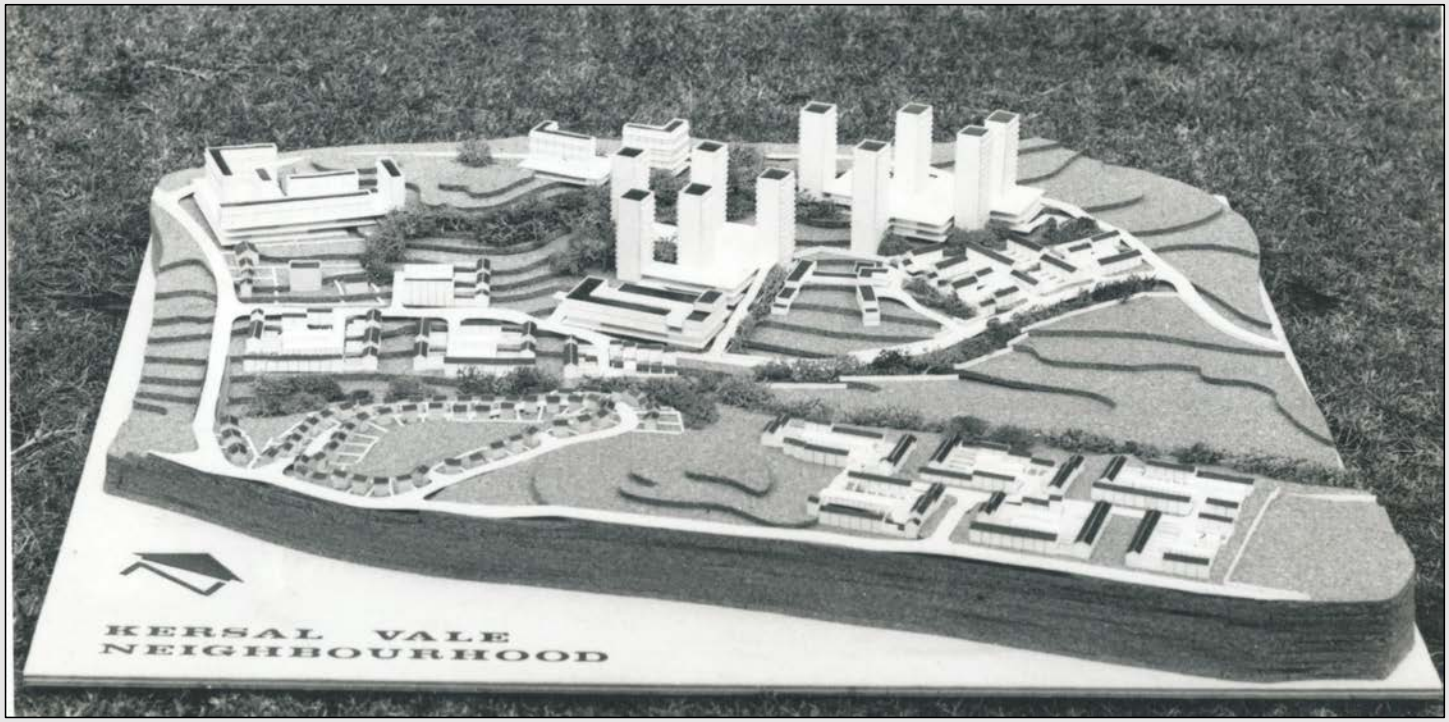


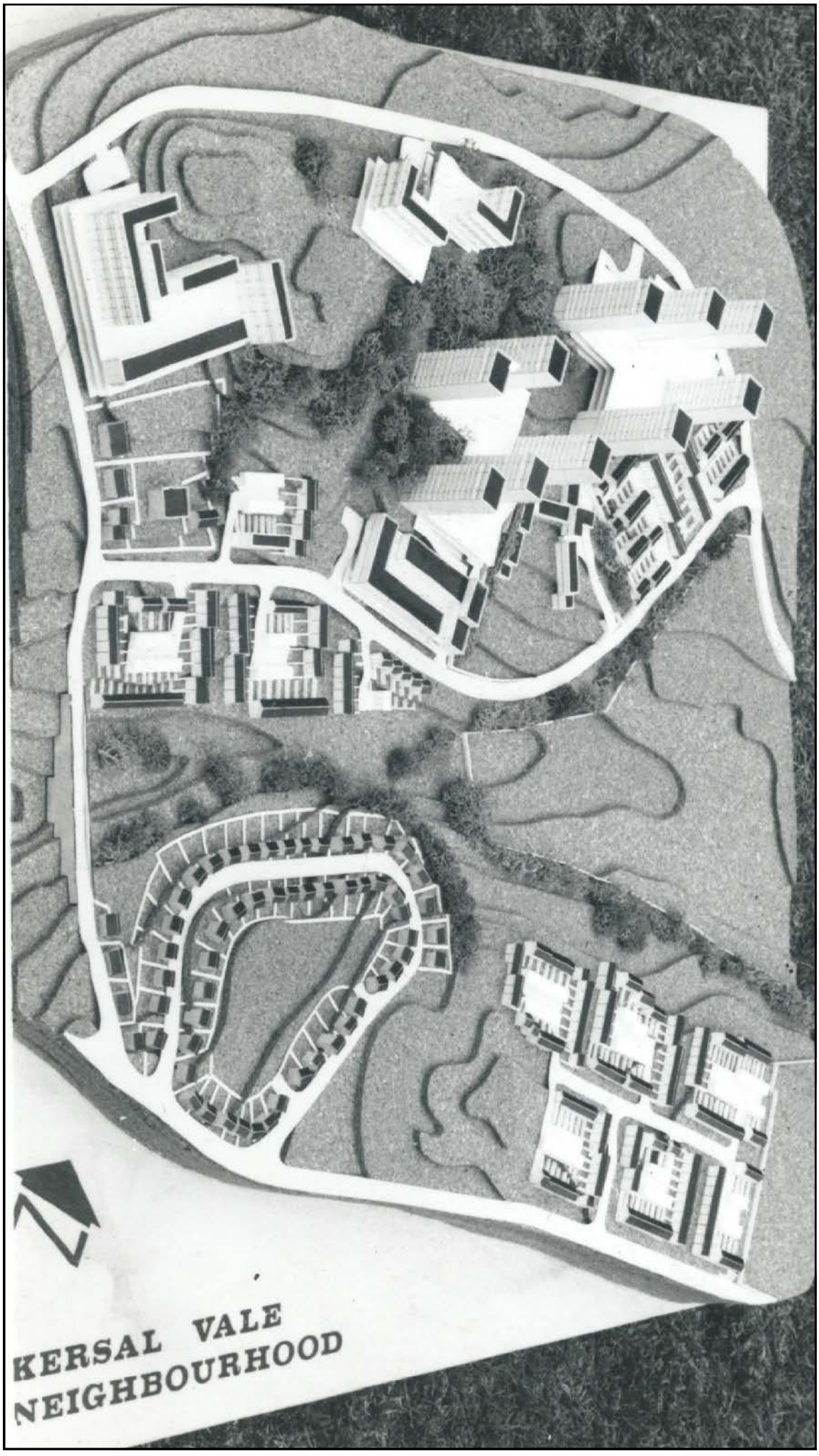


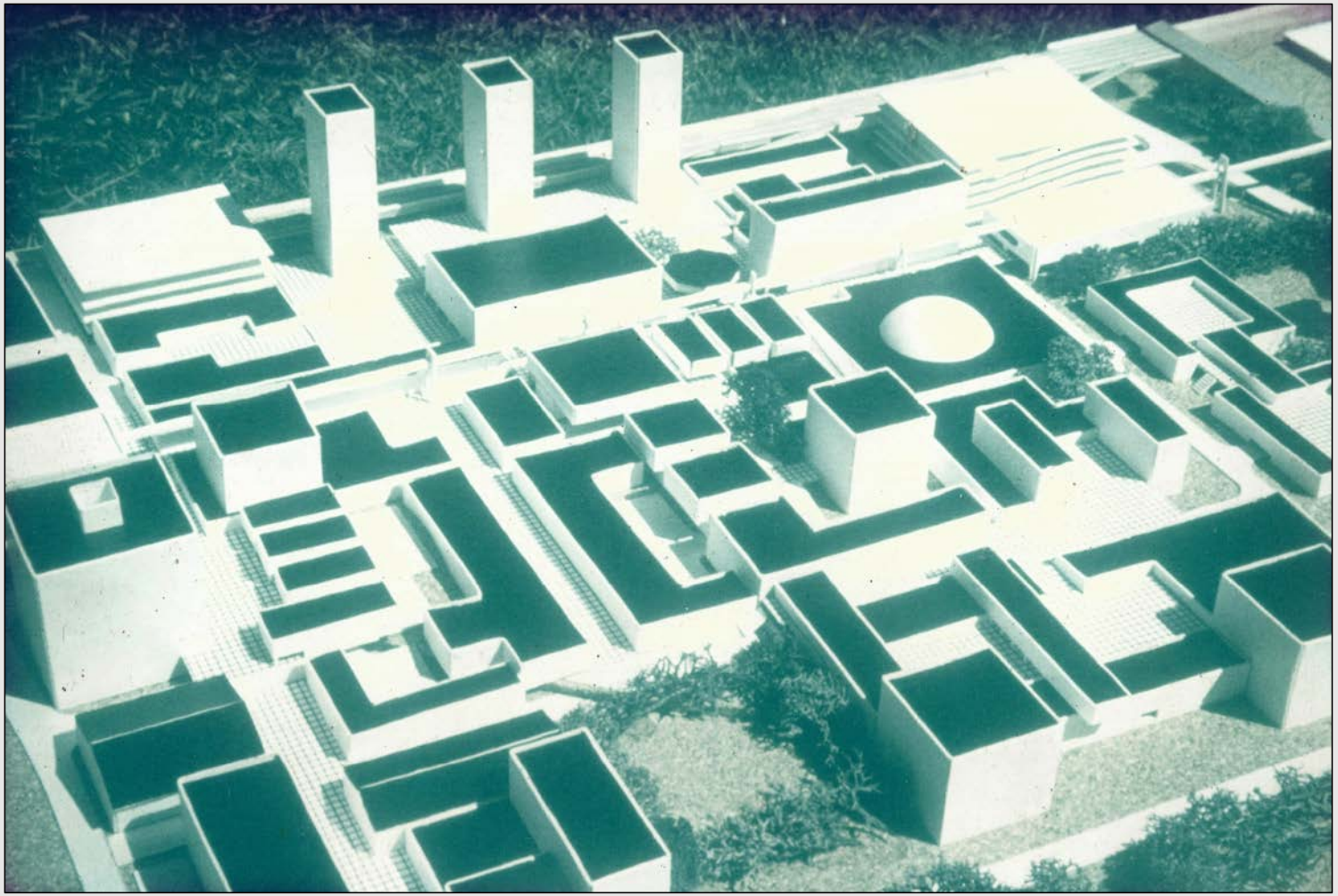


Let me also show you a picture of the world at the founding of the school not about us in Manchester but from my erstwhile predecessor at UCL, Patrick Abercrombie

Let me indulge myself further because in one sense this is why I went to Manchester in 1962. here is one of our second year projects – high rise and low rise – mixed development at Kersal Vale – awful stuff




N
KERSAL VALE
NEIGHBOURHOOD



Manchester, Computation and the Emergent Digital Transformation of Cities and City Planning

You know back in the day we never ever thought we could build computer models of of building environments. CAD did not come onto the agenda until the PC revolution in the late 1970s .

These models like Kersal Vale and Lower Deansgate, were called ‘iconic’. There was no sense that we could ever represent these as digital forms but why not? As Turing had told us repeatedly computers were universal machines.

But of course none of this anticipated computer cartography and GIS. I have not singled out GIS as a theme in my rapid survey but it is everywhere and from the 1980s up until the mid 1990s was the world of GIS. And GIS quickly moved from 2 to 3 dimensions. In 2000, there were about 60-70 3D city digital models but now there are many thousands. In CASA, we began in 2000 and Andy will continue the story tomorrow.

From Architectural Design, Volume 75 (6), 42-47, 2005

As the digital revolution deepens and pervades every aspect of daily life, virtual realities begin to penetrate one another in a multiplicity of ways. The amount of sensing data being compiled on the city grows, enabling the construction of virtual realities that can, in turn, be transformed for diverse purposes. Here, Michael Batty and Andrew Hudson-Smith from the



1. Virtual Cities

Jean Baudrillard (1994) defines a simulacrum as a 'simulation of a simulation', a model of a model if you like.[1] In terms of cities in the digital realm, it is easy to translate such a conception into multiple layers of abstraction that we build up from the raw data we sense, perceive and explain in simulating urban form and structure. A generation or more ago, when computers were first used to represent cities, typical simulations were immediate and direct. Either the geometry of the city was used to construct digital 'iconic' models through which one could navigate, and sometimes use for CAD (computer-aided design), or geographic and economic functions were represented using 'symbolic' mathematical models that could be analysed and manipulated for the same ends: better design, better planning. As the digital revolution has matured, these conceptions have blurred, and now there are mathematical models that sit within iconic models, and vice versa, whose symbology exists on many levels. More importantly, perhaps, as computers have come to be used in everything from extracting data remotely, to mining it to find new

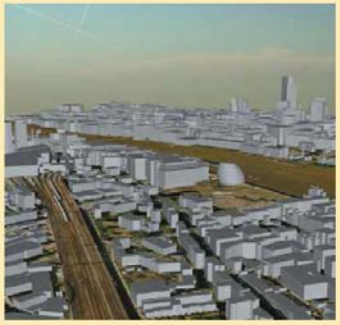


Figure 1: View west from Tower Bridge across Virtual London, showing the raw geometry of the virtual city before it is populated with data.

patterns, visualising it in diverse ways, modelling it for the same diversity, and embedding users virtually into the process of use, models have come to be represented within models, worlds within worlds, as the power of recursive digital construction has gathered pace. This is simulacra: virtual cities within virtual cities where such embedding twists the process in curious but illuminating ways.

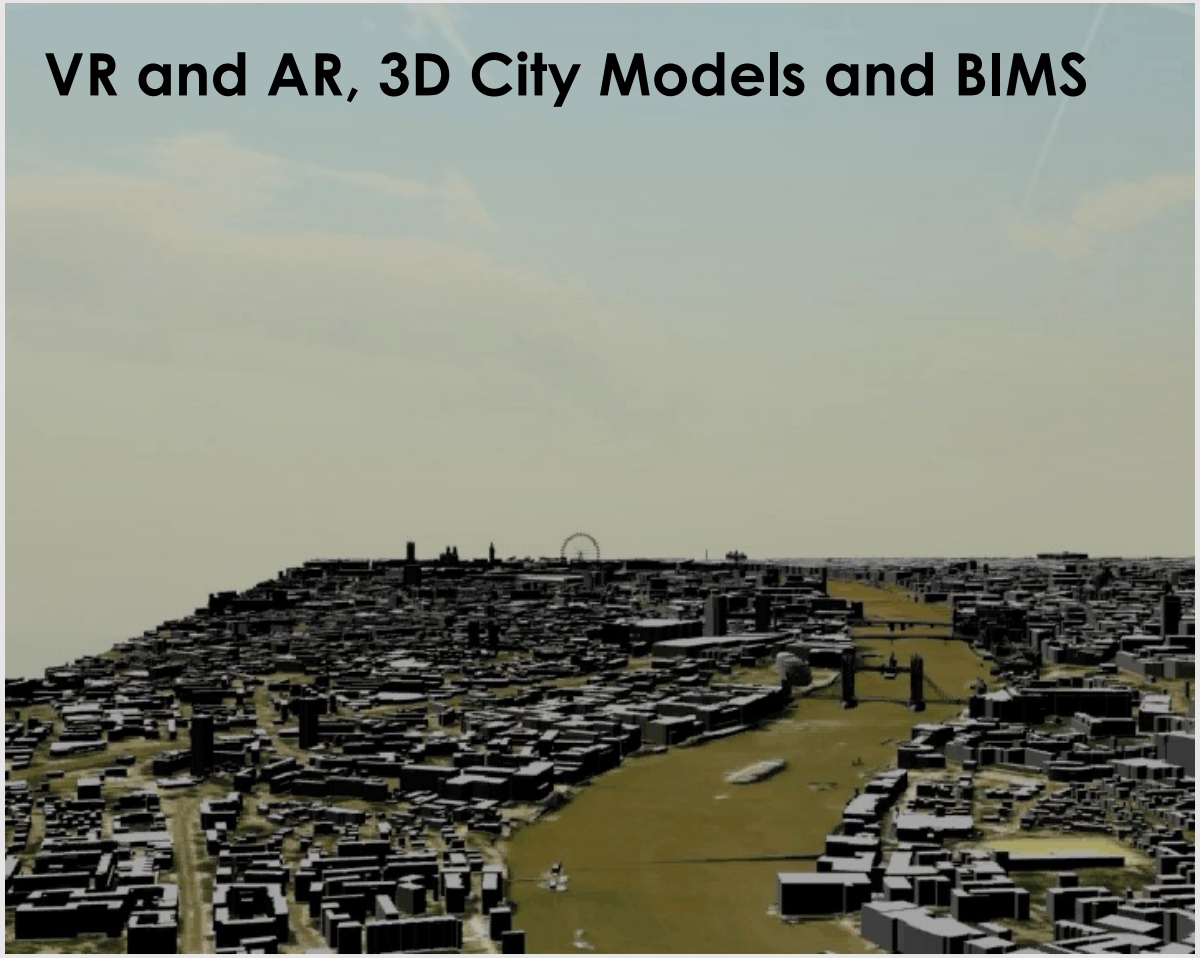
We will begin by describing the construction of a digital iconic model of central London that we somewhat euphemistically refer to as 'Virtual London'. Virtual London is in fact a 3-D geographic information system (3-D-GIS), which is in essence a large spatial database that can be analysed and queried. We can view it in 3-D because we can hold and file the data via digital representation of streets and building blocks. However, this is just one way of viewing the data – one perspective on the virtual city – and there are many others that need not stress the spatial dimension nor its built form. We construct this model as a series of data layers that we can overlay in 3-D. We can then embellish the model, adding a variety of digital media that we can deliver and display in everything from web browsers to holographic-like displays.

Such models can also be imported into other digital media. We illustrate the conception of a simulacrum by embedding it within a virtual world – a virtual design studio or exhibition space – which users can enter as avatars and then view and manipulate the model in the presence of other users, who are also avatars. This embedding can be recursive in that we can enter such worlds, view the model and then fly through it, adding new digital media at points where we need to render the environment with different images. Like many of our simulacra, Virtual London is designed so that users can learn about and redesign their environment in a



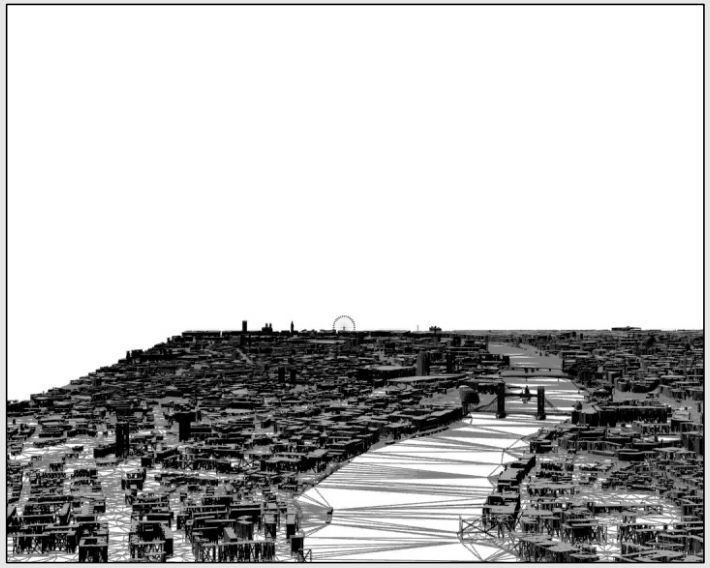
Figure 2: Building the virtual city in layers from the ground up. (a) Extruding parcel data to average height and inserting a LOAM image of St Paul's Cathedral into the scene. (b) Adding a digital panorama of the area around the Swiss Re headquarters building.

VR and AR, 3D City Models and BIMS

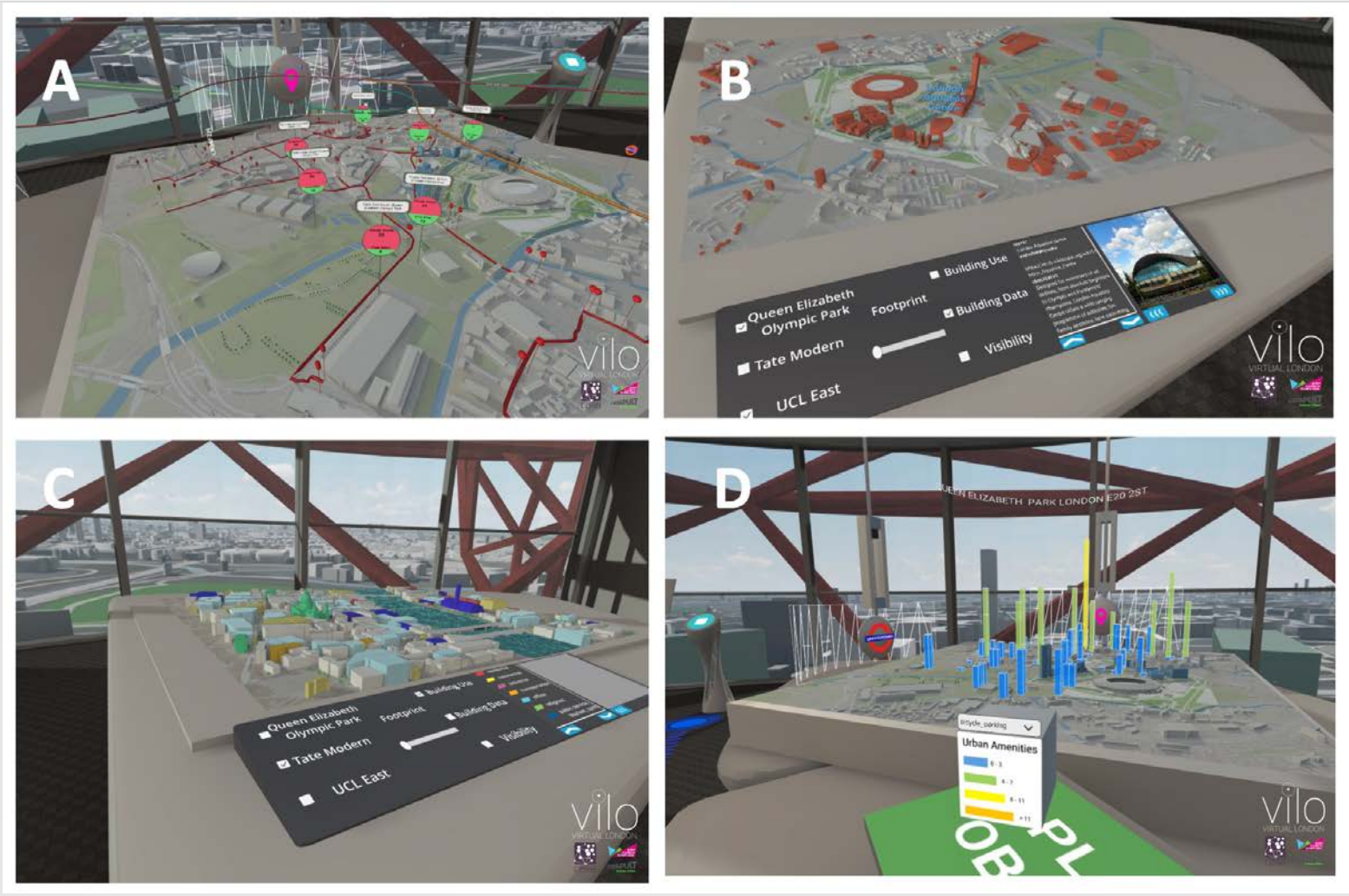


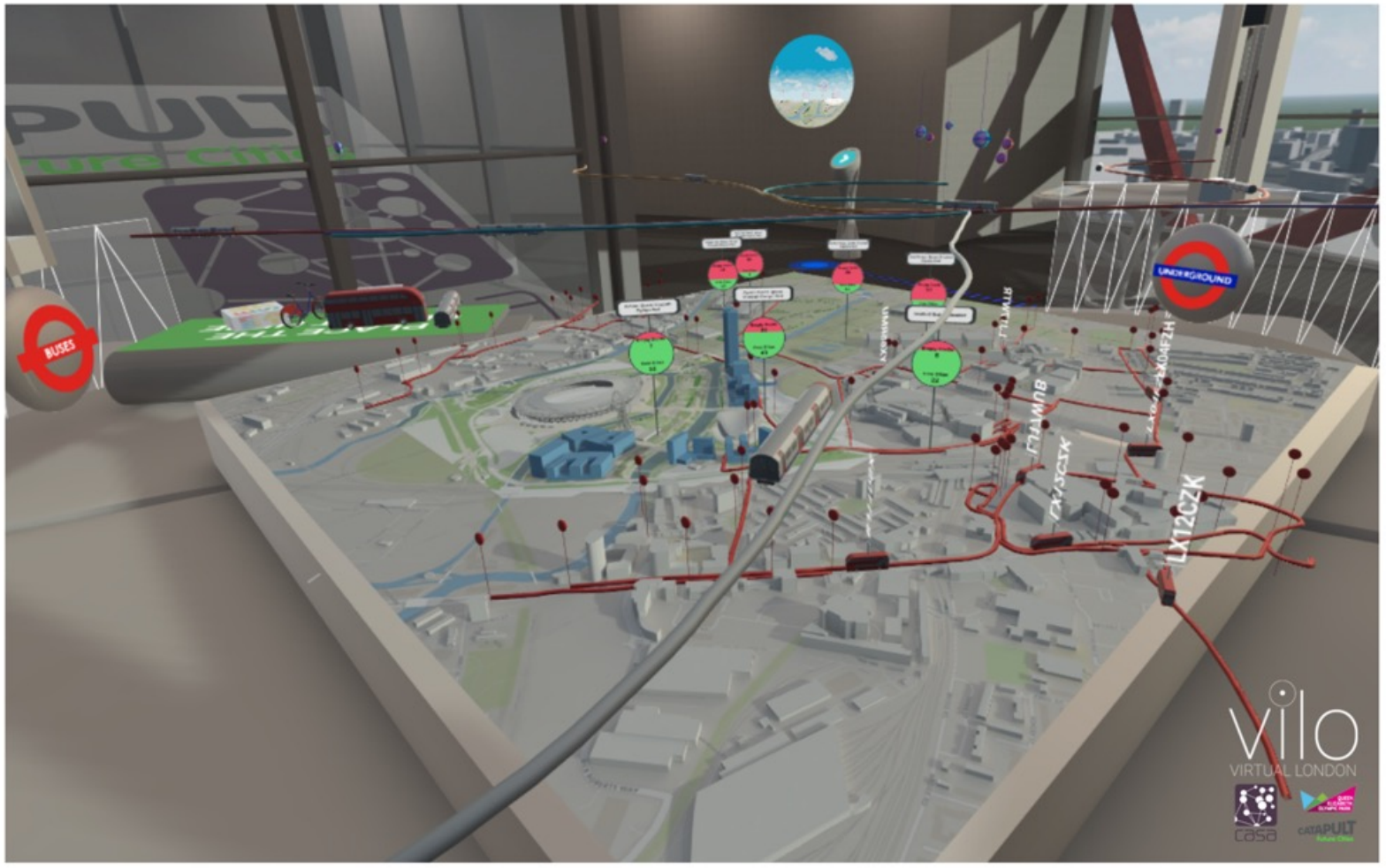








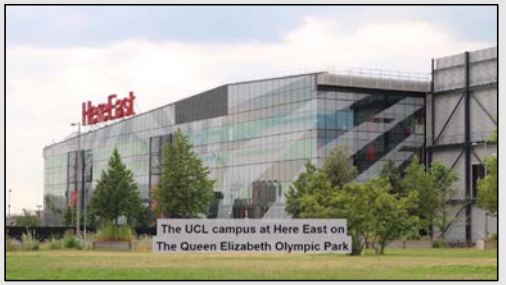

A
B
Queen Elizabeth Olympic Park
Tate Modern
UCL East
Footprint
Building Use
Building Data
Visibility
vilo
VIRTUAL LONDON
C
D
Urban Amenities



Manchester, Computation and the Emergent Digital Transformation of Cities and City Planning

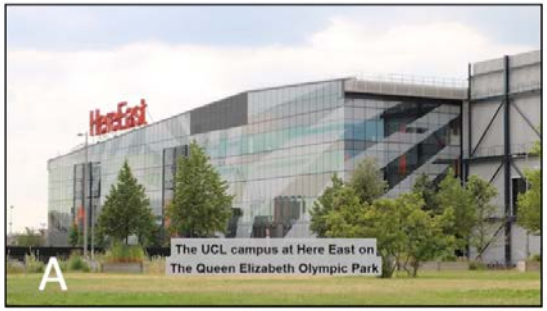
Smart Buildings – UCL Here East





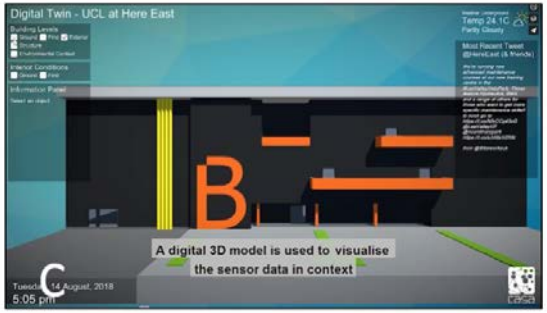




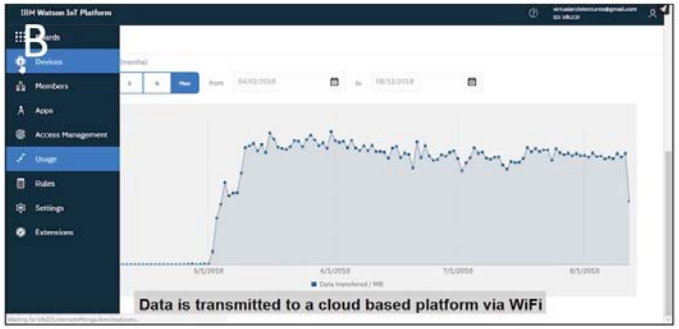

A
The UCL campus at Here East on
The Queen Elizabeth Olympic Park

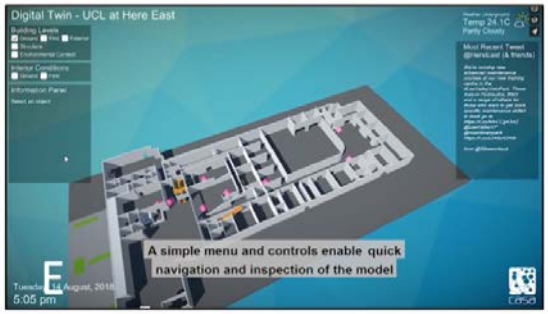

B
Twenty environment sensors were installed
for a six month trial from April 2018


A


Digital Twin - UCL at Here East
B
A digital 3D model is used to visualise
the sensor data in context
C
5:05 pm


Each sensor measures temperature,
humidity, pressure and ambient light levels
D


IBM Watson IoT Platform
B
Devices
Members
Apps
Access Management
Usage
Rules
Settings
Extensions
Data is transmitted to a cloud based platform via WiFi


Digital Twin - UCL at Here East
A simple menu and controls enable quick
navigation and inspection of the model
E
5:05 pm

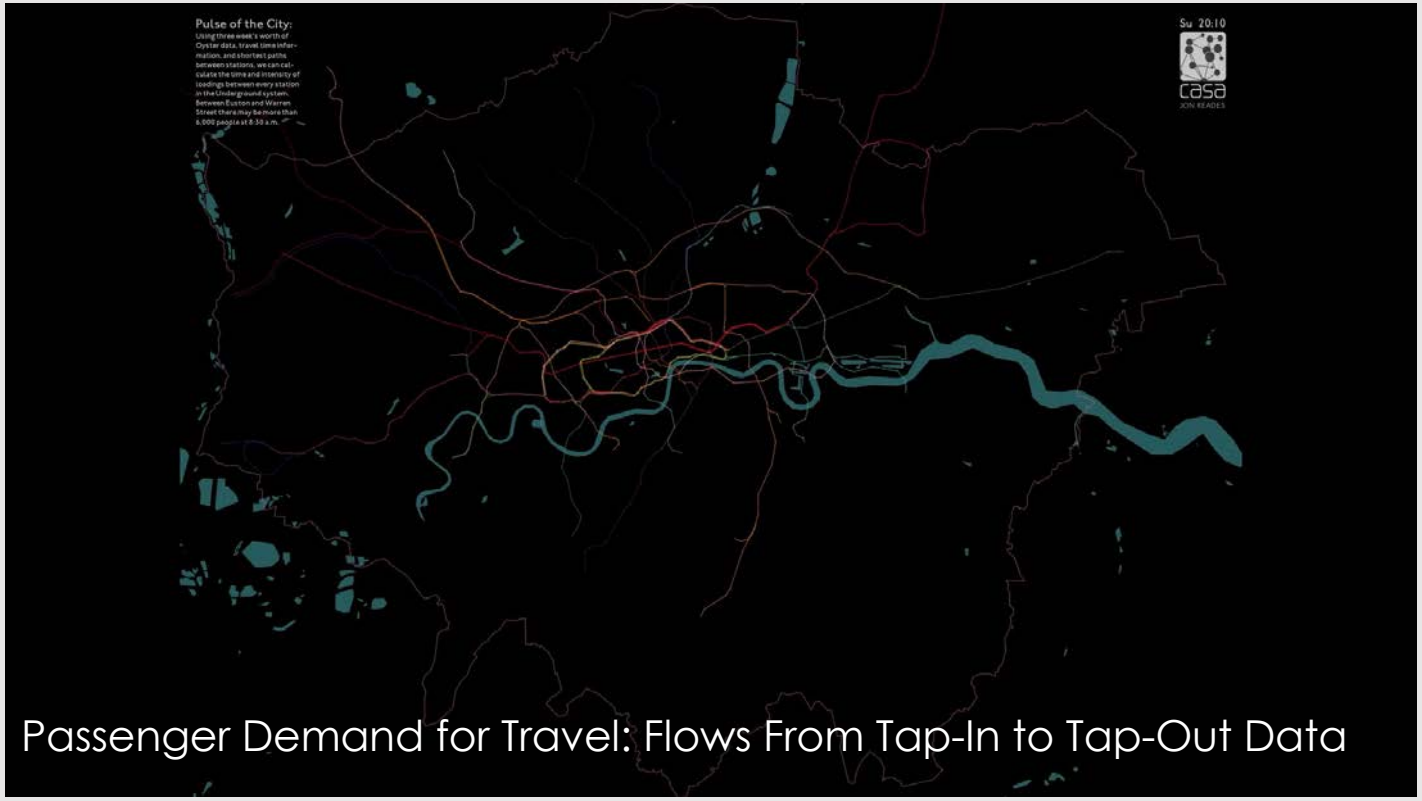

Digital Twin - UCL at Here East
The wider site context is also visualised in 3D
F
5:06 pm

The Emergence of the Smart City and the Platform Economy

I don't have time to say much about the smart city but just as iconic models became symbolic and digital, the city itself is becoming digital – the BIM example alludes to this

As computers have scaled down they have become embedded into the fabric of the city, they generate data all the time about what is happening – this is streamed in real time and it is called big data. One of the biggest areas of the ***high frequency city*** is data bout mobility. Note the contrast with the ***low frequency city*** that most of my talk has been about

Let me just tantalise with some big data from our Oyster project

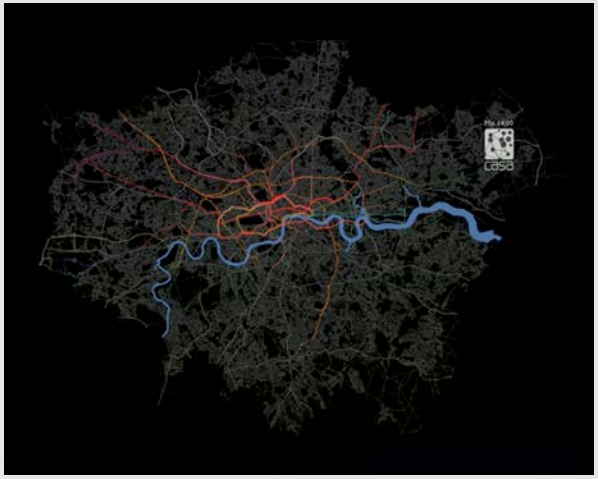


Passenger Demand for Travel: Flows From Tap-In to Tap-Out Data









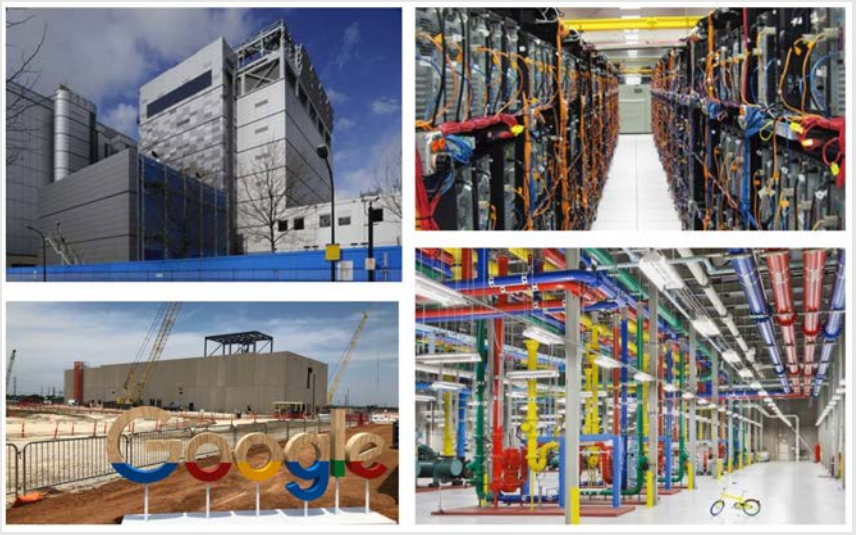






Manchester, Computation and the Emergent Digital Transformation of Cities and City Planning

The Digital World: Using Models in Everyday Life









Where Next?

- Town and Country Planning – relevance in the digital age
- We must focus on planning applications – there are over half a million each year and this is an enormous data base that needs to be unlocked and standardised
- We urgently need new theories and new models. And this does not mean more machine learning. But better theory.
- We need a Renaissance of local and structure plans. Most are not fit for purpose and we need to train many planners to embrace the many tools noted here.
- ….. tomorrow Wei Yang will talk about our taskforce …..

The Digital Transformation: Our Recent Taskforce



A Digital Future for Planning

Spatial Planning Reimagined

The Recommendations

1: Recognising the Vital Role of Spatial Planning where Digital Transformation is to Tackle the Grand Challenges
2: A Chief Spatial Planning Officer in the Cabinet Office
3: Implementing an Integrated Digitally Enabled Spatial Planning Methodology
4: Establishing a Central Resource and Delivery Body to Empower Cross-Sector Innovation,
5: Creating a Comprehensive Mapping System, a Common Spatial Data Environment, and Analytic Functions
6: Establishing a Chief Spatial Planning Officer Role in Every Local Authority
7: Investing in Digital Planning in Research, Practice, Education, and Lifelong Learning
8: Developing a National Cross-Departmental Strategy for Digital Planning

About the Task Force

Digital Task Force for Planning

The Digital Task Force for Planning is an independent panel set up by Michael Batty and Wei Yang in February 2021. The Task Force is comprised of an interdisciplinary panel of 10 influential thought leaders drawn from a broad spectrum relating to planning and digital technology.

Digitisation vs Digitalisation

The research methodology:
Evidence collected to develop the report including **4** Task Force panel meetings, over **100** meetings with the Co-Chairs, **16** roundtable discussions, online surveys of Local Planning Authorities and Planning Schools, RTPI General Assembly discussions, a generic call for evidence questionnaire, **9** visionary & reflection statements from Panel Members, and **20** Case Studies.

Task Force Members

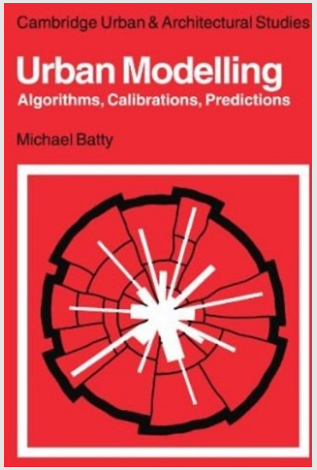


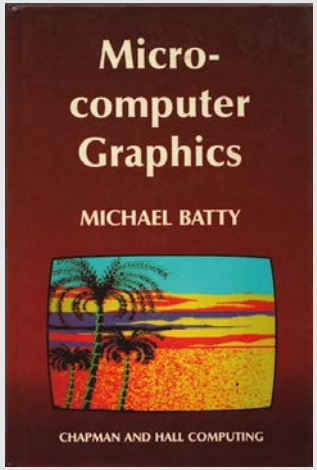
https://digital4planning.com/a-digital-future-for-planning/

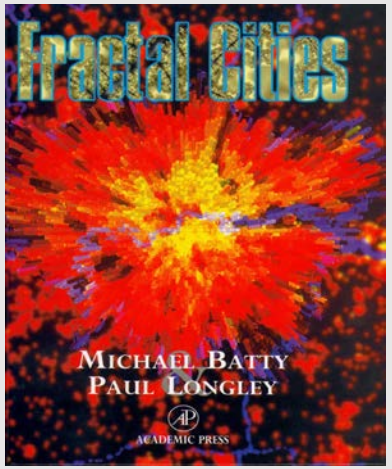
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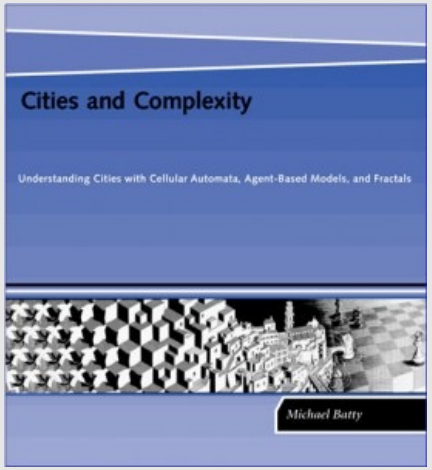
Michael Batty
Centre for Advanced Spatial Analysis
CASA-UCL

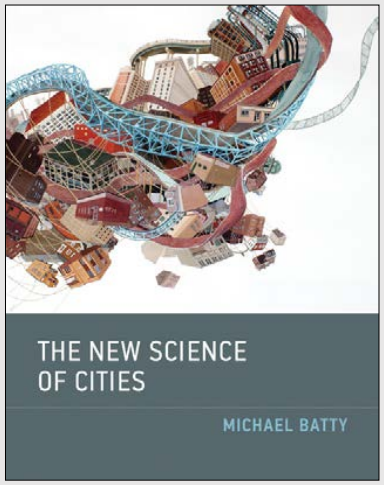
m.batty@ucl.ac.uk
@jmichaelbatty

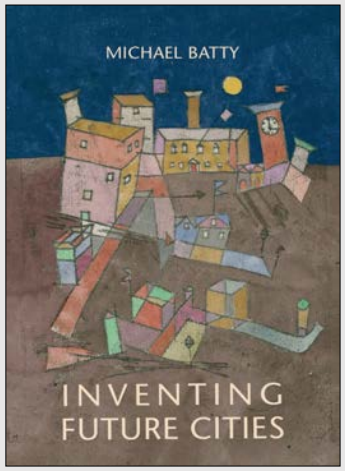

Cambridge Urban & Architectural Studies
Urban Modelling
Algorithms, Calibrations, Predictions
Michael Batty

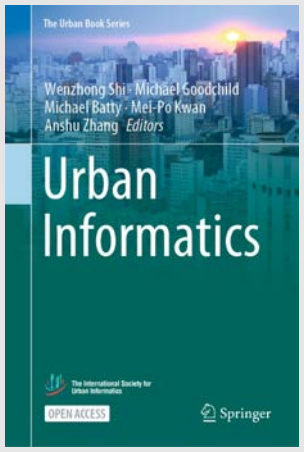

Micro-computer Graphics
MICHAEL BATTY
CHAPMAN AND HALL COMPUTING


Fractal Cities
MICHAEL BATTY
PAUL LONGLEY
ACADEMIC PRESS


Cities and Complexity
Understanding Cities with Cellular Automata, Agent-Based Models, and Fractals
Michael Batty


THE NEW SCIENCE OF CITIES
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The Urban Book Series
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A Digital Future for Planning
Spatial Planning Reimagined
Professor Michael Batty & Dr Wei Yang
Co-chairs, Digital Task Force for Planning
12 May 2022
www.digital4planning.com

X 20

TRANSPORT ENGINEERING
(*Third Year Degree*)
(*First Year Full-time Post-graduate Diploma*)
(*Second Year Part-time Post-graduate Diploma*)
CIVIL ENGINEERING II (TRANSPORT)
(*Fourth Year Diploma*)

UNIVERSITY OF MANCHESTER

DEGREE OF B.A.
(HONOURS IN TOWN AND COUNTRY PLANNING)
PART I (*b*) EXAMINATION
DIPLOMA IN TOWN AND COUNTRY PLANNING
[*1964–65 and 1959–60 Regulations*]

3 June 1965, 2—5

Answer FIVE *questions.*

1. Outline the economic and social fuctions of transportation in a modern society, using the historical development of transport and its relationship with high density communities to illustrate your essay.

2. There appears to be a conflict in urban transport planning arising from the desire to extract the maximum capacity from existing road systems and the awareness that the use of roads to such a capacity makes a town extremely unpleasant. Discuss the factors which affect the capacity of roads, distinguish between the various definitions of capacity, and proceed to argue a "solution" to the problem in terms of the commercial and social consequences of the measures you recommend. In your discussion make any necessary distinctions between the transport needs of goods and people and include all forms of transport appropriate to the situation.

3. Define the various operations necessary in the comprehensive planning of a transport system for a large urban area. Display these operations in tabular form showing how each one is linked to or depends upon others, and add a commentary indicating the nature and importance of each step.

4. Write the successive terms of the Binomial distribution and of the Poisson distribution. Explain the meaning of these terms and point out the essential difference in application of the two distributions by giving for each an example of the type of situation where it might be appropriate.

In a survey of old property, it is found that, on the average, twenty-five out of every hundred houses in a certain district need major structural repair. If a particular row of twenty houses was inspected in this district, what would be the probability of finding

(*a*) that the number of houses needing repair in the row is four, and

(*b*) that the first four houses in the row need repairs and the remainder are in good condition.

5. Choose a simple four-zone problem to illustrate the Fratar method of predicting future interzonal trip distribution. Assume that the present and future trip generation figures are known for each of the zones and that the present interzonal movements are known. Carry out only one iteration on the figures you choose indicating each step clearly. Comment briefly on the limitations of this method.

6. Write an essay describing the principles governing the horizontal and vertical alignment of roads. In your discussion include comments on the equilibrium of a vehicle related to superelevation and side friction, the justification and use of horizontal transition curves and the criterion of sight distance applied to horizontal and vertical curves.

X 17

VALUATION AND ESTATE MANAGEMENT
(*Third Year Degree*)
(*Second Year Full-time Post-graduate Diploma*)
VALUATION OF LAND AND BUILDINGS
(*Third Year Part-time Post-graduate Diploma*) (*1962–63 Regulations*)
STATUTORY PLANNING PRACTICE (VALUATION)
(*Fourth Year Diploma*) (*1959–60 Regulations*)

UNIVERSITY OF MANCHESTER

DEGREE OF B.A.
(HONOURS IN TOWN AND COUNTRY PLANNING)
PART I (*b*)
DIPLOMA IN TOWN AND COUNTRY PLANNING
[*1959–60, 1962–63 and 1964–65 Regulations*]

1 June 1965, 9-45—12-45

Answer TWO *questions in Section* A *and* THREE *in Section* B.

SECTION A

1. A vacant parcel of accommodation land of approximately 20 acres is required by Ambridge County Council, as Education Authority, for a new Secondary Modern School.

You have been instructed by the freeholder to negotiate with the Local Authority to agree the compensation payable. The land has been vacant since 1943.

Under the provisions of Part VI of the Town and Country Planning Act, 1947, a claim for loss of development value was admitted by the Central Land Board as follows:

Unrestricted Value	£9,000
Restricted Value	£1,500
Development Value ..	£7,500

You are aware that, when calculating the unrestricted value, the 10 acres of frontage land was worth per acre double that per acre of the remaining land.

In 1958 an application for planning consent to develop some 6 acres of the frontage land for residential purposes was refused, and in consequence the freeholder submitted a claim for and received compensation in accordance with Part II of the Town and Country Planning Act, 1954 (now Part VI of the Town and Country Planning Act, 1962). If the application had been successful, the freeholder would have sold his interest in these 6 acres to a firm of local builders for £7,500.

You have had an informal discussion with the Local Planning Authority from which it is apparent that they would issue a certificate under Section 17 of the Land Compensation Act, 1961, indicating that residential development was appropriate in the relevant circumstances.

Since 1947 you consider that agricultural values have doubled and that land with planning consent for housing has increased fivefold.

Assess the compensation payable to the freeholder.

2. In 1936 a Property Company purchased at public auction the leasehold interest in a block of shops, with the benefit of vacant possession, for £800.

During the course of the same year the Property Company concluded negotiations with the freeholder, a Nationally-known Insurance Company, whereby the leasehold interest was surrendered in return for a 99 years building lease at a ground rent of £450 per annum, contingent upon the Property Company demolishing the parade of shops and erecting a block of offices in their place.

This redevelopment was completed in the late summer of 1938, but the premises were destroyed by fire last year, and a refusal of planning permission to rebuild the offices has just been received by the Property Company.

What remedies are available to the Insurance Company and the Property Company against the determination by the Local Planning Authority and what compensation (if any) could be payable to either company, assuming that values have increased sixfold since 1936?

3. The freeholder of a factory in North-East Lancashire, built about the turn of this century, envisaged building an extension of 12,000 square feet to his factory which would ultimately give him a total net effective floor area of 150,000 square feet.

The idea behind this extension, which would be the first of its kind and was programmed to cost £30,000 (exclusive of fees, etc.), was to allow the enlarged building to be adapted for more modern production techniques.

Planning permission was refused by the Local Planning Authority on the ground that the factory was situated in an area allocated in the approved Development Plan for residential purposes.

You estimate that the net rental values, had the scheme of modernisation been permitted, would have increased from 7s. 6d. to 9s. per square foot overall.

Assess the compensation (if any) payable to the freeholder in respect of this adverse planning determination, and briefly describe the relevant statutory provisions concerning compensation.