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**Residential property developers in urban  
agent-based models: Competition, behaviour  
and the resulting spatial landscape**

Fraser John Morgan

A thesis submitted in fulfilment of the requirements for  
the degree of Doctor of Philosophy in Geography.  
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It is not the mountain we conquer, but ourselves.

Sir Edmund Hillary

## Abstract

While it is widely acknowledged that property developers are the most important agent in the urban development process, existing urban agent-based models often fail to examine the diversity of their types, strategies and behaviours and the resulting effects this differentiation has at a spatial level.

To examine this, a spatial multi-agent model that accounted for the variation in how developers purchase and subdivide land was created. Developer agents within the model all accessed the same set of behaviours, but implemented them differently based upon the capital available to the developer. These behaviours include how developers: assess the property market, evaluate parcels for purchase, evaluate the timing of subdivision, manage their risk, and focus transactions within a defined territory. To enable the subdivision of parcels, a hierarchical landscape was created that provided the framework for developer agents to understand, analyse and enact the mechanism of subdivision on the urban environment.

Using this agent-based model, two experiments were conducted. The first experiment varied the level of developer competition to examine how the diversity of capital affects the development of the urban landscape. The second experiment compared the default heterogeneous application of the behavioural traits with a homogeneous application to explore the resulting affects on the pattern of development. This was done to both understand the importance of the behaviours but to also explore the way in which heterogeneity affects urban agent-based models.

The resulting contributions to the field of urban modelling vary from methodological to more applied knowledge. Methodologically, this research has developed a more accurate representation of space that enables a realistic form of residential property development to be modelled. In addition the research moved away from the mathematical formalism found in other urban models and developed a more process-based approach that enables more behaviourally focused agents to be included.

Building on the methodological achievements, the research answered a range of applied questions that highlight the importance of residential developers when examining the changes in urban growth and form. These focused on how varying levels of developer competition can shape the resulting development pattern, and the role that developer behavioural heterogeneity has in shaping the form of urban development, particularly around the importance of satisficing in their decisions.

From this analysis, it is clear that residential developers play a substantial role in shaping the resulting urban landscape, through the structure and composition of the residential developer market as well as the spatial application of their behavioural activities.

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## Table of Contents

Abstract.....	iv
Acknowledgements.....	v
Table of Contents.....	viii
List of Figures .....	xii
List of Tables .....	xvi
List of Equations.....	xvii
Glossary.....	xviii
1 Introduction.....	1
1.1 Research issues and goals.....	4
1.2 Structure of dissertation.....	6
2 Modelling urban growth: Residential property development as a complex spatial system.....	10
2.1 Urban models before 1973.....	11
2.2 Critiques of urban models .....	14
2.3 The rise of comprehensive urban models .....	17
2.4 Complexity in urban systems.....	18
Cellular Automata.....	20
Agent-based models.....	23
2.5 Developers and the urban development process within urban models.....	27
2.6 Representations of space in urban models .....	28
2.7 Conclusion.....	30
3 Urban development: Property, process and models .....	32
3.1 Structure and Agency .....	33
3.2 Integration of Structure and Agency within property research .....	34
3.3 Conceptual models of the urban development process .....	36
Neo-classical equilibrium models.....	38

Event-sequence models .....	40
Agency models.....	42
3.4 Conclusion.....	45
4 Developers and their role in the urban development process .....	46
4.1 Empirical research into developer types .....	49
4.2 Large vs. Small – Size-based stratification of developer behaviour .....	51
4.3 Conclusion.....	58
5 Behaviour and modelling: An agent-based model of residential property developers .....	60
5.1 Platform .....	62
5.2 Representations.....	64
Spatial .....	64
Agents.....	65
Process.....	66
Time .....	67
5.3 Model verification.....	67
5.4 ODD protocol .....	69
Overview.....	70
Purpose .....	70
Entities, state variables, and scales .....	71
Process overview and scheduling .....	74
Design concepts.....	75
Emergence .....	75
Adaptation .....	76
Objectives .....	76
Learning .....	76
Prediction.....	77
Sensing.....	77
Interaction.....	77
Stochasticity.....	78
Observation.....	79
Details .....	79
Initialisation .....	79
Input.....	81
Submodels.....	81
5.5 Conclusion.....	87

6	Urban landscapes and developer subdivision through binary space partitioning .....	88
6.1	Spatial representation .....	90
6.2	Tree data-structures .....	90
6.3	Theoretical implementation .....	94
6.4	Implementation within NetLogo .....	96
6.5	Results.....	99
	Pattern variations .....	103
	Partitioning maps .....	107
	Subdivision.....	110
6.6	Outputs to results .....	111
	Landscape statistics .....	114
6.7	Conclusion.....	119
7	Developer competition and the resulting landscape in an agent-based model of urban development .....	121
7.1	Parameterisation .....	122
	BSP Tree Initialisation .....	122
	Maximum and minimum parcel sizes .....	122
	Root location.....	123
	City size .....	125
	Model Initialisation.....	128
	Duration .....	128
	Percentage of parcels for sale per round .....	130
	Market .....	131
	Allocation of developer capital.....	132
7.2	Experimental design .....	134
7.3	Results.....	136
	Overview results.....	136
	Change in urban area .....	141
	Change in parcel size (Level).....	150
7.4	Developer and landscape responses to competition .....	162
7.5	Conclusion.....	165
8	Effects of homogeneity in developer behaviour on a agent-based model of urban development.....	166
8.1	Experimental design .....	167

8.2 Results.....	170
Overview results.....	171
Parcel Assessment .....	176
Change in urban area .....	178
Change in parcel size (Level).....	186
8.3 Developer and landscape responses .....	196
Parcel Assessment .....	197
Subdivision.....	197
Territoriality.....	199
Riskiness.....	201
Accuracy.....	201
8.4 Conclusion.....	202
9 Conclusions and future research directions.....	204
9.1 Methodological implications for urban modelling .....	207
9.2 Developer implications for urban modelling .....	209
Competition.....	210
Behaviour.....	211
9.3 Implications for other disciplines.....	212
9.4 Future research directions.....	213
Landscape .....	213
Model.....	214
Experiments.....	215
9.5 Conclusions .....	217
10 References .....	219
Appendices.....	237

## List of Figures

Figure 2.1: von Thunen's agricultural land-use model .....	11
Figure 2.2: Alonso's monocentric spatial structure model.....	12
Figure 2.3: Stylised representation of dispersal within a cellular automata model....	20
Figure 2.4: Stylised representation of an agent moving in an agent model .....	24
Figure 3.1: Drewett's (1973) model of residential development .....	43
Figure 3.2: Kaiser and Weiss's (1970) model of land conversion .....	43
Figure 3.3: Bryant, Russwurm, and McLellan's (1982) agency model of residential development.....	43
Figure 4.1: Central role of the developer .....	46
Figure 4.2: Market structure for the development industry .....	51
Figure 5.1: The ODD protocol .....	70
Figure 5.2: Flowchart outlining the process each developer undertakes when developing in each time-step .....	83
Figure 6.1: Basic tree data-structure, in this case a binary tree.....	91
Figure 6.2: Quadtree implementation .....	92
Figure 6.3: Binary space partitioning .....	93
Figure 6.4: Pseudo-code of BSP tree implementation.....	94
Figure 6.5: Four level BSP tree represented in NetLogo. ....	97
Figure 6.6: Representative forms of the resulting urban landscape .....	100
Figure 6.7: Urban Patterns resulting from a BSP tree using a distance-weighted linear equation.....	101
Figure 6.8: BSP tree with the lower left corner as the root-node .....	102
Figure 6.9: Un-seeded BSP Tree within NetLogo .....	102
Figure 6.10: Resulting patterns from changes in the equation used in its creation .	105
Figure 6.11: Changes in the resulting pattern with increase in power transform used .....	106
Figure 6.12: Development maps for shaping the BSP tree.....	108
Figure 6.13: Real world implementation of a BSP tree on Auckland cadastral data.	109
Figure 6.14: Example of a nine level subdivision process using the BSP process .....	110
Figure 6.15: An example output from the model showing the binary 'urban' landscape .....	112

Figure 6.16: An example output from the model showing the parcel size (LEVEL) attribute .....	112
Figure 6.17: Four reference landscapes to examine the change in landscape metrics .....	117
Figure 7.1: Comparison between an original and revised quarter landscapes .....	124
Figure 7.2: Average time-series examining the change in urban parcels based on city-size.....	126
Figure 7.3: Time-series examining the change in urban landscape contagion metric based on a changing city-size value .....	128
Figure 7.4: Comparison between model durations on the urban landscape .....	129
Figure 7.5: Graphical representation of the distribution of capital for each developer set.....	135
Figure 7.6: Time-series comparing the change in mean number of urban parcels for the five developer sets.....	137
Figure 7.7: Time-series comparing the change in mean urban parcel size for the five developer sets.....	138
Figure 7.8: Time-series showing change in the mean distance from each rural to an urban cell.....	140
Figure 7.9: Comparison between the initial and resulting urban landscapes for the five levels of developer competition for a single random seed value.....	142
Figure 7.10: Change in Average Polygon Perimeter-Area Ratio for the urban class through developer competition.....	144
Figure 7.11: Change in Aggregation Index for the urban class through developer competition.....	145
Figure 7.12: Change in Total Polygons for the urban class through developer competition.....	145
Figure 7.13: Time-series showing change in Average Polygon Perimeter-Area Ratio for the urban class through developer competition.....	146
Figure 7.14: Time-series showing change in Aggregation Index for the urban class through developer competition.....	147
Figure 7.15: Time-series showing change in total urban polygons for the urban class through developer competition.....	147
Figure 7.16: Principal components analysis of urban class landscape metrics based on developer competition .....	149
Figure 7.17: Comparison between the initial and resulting parcel size landscapes for the five levels of developer competition for a single random seed value .....	151
Figure 7.18: Change in parcel area based on parcel size classes caused by developer competition.....	153

Figure 7.19: Change in Average Polygon Perimeter-Area Ratio for a parcel size landscape through developer competition .....	155
Figure 7.20: Change in Edge Density for a parcel size landscape through developer competition.....	155
Figure 7.21: Change in Contagion for a parcel size landscape through developer competition.....	156
Figure 7.22: Time-series showing change in Contagion for the parcel size landscape .....	158
Figure 7.23: Principal components analysis of change in parcel size landscape metrics based on developer competition.....	161
Figure 8.1: Time-series showing change in number of urban parcels.....	173
Figure 8.2: Time-series showing change in mean urban parcel size .....	174
Figure 8.3: Time-series showing change in mean distance between all parcels and the root node .....	175
Figure 8.4: Average change in number of urban parcels for each trait.....	177
Figure 8.5: Average change in number of non-urban parcels for each trait.....	177
Figure 8.6: Comparison between the initial and resulting urban landscapes for the five behavioural traits and the 'all on' Baseline for a single random seed value.....	179
Figure 8.7: Change in Aggregation Index for an urban landscape through developer behaviour .....	181
Figure 8.8: Change in Average Polygon Perimeter-Area ratio for an urban landscape through developer behaviour .....	181
Figure 8.9: Change in Edge Density for an urban landscape through developer behaviour .....	182
Figure 8.10: Time-series showing change in Aggregation Index for the urban class through developer agent homogenisation of behavioural traits .....	183
Figure 8.11: Time-series showing change in Edge Density for the urban class through developer agent homogenisation of behavioural traits .....	184
Figure 8.12: Time-series showing change in Average Polygon Perimeter-Area ratio for the urban class through developer agent homogenisation of behavioural traits.....	184
Figure 8.13: Time-series showing change in Total Urban Polygons for the urban class through developer agent homogenisation of behavioural traits .....	185
Figure 8.14: Time-series showing change in Total Urban Area for the urban class through developer agent homogenisation of behavioural traits .....	185
Figure 8.15: Comparison between the initial and resulting parcel size landscapes for the five behavioural traits and the 'all on' Baseline for a single random seed value	187
Figure 8.16: Change in Contagion for an parcel size landscape through developer behaviour .....	189

Figure 8.17: Change in Total Polygons for an parcel size landscape through developer behaviour .....	189
Figure 8.18: Change in Total Polygons based on parcel size classes caused by developer behaviour .....	190
Figure 8.19: Change in Edge Density for an parcel size landscape through developer behaviour .....	191
Figure 8.20: Change in Average Polygon Perimeter-Area ratio for an parcel size landscape through developer behaviour .....	192
Figure 8.21: Time-series showing change in Contagion for the parcel size landscape .....	193
Figure 8.22: Time-series showing change in Edge Density for the parcel size landscape .....	194
Figure 8.23: Time-series showing change in Average Polygon Perimeter-Area ratio for the urban landscape .....	195
Figure 8.24: Time-series showing change in Total Polygons for the parcel size landscape .....	196



## List of Tables

Table 3.1: Conceptual models of the urban development process.....	38
Table 4.1: Summary of key developer behaviour .....	54
Table 5.1: State variables for each developer .....	72
Table 5.2: State variables for each node .....	72
Table 5.3: State variables for each cell .....	73
Table 6.1: Aspatial metrics calculated internally within NetLogo each time step ....	114
Table 6.2: Landscape metrics used in analysis .....	116
Table 6.3: Landscape metrics for each of the reference landscapes .....	117
Table 7.1: Average change in the number of parcels based on city-size for 160 model runs .....	126
Table 7.2: Average distance between all parcels and the root node based on city-size .....	126
Table 7.3: Average change in parcel size landscape metrics based on city-size .....	127
Table 7.4: Developer set composition and the HHI.....	133
Table 7.5: Tabular information for each of the fixed developer sets.....	136
Table 7.6: Mean values of three landscape metrics examining the resulting urban/non-urban landscape by developer set .....	146
Table 7.7: Axis predictivities for and quality of the principal components analysis of urban class landscape metrics .....	149
Table 7.8: Mean values of three landscape metrics examining the resulting parcel size landscape by developer set .....	156
Table 7.9: Axis predictivities for and quality of the principal components analysis of parcel size landscape metrics .....	161
Table 8.1: Description of runs performed in behaviour trait experiment.....	168
Table 8.2: Detailed description of how the traits are applied in both the 'on' and 'off' approaches.....	169
Table 8.3: Mean values of three landscape metrics examining the change in the resulting urban/non-urban landscape by behavioural trait .....	182
Table 8.4: Mean values of four landscape metrics examining the change in the resulting parcel size landscape for each behavioural trait .....	192

## List of Equations

Equation 5.1: Equation to create a Herfindahl-Hirschman Index (HHI) .....	80
Equation 6.1: Linear distance-weighted equation.....	95
Equation 6.2: Wider function which governs the partitioning of the tree data structure.....	96
Equation 6.3: Natural logarithmic transform of the distance weighted equation....	104
Equation 6.4: Sine function of the distance weighted equation .....	104
Equation 6.5: Combined Cosine and natural logarithmic transform of the distance weighted equation .....	104
Equation 6.6: Power transform of the distance weighted equation .....	106

## Glossary

ABM	Agent-based models
ASCII	American Standard Code for Information Interchange
BSP	Binary Space Partitioning
CA	Cellular Automata
DRAM	Disaggregate Residential Allocation Model
DS	Developer Set
DUEM	Dynamic Urban Evolutionary Model
GIS	Geographic Information System
HHI	Herfindahl-Hirschman Index
IAN	Image Analysis
LIDAR	Light Detection and Ranging
LUCC	Land Use and Land Cover Change
ODD	Overview, Design Concepts, and Details
PCA	Principal Component Analysis
PLUM	Projective Land Use Model
PNG	Portable Network Graphics
SLEUTH	Slope, Landuse, Exclusion, Urban extent, Transportation and Hillshade
SLUCE	Spatial Land Use Change and Ecological Effects at the Rural-Urban Interface