Modelling as alchemy? Reflections from a PSS developer on the politics of land use models

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Abstract: Planners use land use models to understand how cities function and to explore what cities might become. However, the development and use of such models is not unproblematic. Post-modern analyses of models highlights that they are socially constructed and that the context within which models are developed subsequently impacts their construction, use and influence. The paper uses a land use model developed by Auckland Council to examine how political actors, institutional and public politics influence the use of land models as an 'evidence base' for decision making. The land use model was developed as part of the council's 'Capacity for Growth Study', to improve understanding of the relationships between zoning decisions, land supply and development in Auckland. The case study illustrates how models become politicised. These findings highlight the importance of PSS developers looking openly and carefully at the argument, audience and the politics within which their model will be developed and implemented, in order to facilitate the use of models for planning.

Introduction:

Planning has always needed to understand how cities function spatially, economically and socially, and computer models are part of the tool kit utilised to achieve this. The models available to planning have changed immensely since the development of spatial science in geography in the early 1960's due to changes in technologies (Klosterman, 2012). Improved computer technologies and processing power have enabled models of land use change to become increasingly granular in spatial resolution, to forecast change over significant time periods (50 to 1000 years) and to incorporate a range of socio-economic and biophysical systems in their operations (see Verburg et al, 2004 for an overview of models of land use change). The use of models in planning practice does not occur in a vacuum however, and the relationship between knowledge, politics and decision making is a focus of planning theory literature (Waddell, 2011). In this analysis models are acknowledged as social constructions, embedded within particular social, political and institutional contexts that in turn influence their development and use.

Traditional views of planners providing unbiased and objective advice and analysis, often in the form of quantitative information, to decision makers, who subsequently act consistently and unproblematically with the advice provided, under the under the rubric of 'instrumental rationality' have been heavily critiqued (Hoppe, 1999; Innes, 1998). Habermasian informed communicative planning theorists highlight the non-linearity of policy development and implementation, the lack of objectivity of planners and policy advisors (not the value free autonomous agents implied in the framework), that information 'use' can unfold in multiple and unintended ways, and that ideas of certainty are misplaced (Gunder, 2008). Other analysis problematises the relationship between rationality and power, showing it to be reciprocal in practice. As Flyvbjerg (1998) concludes "one of the privileges of power, and an integral part of its rationality, is the freedom to define reality" (p. 227). Moreover what constitutes knowledge in planning has also undergone change. Stories, photos, histories, common sense and community knowledge or input are now considered relevant knowledge sources for planning (see Hillier, 1995).

The communicative planning literature highlights the need to understand how information becomes embedded in and used by individuals and organisations, yet the ghosts of instrumental rationality remain in New Zealand planning practice. Recent amendments to the Resource Management Act have both legislated and prioritised a 'value-neutral' approach to policy analysis (cost benefit analysis), and the pinnacle within the hierarchy of evidence in New Zealand's Environment Court remains the 'independent expert'. In addition to these national drivers of objective, data driven approaches, the Local Government Auckland Amendment Act (2009), states that Auckland's Spatial Plan must:

"Provide an evidential base to support decision making for Auckland, including evidence of trends, opportunities, and constraints ... must visually illustrate how Auckland may develop in the future...

including how growth may be sequenced and identify the current and future and mix of land uses including residential, business and rural activities".

This paper examines the genesis, construction and uptake of a computer model developed to support land use planning in Auckland, New Zealand. The aim is to explore how political actors, institutional and public politics influenced how the land model has been used, and how this affected its use as an 'evidence base' for decision making.

Review of the politics of models in planning

In practice certain types of knowledge occupy a hegemonic position in planning. In the field of transportation planning, complex spatial computer models remain the gold standard of evidence (Gudmundsson, 2011; Waddell, 2011). Detailed mathematical models forecasting variables as diverse as population, traffic movements and storm water contaminants, and various short to long term financial models remain core to operational and asset management planning.

While computer models occupy a significant role in planning, literature across a number of disciplines has displaced the notion of them as objective measures of the world. Social science analysis highlights the performativity of research methods; that is, the application of method is able to "enact whatever it is they describe into reality" (Law and Urry, 2004). Other research has shown how models are more than tools to conduct scientific work; that they are technologies to calculate truth, to govern and to conduct politics (e.g. based on this forecasted use, this course of political action is required) (Henman, 2012). Hereby we can draw attention to the performativity of the model despite its frequently perceived objectivity.

Models are a simplification of reality and their construction requires decisions be made about what aspects are included and excluded. The selection of model 'assumptions' is a political act because assumptions "shape the analysis results, the way problems are perceived, and the solutions that are considered" (Klosterman, 2012, p. 5). Yet despite their inherent political construction, models often remain perceived as 'correct' due to their apparent rationality and accuracy. Their perceived truth helps them become positioned as political technologies: "models are constructed to embody specific values and assumptions, and the partisan nature of those assumptions can then be "neutralised" through the ... perceived truth production capability of such models" (Henman, 2012, p. 163).

Recent planning literature has introduced new types of models and modeling discourses under the title Planning Support Systems (PSS). PSS models are designed to help planners explore, represent, visualize and ultimately understand planning matters, and to enable the construction of 'what-if' type scenarios with stakeholders. Definitions of PSS vary (see Klosterman et al, 2005), but they have three core components: they address a specific planning task or problem, model the information relevant to informing planning issue, and transform the analysis and data into information (often through geo-visualisation) (Geertman and Stillwell, 2003; Brommelstroet et al, 2010).

PSS and other modeling literatures highlight the continued lack of adoption, use and influence of models in planning institutions (Waddell, 2011). This is referred to as the 'implementation gap'. The gap exists for number of reasons, including model complexity, a lack of awareness and interest, and the development of models on a technological rather than planning or political needs basis (Geertman and Stillwell, 2002; Uran, 2003; Vonk et al, 2007). Research examining how to address this implementation gap recommends that model developers attend to the social processes of model construction, remaining centred on end users' needs (Brommelstroet et al, 2010). Focussing on the end user requires improving the transparency of model operations, ensuring they maintain contact with real planning problems, and balancing simplicity of use, development and maintenance with the complexity of the issues being modelled (Geertman and Stillwell, 2004; Brommelstroet et al, 2010).

The above discussion draws attention to the technical content and issues of models, and the influence of the planning context on the use of this particular knowledge technology. Gudmundsson (2012) proposes a structure for analyzing the use and impact of knowledge technologies (such as PSS models) that emphasises technology content, the context of its application and the connections between the two. The remainder of this paper applies this framework. It outlines the context of the genesis of the Auckland Council's 'Capacity for Growth' models, describes their development and design, and finally aspects of the reaction to both the models' results and the models themselves.

Auckland's spatial plan and modelling 'capacity':

Auckland is New Zealand's largest urban area and is home to some 1.5 million residents. In November 2010 the eight regional, city and district councils were amalgamated into a Unitary Authority. Following the amalgamation, the Auckland Council produced its first spatial plan for all of Auckland. The plan includes a Development Strategy that details a possible normative land use future for the region at 2041. The land use continues and expands legacy planning visions, emphasising a quality compact urban form. Under the strategy the existing urban area, defined as all land with the 2010 metropolitan urban limit (MUL), will accommodate 60 to 70 per cent of future growth. This growth will be concentrated around town centres and corridors. 'Moderate' changes to large swathes of suburban Auckland are also envisaged. Development outside the existing urban area, estimated to be between 30 to 40 per cent of future growth, will occur in stages through a rural urban boundary. Additional rural development, such as within coastal villages, is also foreseen (Auckland Council, 2012).

With the completion of the spatial plan, Auckland Council is now focused on its implementation. The priority is the replacement of the existing operative district and regional land use plans with a single Unitary Plan. The Unitary Plan will be the region's planning rule book, describing the types, locations and levels of possible residential and non residential development. While the objectives of the Unitary Plan are many and varied, two issues dominate. Firstly the plan should, through its zoning provisions, enabled a future land use commensurate with the Development Strategy. Secondly it must encourage the supply of residential housing. Both objectives relate to land.

Policies and directives on measuring and monitoring Auckland's land supply and development capacity have existed since at least 1999, and are included in the Auckland and Unitary Plans. The continued inclusion of these policies arises, in part, because of concerns about the effect of legacy land use policies (in particular the metropolitan urban limit) on housing affordability. Nick Smith, the current housing minister, recently described his desire to smash the limit which was, in his view "killing the dreams of Aucklanders by driving up house prices" (New Zealand Herald, 2013).

The Auckland Plan requires an "average of seven years of unconstrained development capacity" (Auckland Council, 2012, p. 50). Unconstrained capacity is defined as land with an operative zoning and serviced with bulk infrastructure. The proposed Unitary Plan includes a regional policy objective that is to ensure "sufficient supply of land and development capacity to enable urban growth" (Auckland Council, 2012, p. 9). To support this objective, the policy of the draft Unitary Plan is to ensure that there is twenty years' planned forward supply of urban development capacity at all times. The practical effect of this policy occurs through zoning provisions; planning is seen as *enabling* development by putting rules and frameworks in place for others to work within – should they choose to do so.

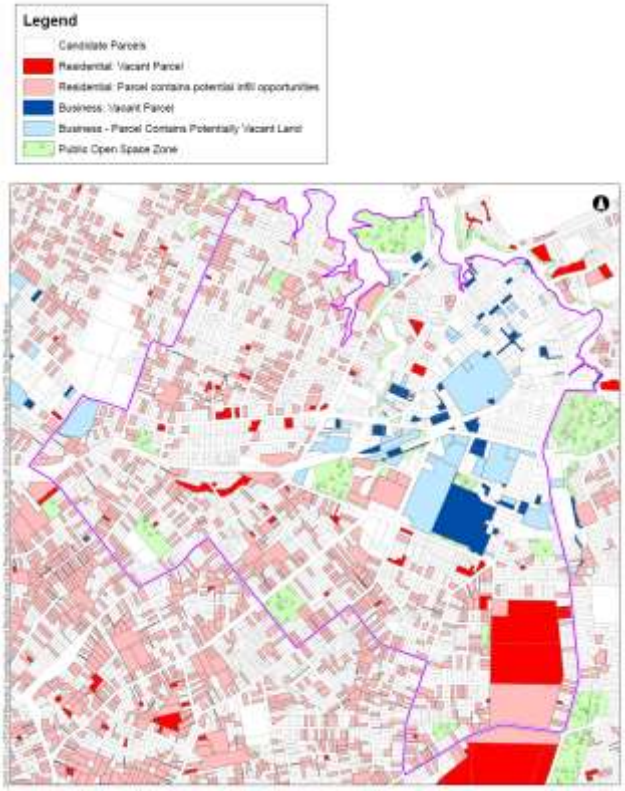
Given the political interest and policy prominence of housing, land and capacity, Auckland Council identified a need to understand the relationships between its zoning decisions, land supply and development. The Council developed two bespoke PSS models in collaboration with Critchlow Ltd, as part of its Capacity for Growth Study (CfGS hereafter). The first model was built using the 2012 operative planning rules, the second using the Notified Unitary Plan (previous studies had been undertaken by the Auckland Regional Council in 1996, 2001 and 2006). The models[1] measure development capacity on all urban parcels and rural titles in the region by combining corporate geospatial data sets with either March 2012 operative planning rules or Notified Unitary Plan rules, to calculate potential additional development. Through a series of geometric queries on all residentially zoned parcels, the models indicate whether each site is vacant and how many additional residential dwellings can occur through infill[2] or redevelopment[3]. For land zoned for business purposes (e.g. town centres) both models create a volume of floor area that is disaggregated into residential and non residential proportions; the residential component is then divided by a standard dwelling size to derive a quantum of residential units (see Fredrickson and Balderston 2013a and 2013b for additional

[1] In April 2013, the model won the Association of Local Government Information Managers (ALGIM) GIS project of the year award and was recently shortlisted for the ALGIM innovation of the year award and SOLGM Local Government Excellence Awards.
[2] Infill is development is where the property remains on site and development occurs around it.
[3] Redevelopment involves the removal of the dwelling and the site. The land area is then divided by the minimum lot sizes generating a development yield.

detail). The model utilising the unitary plan rules has become further advanced, and now includes 3-D building envelopes for all land in town centres and business areas.

The models are calculating potential supply. They act as a census of land and development capacity, allowing the Auckland Council to determine whether its strategy and policy goals are able to be met. The models include the three key components of a PSS. They address a specific planning issue, the amount of development capacity within Auckland. The models' design and architecture allow for the development and testing of scenarios through the inclusion of amenable modelling variables; subdivision parameters such as minimum lot sizes, setbacks and driveway widths are replaceable with alternate rules to determine the relative differences in development capacity. The outputs are highly visual and are able to be incorporated into GIS through linking with the corporate cadastral dataset. This allows for spatial analytical questioning, such as how much capacity exists either side of certain classes or types of infrastructure.

Figure one: example residential capacity model output for New Lynn suburb



Source: Fredrickson and Balderston, 2013b

A draft working report was circulated amongst internal staff to facilitate discussion and debate about the study in November 2012. The report included a series of preliminary results along with examples of how the results could be used, and the model amended, to support planning decisions and answer policy questions (see Fredrickson and Balderston, 2012 pages 17 to 20). The model developers received feedback from staff and management, and some minor changes were made to the model design. Council planning staff checked and confirmed the modelling assumptions. The model was then re-run and two technical reports were released in March and April 2013[4]. The methodology and assumptions reports were released in March, followed by a results report in April that provided the full set of results, including maps and capacity figures for the whole region.

Capacity and the politics of calculation:

Immediately prior to the release of the results, the Ministry of Business, Innovation and Employment (MBIE) released its own report on Auckland's land supply situation. This report concluded that the

[4] The model for the Notified Unitary Plan remains under development.

region had sufficient greenfield land to provide for 15,000 residential dwellings, while also stating that the Council was short of achieving its land supply target. Citing the October 2012 working report, the Government's analysis concluded that even if all modelled redevelopment capacity was built (227,000 dwellings), this would be less than the Development Strategy objective for the urban area (242,000)[5]. There was considerable debate amongst Council staff concerning how the study results, in particular the 15,000 greenfield sections, aligned with those presented in the MBIE report. This was fostered by debate over the issue of section 'availability' within the media; according to some, Council officials had not undertaken a rigorous analysis of the state of land supply (New Zealand Herald, 2013b; National Business Review, 2013a). The decision was made to include a specific section on greenfield land in the results report.

The results produced immediate media interest, driven in part by an Auckland Councillor who argued that the results report was useless and inaccurate: "blunders have been made in the Otara-Papatoetoe Ward where the Middlemore/Auckland Golf Course, the Grange Golf Course, De La Salle College and large church grounds have all been included as land marked for intensive housing development" (Quax, 2013). The National Business Review, a high profile and right wing newspaper, also commented on the study. Under the provocative headline "Len Brown's bulldozer line up Graeme Hart's mansion and old peoples' homes", the paper noted that "golf clubs, parks, old peoples' homes and the home of New Zealand's richest man are among the sites earmarked for infill housing in a new Auckland Council report" (NBR, 2013b). Earlier in 2013 the paper had been highly critical of New Zealand city mayors, stating that Len Brown has a "penchant to overstate the availability of residential sections ready for purchase" (NBR, 2013a).

The criticisms were enabled by the visual outputs of the models. Both models allow for the comparable measurement and comparison of all land (i.e. a score for possible development enabled under the appropriate planning provisions). The homogenized perspective was in fact a re-visioning of Auckland's cadastral pattern that challenged certain views. Many accepted that vacant residentially zoned land was an underutilised resource, yet land with a different use (e.g. education) but the same underlying zoning, was not seen as 'capacity'. The model outputs standardised a certain way of thinking about land which could be, challenged, reified, and thus given a life of its own.

The criticisms also highlight contestation over the models outputs that can be framed as a debate over calculation. The earlier critiques imply a particular framing of capacity, in which certain land types and uses are immutable and should not therefore be counted. Yet evidence suggests that these unchangeable land uses are indeed alterable: Fletcher Residential and Ross Reid Contractors have acquired the Manukau Golf Club for in an estimated $32 million dollars (New Zealand Herald, 2011), the Ministry of Education has a building and land disposal program in Auckland, and Auckland's most central camping ground has been sold to developers in response to high rating increases (see figure two). Indeed such change is at the core of the Auckland Plan. In order to accommodate 70 per cent of growth within the existing urban area, all locations will have to undergo change, and some more than others.

[5] If the study had used the April 2013 results, it would have concluded that there was sufficient capacity to meet the growth targets for the urban area as per the Development Strategy..

Figure two: Immutable land uses for sale

Metro

City camping options shrink again

Just 7km from CBD, Remuera lodge and tent site facility sold by family company as land values, rates soar

Source: New Zealand Herald

A different interpretation of the study results was put forward by SD4, a private consultancy commissioned by the Property Council to review the project. SD4 concluded that the study "assumes all potential development sites will be developed to 100% of its maximum potential, whereas the CfGS12 should have allowed for: the likely capacity utilization of property owners who choose to redevelop" (SD4, 2012, p. 1). The reported concluded that Auckland Council "needs to urgently engage [a fine grained analysis] on all of the areas covered by the CfGS 2012" (SD4, 2012, p. 1).

These comments contrast with The Transport Blog, one of the New Zealand's most widely read blogs on transport and planning issues, which stated that:

"The results report emphasises that the purpose of the project is not to analyse the likelihood of redevelopment occurring, but rather to give us an idea of what development potential exists in different parts of Auckland *if* sites were to be developed to their potential. The study also assumes that development will comply with the development controls (like height, driveway widths etc.) and only the lowest level of resource consent for an activity is used (i.e. densities that are permitted activities or whatever the easiest consent to get is if nothing is permitted)".

The SD4 criticism was misplaced as any analysis of uptake would have to commence with a sound understanding of the current supply situation. Indeed the results report addressed this issue specifically. The study measured capacity enabled under the plan and "does not examine the likelihood or feasibility of its uptake" (Fredrickson and Balderston, 2013b, p. 1). Future work to examine these, and other issues, was outlined under section 12.0 Recommendations for Future Work.

Debates about capacity 'uptake' also occurred as part of the working report and sign off on the results report. In both circumstances the capacity results were discussed as being 'theoretical', rather than capacity that was 'plan enabled' which, as stated earlier, is consistent with the framing of land use zoning regulations in New Zealand under the Resource Management Act. The basic premise was that any identified capacity that was not 'likely' to be built upon should not count as part of the measurement towards Auckland's plan and strategy targets. Capacity therefore was not seen as a latent feature of land, enabled through land use zoning, as many planning staff conceptualise it. Rather, as the SD4 criticisms suggest, to be real, capacity had to be (or be likely to be) consumed.

The criticisms raised a number of issues with ramifications for planning staff. The fact that some schools did not have an education designation, which meant they were counted as having residential development capacity, highlighted the different treatments legacy Councils applied to some land uses. Given that the Council is attempting to shift to a standardised view on zoning (where possible), the results questioned the extent to which this situation should continue. The draft Unitary Plan now includes designations on all public school zones, meaning that they are no longer counted as having capacity in new iterations of the model. These criticisms also impacted on plans for future research; the project now includes another phase focussing on the role of constraints in relation to development

feasibility, and has prompted a research project on long-term vacant residential land and land owner intentions.

Conclusion:

Auckland Council's Capacity for Growth Study involved the development of two bespoke PSS models to provide a tool for planning staff to understand how their work might emerge 'on the ground', and to answer a specific land use policy question. The study results emerged within the context of significant regional and national debate about the relationships between planning, land supply and housing affordability. This debate has continued and a series of central government legislative changes are underway. These include a new principle in part 6 of the Resource Management Act (1991) regarding the availability of land to support population growth and changes in urban development demand; Councils must ensure adequate land supply to provide for at least 10 years of projected growth. The study generated a significant level of public interest, focussed on the models, the assumptions upon which they were constructed and on issues of calculation. What then are some lessons that PSS model developers can take from this experience?

Firstly, the case study illustrates that PSS models, and indeed all knowledge technologies, will not appear, emerge or be understood the same way for all individuals (Green, 2012). It should not be assumed that the 'best' PSS model (one that is aligned with planning needs) will be understandable, transparent, of appropriate scale and resolution, and collaboratively designed. Nor will it automatically address the 'implementation gap' or be 'welcomed' by decision makers. The comments of the Auckland councillor suggest that the level of alignment between the world view of the user (in this case a decision maker) and the assumptions upon which the models were built, has an impact on the amount of buy-in for the models and their subsequent use. The case study illustrates that 'transparency' can foster new forms and sites of dispute. Opening up the black box is necessary not only to allow others to understand what assumptions are used and how, but also to dissolve the boundaries between models and planning, and those between instrumental rationalism and 'rational' action.

The case study illustrates how models become contestable political technologies. There was considerable debate about the truth of the capacity being measured; the visual nature of the outputs made it readily suited to being co-opted into politics. The case study highlights the significant relationship between numbers and politics, a critical consideration for planning and other disciplines (Crampton and Elden, 2006), and the capacity of stakeholders to redefine 'truth' in planning models. The study shows how PSS may be used in politics to construct a partisan point of view which has as much to do with "the politics of the moment" (Jacobs and Lees, 2013, p. 1577) as it does with the construction of a PSS. The decision to undertake analysis of greenfield capacity and include it in the results report is an example of this.

Lastly, the study highlights that PSS operate in volatile environments characterised by a plethora of agents, perspectives and agendas, which creates opportunities for the PSS developer. Majone (1989, cited in Wolfe, 2004) argues that 'evidence', "is information selected from the available stock and introduced at a specific point in the argument in order to persuade a particular audience of the truth or falsity of a statement" (p. 66). The criticisms of the operative planning capacity assessment have influenced subsequent analysis and modelling. The reporting of the Notified Unitary Plan capacity will include results on 'realistic short term' capacity (capacity which may be absorbed within seven years), rather than pursuing a land census approach. Therefore rather than assuming that PSS will be unproblematically used as part of any evidence base, PSS developers need to look openly and carefully at the argument, audience and the politics within which their model will be developed and implemented in order to facilitate the model's use in planning. PSS developers must see themselves as political actors, with opportunities to set, frame and reframe political agendas and policy debates.

References:

Auckland Council (2012) *The Auckland Plan Addendum.*

Auckland Regional Council (1999) *The Auckland Regional Policy Statement*.

Briassoulis, H. (2008) Land-use policy and planning, theorizing, and modeling: lost in translation, found in complexity? *Environment and Planning B: Planning and Design*, vol. 35, pages 16 – 33.

Brommelstroet, T. M., and Schrijnen, M. P., (2010) From planning support systems to mediated planning support: a structured dialogue to overcome the implementation gap, *Environment and Planning B: Planning and Design*, vol. 37, pages 3 – 20.

Couclelis, H. (2005) ``Where has the future gone?'' Rethinking the role of integrated land-use models in spatial planning, *Environment and Planning A*, vol. 37, pages 1353 – 1371.

Crampton, J., and Elden, S. (2006) Space, politics, calculation: an introduction, *Social and Cultural Geography*, vol. 7, pages 681 – 685.

Flyvjberg, B. (1998) *Rationality and Power: Democracy in Practice,* The University of Chicago Press, Chicago.

Fredrickson, C., and Balderston, K. (2012). *Capacity for Growth Study 2012 Working Report*, Auckland Council, WR2012/006.

Fredrickson, C., and Balderston, K. (2013a) *Capacity for growth study 2012: methodology and assumptions*, Auckland Council, TR2013/009.

Fredrickson, C., and Balderston, K. (2013b) *Capacity for growth study 2012: results*, Auckland Council, TR2013/10.

Geertman, S. and Stillwell, J. (2003) Planning Support Systems: An Introduction, in Geertman, S. and Stillwell, J. (eds) *Planning Support Systems in Practice*, Springer, pages 3 – 10.

Geertman, S. and Stillwell, J. (2004) Planning support systems: an inventory of current practice, *Computers, Environment and Urban Systems*, vol. 28 pages 291 – 310.

Green, N. (2012) A policymaker's puzzle, or how to cross the boundary from agent-based model to land-use modelling, *Transactions of the Institute of British Geographers*. vol. 38, pages 1 – 5.

Gudmendsson, H (2011) Analysing Models as a Knowledge Technology in Transport Planning, *Transport Reviews,* vol. 31, pages 145 – 159.

Gunder, M. (2008) Ideologies of Certainty in a Risky Reality: Beyond the Hauntology of Planning, *Planning Theory,* vol. 7, pages 186 – 206.

Henman, S. (2002) Computer Modeling and the Politics of Greenhouse Gas Policy in Australia, *Social Science Computer Review*, vol. 20, pages 161 – 173.

Hillier, J. (1995) The unwritten law of planning theory: Common sense, *Journal of Planning Education and Research*, vol. 14, pages 292 – 296.

Hoppe, R. (1999) Policy analysis, science and politics: from 'speaking truth to power' to 'making sense together', *Science and Public Policy,* vol. 26, pages 201 – 210.

Innes, J. (1998) Information in Communicative Planning, *APA Journal,* vol. 64, pages 52 – 63.

Jacobs, J., and Lees, L. (2013) Defensible Space on the Move: Revisiting the Urban Geography of Alice Coleman, *International Journal of Urban and Regional Research*, vol. 37.5, pages 1559 – 83.

Kitchen, R., Gleeson, J., and Dodge, M. (2012) Unfolding mapping practices: a new epistemology for cartography, *Transactions of the Institute of British Geographers,* vol. X, pages 1 – 17.
Klosterman, R. (2012) Simple and Complex models, *Environment and Planning B: Planning and Design*, vol. 39, pages 1 – 6.

Klosterman, T. and Pettit, C. (2005) An update on planning support systems, *Environment and Planning B: Planning and Design*, vol. 32, pages 477 – 484.

Legg, S. (2006) Governmentality, congestion and calculation in colonial Delhi, *Social and Cultural Geography*, vol. 7, pages 709 – 729.

The National Business Review (2013a), *Mayors vastly overstate house section availability*.

The National Business Review (2013b), *Len Brown's bulldozers line up Graeme Hart's mansion and old peoples' home.*

New Zealand Herald (2011), *Courses set for homes not golf,* January 15th, 2011.

New Zealand Herald (2013a), *Minister vows to smash Auckland city limits,* March 7th, 2013.

New Zealand Herald (2013b) *Mayor does u-turn on available housing land*, March 12th, 2013

New Zealand Herald (2013b), *Govt targets land bank 'super profits',* June 27th, 2013.

Quax, D. (2013) Blunders make Councils land capacity report useless, from http://www.scoop.co.nz/stories/PO1304/S00334/blunders-make-councils-land-capacity-report-useless.htm

Rutledge, D. T., Cameron, M., Elliott, S., Fenton, T., Huser, B., McBride, G., McDonald, G., O'Connor, M., Phyn, D., Poot, J., Price, R., Scrimgeour, F., Small, B., Tait, A., van Delden, H., Wedderburn, M.E., and Woods, R.A., (2008) Choosing Regional Futures: Challenges and choices in building integrated models to support long-term regional planning in New Zealand, in *Regional Science Policy & Practice*, vol. 1, pages 85 – 108.

SD4, *Review of Auckland Council's "Capacity for Growth Study 2012"*, accessed 26 August 2013 from http://www.scribd.com/doc/145768406/SD4-Review-of-AC-Capacity-Report-23-04-2013

Transport Blog, *How much upzoning does the unitary plan really enable and is that much likely?* accessed 24 August 2013 from **http://transportblog.co.nz/2013/04/16/how-much-upzoning-does-the-unitary-plan-really-enable/**

Uran, O., and Janssen, R., (2003) Why are spatial decision support systems not used? Some experiences from the Netherlands, *Computers, Environment and Urban Systems*, vol. 27, pages 511–526.

Verburgm P. H., Schot, P. P., Gijst, M. J., and Veldhamp, A, (2004) Land use change modelling: current practice and research priorities, *GeoJournal*, vol. 61, pages 309 – 324.

Vonk, G., Geertman, S., and Schot, P. (2005) Bottlenecks blocking widespread usage of planning support systems, *Environment and Planning A*, vol. 37, pages 909 – 924.

Vonk, G., Geertman, S., and Schot, P. (2007) A SWOT analysis of planning support systems, *Environment and Planning A*, vol. 39, pages 1699 – 1714.

Waddell, P. (2011) Integrated Land Use and Transportation Planning and Modelling: Addressing Challenges in Research and Practice, Transport *Reviews: A Transnational Transdisciplinary Journal,* vol. 31, pages 209 – 229.

Wolf, A. (2004) Research Strategies for Policy Relevance, Social Policy Journal of New Zealand, vol. 23, pages 65 – 85.