ACKNOWLEDGING COMPLEXITY AND CONTINUOUS URBAN CHANGE

Ulysses Sengupta and Eric Cheung

Current practices of urban planning and spatial design have shown an inability to cope adequately with, and successfully intervene in the complex spatio-temporal nature of our cities. With current trends of urbanisation indicating increasing speed of change, the European Urban Summer School event was an opportunity to engage young planners with complex systems and digital tool based approaches aimed at the growing necessity to address temporal and morphological urban systems. Non-deterministic computational modelling techniques simulating complex urban territories in states of rapid change provide the potential to observe, comprehend and test the relative possibilities of spatial and policy based interventions while working with unknown futures and trans-scalar influences (Sengupta, U. 2011). In order to situate spatial design methodologies within current discourses in planning theory, the wide existing gap between theory and practice in urban planning, i.e. between rationale spatial implementation and communicative theoretical intention, must be addressed (De Roo et al. 2012). We believe the potential for bringing spatial and social issues back together, and thus addressing the space of action, lies in the ability to understand the forward projected impact of political, spatial and regulatory interventions on the identifiable trajectories and trends of existing socio-spatial evolutionary conditions.

MULTIPLE FUTURES AND DIAGRAMMING COMPLEX RELATIONSHIPS

The conceptual framework for urban change over time if based on evolutionary theory (Weinstock 2010), requires that one accepts the idea of a singular, fixed or predictable future as a fallacy. If things are constantly changing, and this includes emergent complex behaviours, and the possibility of new or external influences, then it follows that new futures based on tangents to existing directions of change are potentially created at every moment. The idea of working with multiplicity, complexity and change over time can be illustrated in a simple diagram (Figure 01), where the point of intervention on the timeline, and the type of intervention are subject to change and testing based on projections into the future. The diagram below was originally produced as a teaching aid for architecture students at the University of Nottingham, and subsequently reused for the EUSS young planners hosted by the University of Westminster in London.

The principle of working with multiple trajectories and identified social, spatial, economic, political and environmental issues remained important to the tutor group of young planning students with whom we worked directly for the remainder of the summer school. Instead of prioritising a preferred or singular future vision and aiming to take actions towards this singular

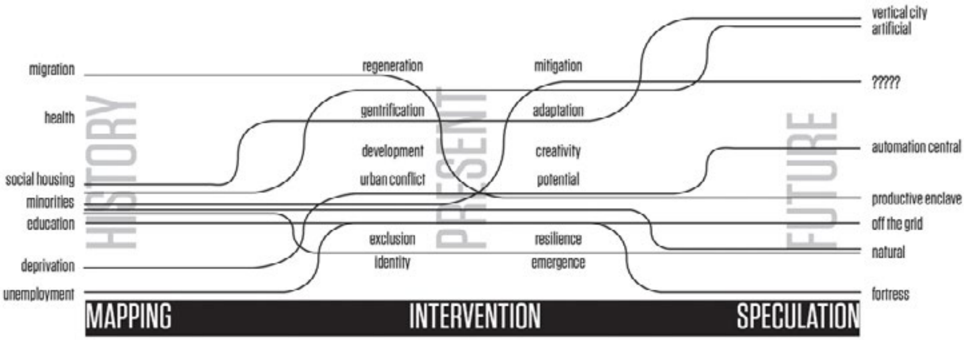

Figure 6-3 This figure illustrates the idea of considering multiple urban futures as part of change over time. Source: Ulysses Sengupta.

goal, or helplessly ignoring the larger issues in favour of small scale interventions with limited transcalar effects, the idea of multiplicity and complex overlapping relationships was further explored through a new diagramming exercise which the students developed in conjunction with us. They called this network graph diagram the SAG (ScarcityActionGoal) tool, and used it to illustrate the networked and looped nature of scarcities, actions and goals (an expansion of SAG), including the impossibility of predicting pure causal relationships by transversing the network both forwards and backwards from scarcities through actions to goals and vice versa (see Figure 6-4, Figure 6-5, Figure 6-6 and Figure 6-7).

The 'scarcity-action-goals' diagram tool created by students for the 2012 European Urban Summer School demonstrates the potential of a network graph diagram where the key issues identified by students are classified in terms of the situation (scarcity) of Bromley-By-Bow, possible actions, and intended outcome. When these are drawn up in a diagrammatic form, we can start to understand and revisit each of the issues and find its relationships within the network by traversing the connections. The main advantage of using such a diagram is to allow one to identify and communicate the key components and possible process of a system that can be readjusted by discussion and negotiation between stakeholders, thus adjusting the diagram and network to incorporate new information and lose out of date aspects, both before and during the actual processes of implementation.

COMMUNICATING SPACE TIME DEPENDENCY: PLAY SIMCITY

The initial condition that must be acknowledged for any planning implementation to take effect is change. However, it is essential to consider change as an on-going process over time with or without the intervention of planners, designers or governance. Too often, planners and spatial designers tend to work from the position of someone who believes it is their job to initiate urban change, and we would like to deconstruct this notion, by introducing the idea that urban change is both inevitable and continuous. Here continuous does not refer to any continuity of speed or constancy, but rather to the idea that 'change' itself is on-going. Hence, the idea of intervening

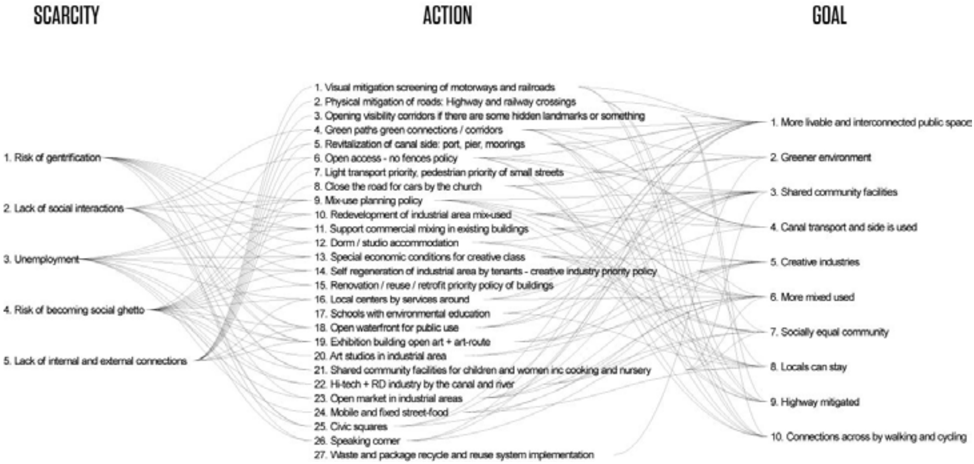

Figure 6-4 Network graph of identified scarcities/risks, potential actions and ideal goals. Source: Ulysses Sengupta, Eric Cheung.

within a stable system or situation must be rethought to engage with the possibilities of working with constant spatial change and multiple tipping points leading to new systems (Holling 1996).

In order to communicate the idea of spatiality as a morphological phenomenon to a generation of young planners educated on a diet of transactive, advocacy, bargaining and communicative planning methods, focused on socio-economic aspects rather than socio-spatial relationships, we thought it useful to run a live exercise in which the computer and console video game SimCity 4 would be used to design, sustain and grow a small city. SimCity is an open ended game in which the player is asked to take the role of the mayor or master-planner whose responsibility it is to initiate, grow and maintain a visually represented city. The first version of the game was published in 1989 and designed by Will Wright. The game works on the basis of controlled top-down interventions by the player, such as housing, factories, schools, roads and services, becoming part of a complex causal network within the virtual city environment, where demands for meeting the requirements of the residents of the city evolve over time based on phenomena such as industrial pollution creating lower living conditions, lack of higher education resulting in a lower skills labour market etc. As the mayor of the city, it is the player's responsibility to keep residents happy, to generate income through taxation and to use this income to intervene with new and additional functions and services, attracting more people, and hence growing the population of the city and the space of the city itself over time.

During gameplay, which took place on screen with audience participation from the EUSS students, in the form of suggestions for interventions, the discussed controllable aspects of the game were the possibility to add housing, schools, power generation, road networks, sewage networks etc. to the city that had grown. However, what was emphasised was the ability to influence these and other specific parameters through particular actions without having any direct control over other changing aspects such as population demographics, industrial pollution, migration, happiness of residents and/or any control over the whole situation/system. Another aspect that was clearly identified was the fact that the various changeable, influenceable and uncontrollable

Figure 6-5 Transversing the risk of gentrification through mediating actions to ideal goals. Source: Ulysses Sengupta, Eric Cheung.

aspects of the game actually worked on the basis of a complex network of interdependencies (as seen with the SAG network graph developed by the students subsequently), which created a non-linear experience. Without these interdependencies, the game would have been linear with a set of right and wrong decisions at every stage.

DEVELOPING NEW TOOLS FOR BROMLEY-BY-BOW

In order to demonstrate the possibility of direct spatial engagement with Bromley-by-Bow, following the conceptual discussions above, a simplified digital tool, called the BBB Generator, which was developed specifically for the EUSS, was unveiled. This tool allows the translation and exploration of limited (see control layers below) policy and governance decisions regarding density, height, mix of uses etc. into a virtual 3D environment. The base map or starting point of the BBB Generator tool reflects the existing networks and urban topography in Bromley-by-Bow, creating a starting point where the primary structural elements such as roads and railway lines provide a basic grounded pattern from which to work. The logic behind this is that these elements are less likely to change quickly in this context than the buildings and urban spaces. This tool is simpler than SimCity in terms of the interdependencies defined and number of elements available. It allows a greater degree of spatial relation to the actual site conditions as it is not based on a regular underlying grid like SimCity, but instead on a closer representation of the existing urban parcellation of Bromley-by-Bow, with buildings and spaces defined to work with these realistic constraints. While there are some overlapping parameters such as the height, plot ratio and plot size, uncontrolled change was not built into the model. Hence, the functionality of the model is aimed at the idea of working with intuitive decisions that affect spatiality, through visual understanding of projected future scenarios. Additional examples shown to the students such as previous work with Cellular Automata, agent based systems and complex adaptive systems, were used to demonstrate and emphasise how more complex relationships and systems would function as models, following multi-scalar studies of specific urban topographies (but these remain outside

Figure 6-6 Transversing the goal of new pedestrian and cycling connections backwards through possible related actions and effected risks/scarcities. Source: Ulysses Sengupta, Eric Cheung.

the scope of this article). The functionality, parameters, controllable elements and underlying logic of the BBB Generator are discussed below.

TYPES AS PARAMETERS

Existing common and likely building typologies are defined through a study of the existing urban topography and recent changes, resulting in the tool being based around four primary 'types' of urban object, where a type is a basic genetic form which can adapt or react to the environmental conditions it is placed in, making it more flexible than the more strictly defined typologies:

1. Houses (terraces, semi-detached or detached)
2. Courtyard/perimeter blocks
3. Low rise/industrial/warehouse blocks
4. Tower/slab blocks

USER CONTROL

The user controls provided consist of four basic colour and value maps which can be changed easily using common software such as Photoshop, reflecting the possibility of changing control parameters and constraints on development in a similar manner to changing planning policies. The resultant change from all the overlapping maps is displayed in a 3D visual output model. The four maps allow the user to control the aspects listed below. (SeeFigure 6 8)

1. Function (residential vs. commercial vs. open green/space)
2. Plot Area (relative size of plots)
3. Height limit (number of storeys)
4. Plot Ratio (height to footprint)

TOOL DEVELOPMENT FOR BROMLEY-BY-BOW

The process of using the BBB Generator to visualise projected futures (25 years?) of Bromley-by-

Figure 6-7 Transversing the action of introducing a new speakers corner through the potential scarcities effected and goals contributed to. Source: Ulysses Sengupta, Eric Cheung.

Bow can be described as a series of algorithmic design stages, including the choice and data taken into the model, and the process applied to this data. The final output of the tool is both visual and statistical, providing a read out of the actual available floor areas etc. once the model based on intuitive decisions is generated.

1 Base Map: Bromley-by-Bow was studied using maps, aerial and street level photographs in order to create a base layer which is split into urban blocks by inputting all observable major boundaries such as roads or railways, with defined widths.
2 Plot Divisions: For each block a similar plot division operation to the Ersi City Engine's (Parish & Müller 2001) procedural generation of parcels by recursive oriented bounding box method is used. The main difference is that instead of using bounding boxes, the closest point in the polygonal boundary (parcels) is used and is re-evaluated at a defined step distance, iterated until it splits the bounding polygon. This is yet to be validated but the aim is to allow more control and adaptation to n-sided irregular parcels found in London. This is a recursive process, it repeats until it reaches a threshold controlled by the user inputs acquired from the plot sizes/areas maps.
3 Building Types and Heights: The plots are then assigned a building type based on the control map for function. The image map colour red, green, blue translates to residential, green and non-residential respectively. A simple weighted random choice is implemented for gradients interpolated between the 3 base colours. A suitable building type is then placed as footprints into the plot by checks on available space. The control layer for height limit and plot ratio is used to determine the number of storeys of the building in relation to the building footprint. At this stage, a visual representation of the situation becomes possible (see Figure 6-9).
4 Report Generation: At the end of each generation, a report quantifying the total floor area produced and the total footprint area occupied by different functions and types can be generated as stack graphs with correlated aerial images and the control image maps for each execution. This provides feedback in the form of ratios of green area, open area, building

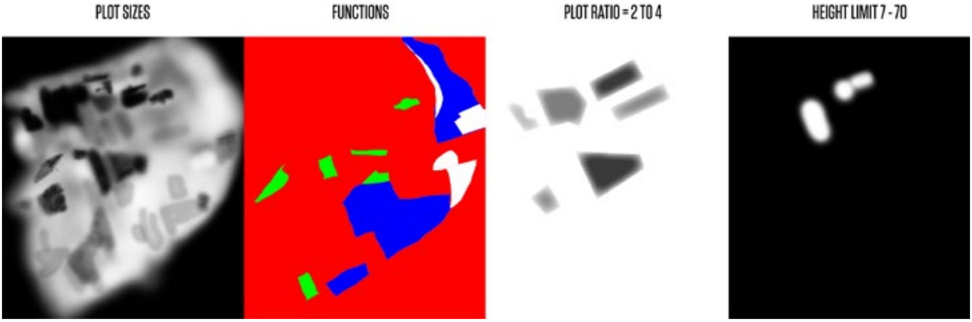

Figure 6-8 Underlying control maps allowing manipulation of spatial policy decisions. Source: Eric Cheung.

footprints area and building areas for housing etc. allowing a comparison between multiple projections/experiments (see Figure 6-10).

LIMITATIONS AND IMPROVEMENTS

In its current state, the BBB Generator is not a simulative urban model based on evolutionary behaviour and its functionality is limited to visualising the effect of specific changing parameters within a given context. We suggest it would be possible to make use of this functionality to roughly understand the potential impacts of policy decisions before they are made, if the definable policy/value layers correlate directly to decision categories of actual policy makers, enabling a direct visualisation of the spatial effect of policy decisions in the foreseeable future. However, it should not be mistaken for a design tool incorporating emergent or evolutionary behaviours.

CONCLUSION

Our ambitious attempt was to create common ground between current planning theory and planning practice, including spatial implementation. This task was undertaken through communication of how overlapping and trans-scalar issues might be approached in an open ended non-deterministic system, through an acknowledgement of the potentials embodied in existing urban situations and constant urban change. While the students had neither the time to learn, customise or use the presented simulative systems or the BBB Generator directly within the limited length of the summer school, we believe the development and use of the SAG tool by students is a positive indicator that the aim of communicating the need to work with change and with multi-polar and trans-scalar issues was achieved, as was the incidental idea that planners can create and work with custom made tools to work with different situations. We hope that this initial exposure to complex systems, new digital planning tools/methodologies and morphological processes will continue to reverberate within the future practice of our young EUSS planners.

References

Holling, C.S., 1996. Engineering resilience versus ecological resilience.Foundations of Ecological Resilience, pp.51–66.

Parish, Y.I. & Müller, P., 2001.Procedural modeling of cities.In Proceedings of the 28th annual conference on Computer graphics and interactive techniques. ACM, pp. 301–308.

Figure 6-9 Visual representation of Bromley by Bow using the BBB Generator. Source: Eric Cheung.

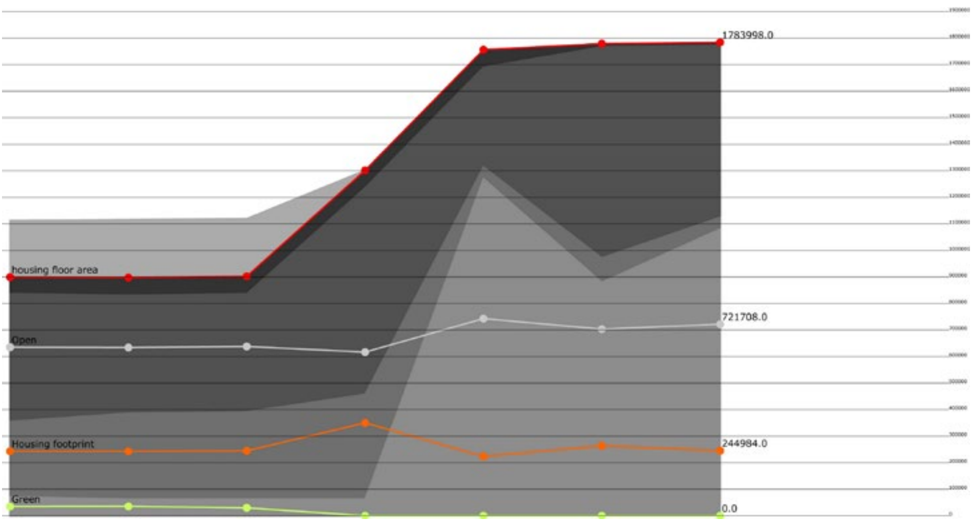

Figure 6-10 Stack graph demonstrating a comparison between seven experiments. Source: Eric Cheung.

De Roo, G., Hillier, J. & Van Wezemael, J., 2012.Complexity and Planning: Systems, Assemblages and Simulations, Ashgate Publishing.
Sengupta, U., 2011. Urban Morphology: Incorporating Complexity and Variation. In Urban change: the prospect of transformation. Wroclaw: UN-HABITAT & Wroclaw University of Technology, pp. 180–189.
Weinstock, M., 2010. The architecture of emergence: the evolution of form in nature and civilisation, Wiley.