

Space Syntax: a **SMART** approach to urban planning, design & governance

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1st July 2014

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The future of cities will be decided by answers to key urban policy questions. Where, and in what numbers, are people going to live, work and take leisure? What forms of movement will exist to connect people together? What flows of resources will need to occur - for example with energy, water and waste – to support human behaviour patterns and what impacts will these have on the natural environment? How will future places be funded and, ultimately, how will decisions be made to address each of these questions?

Rapid global urbanisation provides the opportunity to create striking, new forms of city living, supported by the proliferation of new “smart” technologies. Nevertheless, the delirious enthusiasm of architects and planners should be set against the sobering reality of recent urban history. From pedestrian precincts to cul de sacs and upper level walkways, many innovations in town planning and design have been launched with great optimism over the years, only to create blight in the form of massive social and economic cost. Past results matter greatly for the future planning of cities because professional failure creates public concern and this affects political confidence.

So, before beginning to create visions for novel urban futures, those responsible – the architects, planners and engineers as well as the policymakers and politicians – should first ask why past plans didn’t deliver what was intended. Why, in seeking social harmony, wealth and resilience have cities become divided, unequal and car-dependent?

There seem to be two key reasons for urbanism’s inability to accurately forecast the effects of its actions: first, the scarcity of real knowledge about how people behave in cities and what the impacts of these behaviour are on, for example: land use resilience, land value and safety. Second, the shortage of accurate and reliable forecasting tools to test plans in advance. Until recently it has been expensive and time-consuming to overcome these issues: teams of observers with clipboards have been costly; transcribing video has been a slow and intensive process; computational power has been inadequate and expertise limited.

However, the rise of the “smart” era has witnessed an explosion of data capture and analysis techniques, as well as the technology-literate operators trained to use them. The opportunity now exists for organisations, both public, private and community-based, to behave differently: to build databases of urban performance, analyse the patterns within these, then create future plans in a more robust manner. The prospect of a new *science for cities* is real: a new, evidence-informed and analytic approach to urban planning and design that might obviate, or at least reduce, uncertainty in future urban decision-making.

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Such an opportunity raises fundamental questions about what datasets should be collected and how these should then be analysed. Fundamentally, the ways in which built environment data is used must change. To put it simply, architects need to think at a broader scale than before, planners at a finer grain and both professions need tools that fit these purposes. Currently, architects use Building Information Modelling (BIM) systems that handle data at the building level. While BIM can stretch to small clusters of buildings, it does not usually allow buildings to be set in their wider urban contexts. As a result, the important influence of context on place is lost and too many buildings are designed in isolation, with obviously negative results once built: turning their backs to each other, or surrounding themselves with moats of landscaping.

Planners on the other hand tend to work from regional and city-wide scales down to local neighbourhood levels, where their engagement with urbanism stops. But this approach can prove too crude to provide an accurate picture of what is going on at the important human scale. Planners should be able to analyse data to inform decisions - such as transport plans or changing land values — at least down to the level of the individual street segment and ideally to the different buildings that make up the street level.

An integrated modelling system should allow all of the buildings to talk to each other, then all the blocks in a neighbourhood to talk with each other, then all the neighbourhoods within a district to talk to each other and so on. This would be an “Urban BIM”: an Urban Building Information Management System that links different professional working across multiple spatial scales.

But what does “talking to each other” actually mean? It certainly involves visualisation of data on a common platform. But it also means going beyond visualisation into data analysis, correlation and modelling. Too many conference presentations and media articles about so-called smart cities focus on - sometimes obsess about - the visualisation of data, creating dazzling maps and video clips, but often going no further. Captivating an audience is an important first step in raising awareness of the potentials of a data-driven approach; demonstrating that the data contains the intelligence to inform real urban changes is the next key step.

Urban modelling systems should deliver the full potential of recent technological change by not only visualising data but, more importantly, identifying patterns within those data and establishing correlational relationships between different datasets. After all, urban planning and design practice necessitates the simultaneous analysis and resolution of multiple, complex issues. Urban modelling should seek to serve these ends, being able, for example, to associate *input* decisions on spatial layout and land use allocation to *outcome* phenomena such as land value, movement, crime risk and carbon emissions. Urban modelling systems - based on algorithms that make sense of urban complexity - should equip architects, planners and stakeholders generally to properly weigh up the pros and cons of different options in delivering outcomes. In short, a *smarter* approach is required, one that lets users take a sequence of considered actions:

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Sense/Survey

Capture useful “urban performance” data such as the demographics of a particular place, location of different types of retail, types of employment and typical travel patterns as well as “urban form” data including spatial accessibility, topography, building location, capacity and condition.

Map

Spatially visualise that data. For example: develop maps that geolocate the various urban performance and urban form characteristics.

Analyse

Use statistical tools to search the data for patterns, associations and correlations such as links between observed pedestrian movement data and spatial accessibility levels. Factor in the land use attraction created by shops and transport nodes. Identify algorithms that make sense of the data.

React

Produce evidence-based policies, plans and detailed designs.

Test

Use algorithm-based predictive analytics to forecast the impacts of proposals in advance. For example, infer via a model simulation where residents are likely to want to travel to in the city and what sort of uptake there might be for a new bus route or cycle path. Use the results of these forecasts to discuss ideas with stakeholders, trying out different options for changing the area and reviewing how these would impact on the way the city works, in order to decide on which one would be most appropriate.

Once a particular option has been decided on and implemented, monitor how accurate the predictions were, in order to help refine and further develop the forecast models. In other words, repeat the SMART cycle through further sensing, mapping, analysis, reaction and testing.

For its own part, **Space Syntax** has pioneered the creation of SMART urban models for over 25 years, using the increasingly sophisticated capabilities of 2D and 3D digital platforms to produce ever more capable decision-making platforms. Much experience has been gained during this time in the methods and tools required to develop models that meet the needs of public, private and community organisations. These are models that can be used in a *strategic* mode to robustly test the wide-scale urban planning impacts of various options, but are sufficiently *detailed* to inform architectural and landscape design discussions at a later point in the process.

We have found that the sensing, mapping and analysis of datasets provokes an informed, science-based reaction among policy-makers, planners and designers. In a similar way, our experience is that stakeholders respond more positively to objectively tested proposals - that are evidence-based and supported by visualised analysis - than they do to instinctive, unsupported, opinion-based ideas.

Space Syntax's SMART approach to urban modelling equips local authorities with agile models of how urban areas work across a range of scales. These models are used to evaluate the likely impacts of planning and design proposals on local places as well as on the wider city. They work quickly to inform constructive discussions, which might otherwise degenerate into protracted and emotional conflict. This expedites evidence-based decisions, giving local authorities firm grounds, for example, to negotiate design changes with developers.

Our 25-year experience is itself based on a 40-year research programme at University College London, pioneered by Professor Bill Hillier. A close working relationship between consultancy and university brings deeply studied academic techniques into urban planning and building design practice. In return, the data and the learning from project applications is taken back into the rigorous research environment of a university setting. This two-way process is the **first** fundamental characteristic of Space Syntax's SMART approach: **continuous co-creation** – between academic researchers and professional practitioners for mutual benefit.

The **second** key feature of Space Syntax's methodology is its **focus on human outcomes** above data inputs. The approach is fundamentally concerned with the social, economic and environmental impacts of the planning and design process on people. In practice, this means collecting data on human behaviour patterns: movement patterns on foot, bicycle and in vehicles; standing, sitting and interaction patterns in streets and public spaces; as well as data on socio-economic demographics, crime and health patterns.

Third is a **focus on space**: Space Syntax has created an approach to spatial network analysis that uses the pattern of street connections as a “data framework” onto which other datasets are hung. We do this because we have discovered that spatial networks have fundamental influences on human behaviour. More connected places, for example, can generate higher movement flows, land values and social potentials. Disconnected places can suffer from social isolation and economic underperformance. We have found that it is **essential** to put spatial analysis at the heart of urban

modelling, not least because it is in space that people meet each other and through space that they move. Our experience from stakeholder discussions shows that people understand space intuitively and respond positively to spatial analysis because, it seems, we all “read” space naturally. Our clear conviction is that, without spatial network analysis, urban models are missing their most essential ingredient.

Modelling the impact of resource flows is a **fourth** key feature: the supply of energy and other utilities such as water and telecoms, as well as the handling of waste. Spatial network analysis is again powerful because many utilities are laid in line with street networks, both above and below ground. When urban planners set out a street pattern they are not only determining patterns of movement and human interaction but also the flows of resources that support those behaviours.

The city is the largest intended object of collective human creation and its interactions with the natural environment need to be analysed and understood with modelling. This relationship is handled by the **fifth** fundamental characteristic of Space Syntax SMART models, which connects spatial network analysis to environmental features. For example, sun path analysis is linked to spatial accessibility analysis to modify the overall attraction of a highly connected street if that street is in full sun and a highly shaded, if less direct, alternative is available. In a similar way, linked analyses can be used to optimise the layout of an urban grid by aligning the geometry of the street pattern to the angle of the prevailing breeze.

Together, these five fundamental characteristics define Space Syntax’s approach to the creation of *Integrated Urban Models* that help people make decisions to influence behaviour change towards more resilient, more sustainable ways of living. Built on open source code and increasingly moving to open data platforms, Space Syntax’s aim is to disseminate the approach into general urban practice - to share the benefits of a SMART approach to urban planning, design and governance that has been tried and tested for over a quarter of a century.

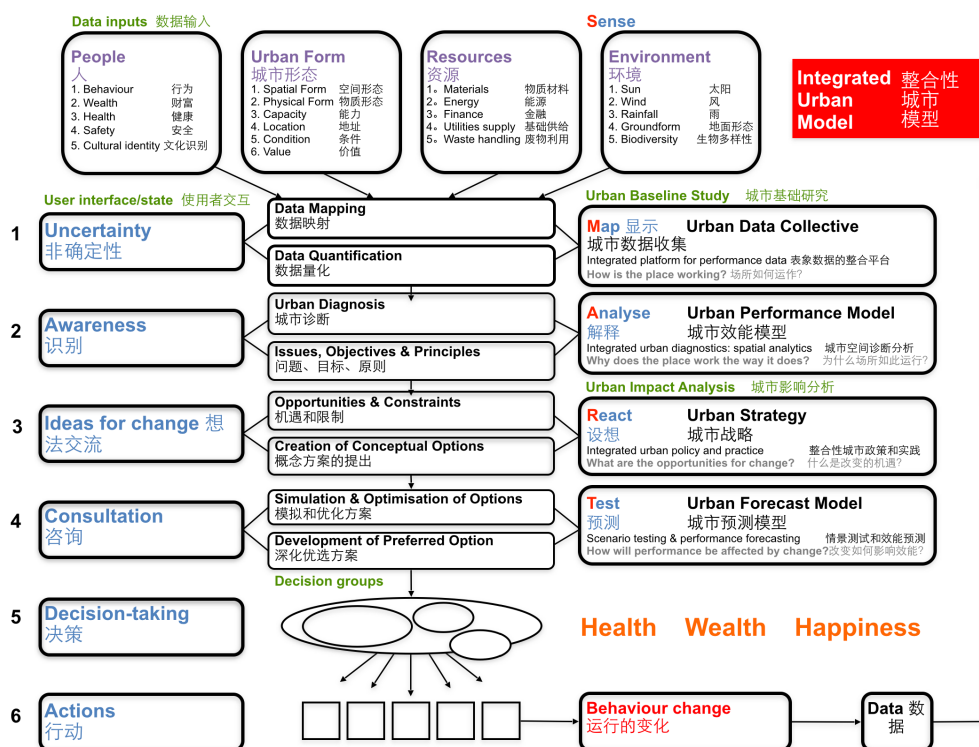
An Integrated Urban Model with PURE data inputs for a SMART approach to urban planning and design

PURE

People, Urban Form, Resources, Environment

SMART

Sense, Map, Analyse, React, Test



We believe that this approach sets a new standard for the planning and management of cities. Our experience shows that there is a demand for urban analytics, as the case study from Darwin demonstrates.

Case Study **Darwin City Centre**

In 2012 the City of Darwin secured a grant from the Commonwealth Government of Australia to produce a Masterplan for the City Centre of Darwin. The purpose of this plan is to provide a road map for development of the city for the next twenty years. To accommodate growth, the City Centre needs to be extended and reinforced. A key aim of the project was to facilitate private sector investment and population growth through the production of high quality public realm.

Space Syntax was asked to join a design team led by Steve Thorne of Design Urban. Our role was to provide comprehensive urban analysis and strategic design input to support the creation of the Masterplan.

Space Syntax provided an evidence-based platform for the creation of a spatial strategy. Our input had five work streams:

Urban Data Collective

Data related to Urban Form (e.g. land use, transport and spatial form) and Urban Performance (e.g. pedestrian and vehicle movement, land value) were collected and analysed using Space Syntax software.

Urban Performance Model

Associations between Urban Performance and Urban Form were analysed in order to provide an Urban Diagnosis from a number of perspectives; spatial, physical, economic and human behavioural.

Spatial Design Strategy

Opportunities and constraints analysis was undertaken using the Urban Performance Model to develop a Spatial Design Strategy. This strategy, including a set of design objectives and principles, has guided the development of the Masterplan design. Option testing using Spatial Accessibility Models played an essential role in the design development process not only to assess design outcomes quantitatively but also to generate new design ideas and options. Frequent and direct communications with the design team, including attendance at workshops in Darwin were key to maintaining a dynamic design process and ensuring an integration between the baseline analysis and the development of the Spatial Design Strategy.

Urban Forecast Model

Forecast models for pedestrian movement and for land value were constructed to quantitatively evaluate the impacts of the proposed designs. The outcomes provided useful indicators of the social and economic performance of the Masterplan.

Urban Design 3D Modelling

3D visualisation of the Masterplan in static and animated formats were created by Space Syntax and used in the stakeholder engagement process. Such visual representations of the Masterplan were effective in engaging the widest possible audience.



The outcome

Space Syntax's work has underpinned the creation of the Darwin City Centre Masterplan. Quantified indications of its social and economic impacts have facilitated meaningful discussions between different disciplines, bringing architects, transport engineers, planners and politicians together with a wide stakeholder base.

Client

City of Darwin, Northern Territory Government, Australian Government

Partners

Design Urban, Urbacity, Michels Warren Munday, Clouston Associates

Year

2013-14