

Institution: University College London
Unit of Assessment: 16 – Architecture, Built Environment and Planning
Title of case study: <i>Space Syntax: improving national and international urban environments</i>
<p>1. Summary of the impact</p> <p>This case study describes impacts arising from pioneering UCL space syntax research by Hillier, Penn et al, funded principally by the EPSRC. Impacts have been achieved particularly through the establishment and subsequent activities of a technology transfer spin-out company, Space Syntax Limited (SSLtd), which works closely with UCL researchers to provide strategic, evidence-based consulting services in architectural and urban design, planning, transport and property development. Since 2008, SSLtd has informed the development of 147 projects in the UK and 73 projects abroad. The impacts of these projects, along with over 400 others undertaken before 2008, include significant and measurable economic, social and environmental improvement to urban environments in the UK and internationally, with important follow-on impacts on the quality of citizens' lives.</p>
<p>2. Underpinning research</p> <p>Space syntax, which was pioneered between the mid-1970s and 1990s by Professor Bill Hillier and colleagues at UCL's Bartlett School of Architecture, is a human-focused theory based on empirical observations and methods for representing and measuring the pattern properties of built space. It allows the treatment of spatial configuration as a variable in the analysis of the socio-economic function, cultural significance and behavioural implications of spatial design. This includes patterns of movement, awareness and interaction; density, land use and land value; urban growth and societal differentiation; and safety and crime distribution, whether in contemporary or historical contexts. To the degree that analysis of spatial configuration can account for observed functional or behavioural outcomes, these theories can be used predictively to assess likely functional behaviour and early-stage design options, and thus inform strategic design.</p> <p>The relationship between the Space Group in UCL and SSLtd is intimate. Theories and analytical methods developed in the lab are tested against data provided by live projects in the company. These live projects give rise to questions that challenge theory, regularly testing theory by finding anomalies that need to be accounted for. This then drives innovation in both theory and method. All the while the applications are those that clients are prepared to pay and provide data for since they matter to their business, while various UK Research Councils have recognised the scientific value that this brings, by giving continuous support to space syntax research since the 1980s.</p> <p>This case study focuses on those aspects of the research relevant to two examples of impact: the design of well used public open space, and large-scale urban masterplanning. There are three relevant research findings: the theory of natural movement [a, b]; the theory of the movement economy [e]; and findings about 'static' space use in public open space [c, e]. Briefly, space syntax research from the mid-1980s to early-90s mainly tried to understand how street layout configuration affected pedestrian and vehicular movement. Research projects funded by the SERC and EPSRC found that traffic flows in both modes consistently correlate with measures of network accessibility. By studying homogeneous residential as well as mixed-use commercial/residential areas, it was possible to show the fundamental causal effect of the street layout on urban movement; this 'foot-fall' in turn attracted non-residential land uses, which then attracted further pedestrian and vehicular movement in a 'multiplier effect' [a]. Secondly, the theory of the movement economy showed how urban land use patterns evolve to achieve a structured mixing of uses in historic and unplanned settlements, locating land uses on streets in densities appropriate to their accessibility. Finally, detailed studies of public open space showed how the movement network gave rise to patterns of static space use in urban squares, contributing to vibrant urban life, while accounting for the reverse where planners failed to provide the required conditions [b].</p> <p>Space syntax has for a long time sought to test out its theories against practical live applications. In the 1980s it worked pro-bono on projects for local tenants groups on public housing estates subject to development proposals (e.g. Mozart and Maiden Lane Estates, Coin Street), carrying out analysis and observations in order to give voice to tenants concerns at public consultations and</p>

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planning inquiries. In 1986 UCL's space syntax team was commissioned by Rosehaugh Stanhope PLC to advise on their competition scheme for the Kings Cross Railway Lands, subsequently going on to advise on the later phases of the Broadgate development, Paternoster Square and Peter Palumbo's Mansion House Square scheme. During the 1990s it advised London's South Bank Centre on schemes for the regeneration of that area, and on the Millennium Bridge scheme which links St Paul's to the Tate Modern, and on the 'World Squares for All' scheme to reintegrate the heart of Trafalgar Square into the urban life of London's West End. According to the Department of Transport, the immediate effects of the Trafalgar Square redevelopment, completed in 2003, were profound. Improvements included a 250% increase in pedestrian activity; a 900% increase in its use as a pedestrian through-route; and transformed public perceptions of Trafalgar Square as a destination. In total, an estimated 8,000 user installations of space syntax software have been made worldwide to date, with a sharp rise after the code was open-sourced. All these factors serve as the research background for the various impacts within the REF period outlined below.

The space syntax research was led by Professor Bill Hillier (Senior Lecturer, Reader, then Professor; at UCL since 1974); Professor Alan Penn (Lecturer, Senior Lecturer, Reader then Professor; at UCL since 1989); and Kayvan Karimi (Senior Lecturer; joined UCL in 2009).

3. References to the research

[a] Hillier, B., Penn, A., Hanson, J., Grajewski, T., et al. (1993) 'Natural Movement: or configuration and attraction in urban pedestrian movement'. *Environment and Planning B: Planning and Design*. 20 (1): 2029–66. [Available at <http://eprints.ucl.ac.uk/1398/>]

[b] Penn, A. et al. (1998) 'Configurational modelling of urban movement networks', *Environment and Planning B: Planning and Design*, 25 (1): 59–84. [Abstract available at <http://bit.ly/1gf0wUq>]

[c] Hillier, B. (2008) 'Space and spatiality: what the built environment needs from social theory', *Building Research & Information*, 36 (3): 216–230. [DOI: [10.1080/09613210801928073](https://doi.org/10.1080/09613210801928073)]

[d] Karimi, K. (2012) 'A configurational approach to analytical urban design: 'Space syntax' methodology', *Urban Design International*, 17 (4): 297–318. [Available at: <http://bit.ly/18GufNc>]

[e] Hillier, B. (1996) *Space is the Machine: A Configurational Theory of Architecture*, Cambridge: Cambridge University Press. [ISBN 978-0-9556224-0-3; available at: <http://bit.ly/17zJV9c> – see in particular Chapter 4 on the issues of static occupancy in public open space, and on the movement economy]

The scientific value of the underpinning research has been recognised through continuous Research Councils support for it since the 1980's. Most recently this included three tranches of Platform Funding, only awarded to world leading groups (EPSRC GR/N21376/01, S64561/01, G02619X/1, 2000–14). The research is highly cited (see for example Ch.18 of Bechtel and Churchman, *Handbook of Environmental Psychology*, 2002, devoted to this body of theory), and has given rise to a worldwide community of researchers. Much of the early research was submitted to RAE2001, in which the group was flagged at 5*, evidencing its world-leading research quality.

4. Details of the impact

(i) Contributions to and impacts arising from the transformation of UK Public Spaces:

Projects by SSLtd, underpinned by the UCL research work described above, have informed the local plans, strategies and planning application processes of important projects for more than ten local authorities in the UK. By creating a more robust and evidence-informed planning process, the research has made a significant contribution to the success of those projects, each of which affects many thousands of local constituents [2]. It has also supported the efficient and successful delivery of more than 50 private-led developments in the UK, including Camden Market (with Chelsfield Partners and MAKE Architects, then AHMM), and Elizabeth House (with Chelsfield Partners and Chelsfield Partners) [3].

The regenerative and economic impacts of our contributions to the redevelopment of UK public spaces are well demonstrated in the case of Old Market Square, Nottingham. Work started in 2003 on this £7 million Nottingham City Council project to transform a dysfunctional and problematic urban space, which is used annually by more than 5 million local residents and visitors to the city.

The redevelopment of this high traffic, politically sensitive, and historically listed area drew particularly on UCL research for strategic design recommendations, pedestrian movement forecasts and detailed spatial analysis. In particular, the project's success relied heavily on the ability to deliver static space occupancy, since a space that only supported movement would fail to meet the key objectives of increasing interpersonal communication and transactions within the Old Market Square. The square, which is now the centrepiece of Nottingham's regeneration efforts, reopened to the public in 2007. It has since won multiple awards recognising it as one of the most successful public spaces in the UK, including three Civic Trust awards in 2008 for which it beat a shortlist of 100 contenders [4]. The redesign of this previously relentlessly underperforming historic area has significantly diversified and increased its usage. Thus, for example, it now hosts an annual 'German Market' in December, and is also transformed during the summer into the 'Nottingham Riviera', as well as hosting myriad short-term events throughout the year. The new design and subsequent diversification of the Old Market Square's use has supported increased footfall through the area: in the twelve months to the end of April 2012, Nottingham saw a 0.9% increase in footfall compared to the rest of the East Midlands, which declined by 2.5%, and compared with footfall in UK towns and cities more broadly, which declined by an average of 2% during the same period [5]. These changes helped support local shops and restaurants, a contribution that has been particularly important during the recession. The redesigned square has also brought significant cultural benefits to Nottingham, improving the image of the city and contributing to the preservation of national heritage as a lived environment. Writing in June 2008, the Business Correspondent of the *Nottingham Evening Post* summarised some of the benefits that the redeveloped Square had brought to the city, by saying: *'Only the churlish would fail to acknowledge the difference that the multi-million investment in the Old Market Square has made to the heart of our city. While it may take some time in the current circumstances, there is little doubt that this is an investment that will, in the long run, pay for itself. It hosts events, it showcases the city, it brings in visitors, it is a place where people gather. People spend money in Nottingham's city centre economy as a direct result of the square's enhanced presence.'* [6]

(ii) Contributions to and impacts arising from urban masterplanning in Jeddah:

Further afield, the space syntax team has achieved significant international impacts through research in Jeddah. This began with the 2006 commissioning of SSLtd by the Jeddah Municipality to provide spatial development strategies for the city, the population of which had increased from 2 million in 1993 to 3.2 million at the last census in 2010. The SSLtd project, *Strategic Planning Framework*, has made a vital contribution to planning and decision-making processes affecting the whole city, including the redevelopment of large and highly populous areas of unplanned settlement [7]. It also led to a series of further high profile projects led by SSLtd, including the development in 2008–09 of the masterplan for the City Centre of Jeddah, a 500-hectare area in the heart of the city incorporating both its historic core (Al-Balad) and its waterfront area. Although the project is yet to be implemented, the SSLtd masterplan has already had profound impacts on planning and resource allocation in Jeddah.

Space syntax research into natural movement and the movement economy [a–d], when repeated in the quite different cultural and environmental context of Saudi Arabia, has shown that the principles not only also apply there, but that they can account for the land use and movement patterns even in Jeddah's unplanned settlements. This has allowed the development of evidence-based policy tools to support the municipality's primary socio-economic regeneration objectives, as well as the reintegration of the historic city centre into the vastly expanded context [e].

Since 2008, SSLtd has been working with the Municipality of Jeddah and Jeddah Development and Urban Regeneration Company (JDURC) on six projects – with a total consultancy value in excess of £1.5m – to develop regeneration strategies and development plans for more than 50 such areas of unplanned settlement with an estimated total population of 1 million. These unplanned settlements suffer from multiple urban, social and economic problems, and are considered the most challenging areas for improvement in Jeddah. Using an analytical, evidence-based approach [e], SSLtd has developed prioritisation strategies, spatial designs, financial models and adaptable and interchangeable regeneration scenarios ranging from minimum intervention to full redevelopment. These plans are being used by the communities themselves, as well as by local authorities and private sector organisations, to transform Jeddah's unplanned settlements and enhance socio-economic conditions therein [7]. They have particularly informed

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the *Draft Strategic Plan of Jeddah*, published for consultation in 2010. This plan was revised in 2013 by AECOM (a global provider of professional technical and management support services) along with SSLtd on the basis of consultations in Jeddah, and will be adopted soon.

The same projects are also informing a two-year planning mega project commissioned in February 2013 to inform the development of Jeddah Sub-regional, Structural and Local Plans [7]. Its consultancy fees alone exceed £8million, £1.2m of which goes to SSLtd. In collaboration with AECOM, SSLtd's contribution to that project includes analytical models of the city providing the basis for the precedent studies, baseline research, option assessment and option development at all scales of the project. The project will produce city plans for the next 20 years, affecting millions of current and future residents of Jeddah and accounting for the use of billions of Saudi Riyals. Although its full implementation will take a long time, the impact of SSLtd research on the project is already emerging. The city's department of unplanned settlement is currently using the SSLtd plans to issue planning permissions in 25 unplanned settlements with a total population of over 500,000 [7]. Following SSLtd recommendations, all categories of unplanned settlements have been designated to specific authorities or public-private partnership companies for further actions. The JDURC started the physical transformation of two of these areas (Al-Ruwais and Khozam) in 2011 and is now moving on to work on another six areas. The municipality of Jeddah has also started physical interventions based on SSLtd's recommendations in another eight central areas, including the highly populated areas of Al-Balad, Betrumin and Qulail. These projects will enhance the accessibility of the communities to wider economic and social opportunities in Jeddah [7].

Space syntax research has, moreover, already generated more widespread international impacts through its development of an evidence-based, analytical approach to addressing some of the problems faced by those living in unplanned and informal settlements. The significance of this methodology is acknowledged by its inclusion in important international policy documents including UNICEF's 2012 report on *The State of the World's Children 2012: Children in an Urban World* [8].

Both of the examples outlined here demonstrate the global reach and significance of UCL's world-leading space syntax research, the impacts of which include benefits to the UK economy through export, and to the quality of life of local populations both at home and abroad. The research has also prompted increased public awareness of, and an interest in, the issues it considers. It is an interest demonstrated, for example, by its inclusion in the 2012 Olympic Games opening ceremony as one of Danny Boyle's many allusions to seminal UK research innovations [9].

5. Sources to corroborate the impact

[1] For the positive effects of the redevelopment of Trafalgar Square, see Department of Transport, *Encouraging Walking and Cycling: Success Stories* [<http://bit.ly/Hb7Sc9>, PDF, pp. 20–21]

[2] The influence of the space syntax work on Croydon Council, *Borough Character Appraisal*, 2011, is an example of impact on local authority projects [<http://bit.ly/1cJ5Lb9>, PDF, pp. 2–3]

[3] The Director of Chelsfield Partners may be contacted for a factual statement about the impacts of space syntax research on the development of private projects under his auspices.

[4] Various awards for the Nottingham Old Market Square project [<http://bit.ly/1f6WQBh>]

[5] Statistics on increased footfall in Nottingham City Centre [<http://bit.ly/1gVk5A5>]

[6] Impacts from the redeveloped Nottingham Old Market Square were reported by Richard Baker in the *Nottingham Evening Post*, 3 June 2008.

[7] The Vice Mayor of Jeddah (also its Director of Strategic Planning) may be contacted for a factual statement about the impacts of space syntax research on the city's development. The project is also cited by the UK Commission for Architecture and Built Environment (CABE) as a best practice example of strategic planning [<http://bit.ly/1a01DVJ>]

[8] Space syntax methodology is referenced in UNICEF, *The State of the World's Children 2012: Children in an Urban World* [<http://uni.cf/GBK4a>, PDF, pp. 64–65]

[9] A space syntax map was used in the opening ceremony of the 2012 London Olympic Games, as reported in the *Daily Mail*, 11 July 2012 [<http://dailym.ai/1i5W5li>]