CTBUH
Research Paper

ctbuh.org/papers

Title:	**Empirically Evaluating the Livability Of Local Neighborhoods and Global Cities**
Authors:	Christian Derix, Global Leader, Woods Bagot Lucy Helme, Manager of Data Analytics, Woods Bagot Fabio Galicia, Design Researcher, Woods Bagot Alexander Kachkaev, Data Analyst, Woods Bagot
Subject:	Urban Design
Keywords:	Connectivity Urban Design Urban Planning
Publication Date:	2017
Original Publication:	CTBUH Journal 2017 Issue IV
Paper Type:	1. Book chapter/Part chapter 2. **Journal paper** 3. Conference proceeding 4. Unpublished conference paper 5. Magazine article 6. Unpublished

© Council on Tall Buildings and Urban Habitat / Christian Derix; Lucy Helme; Fabio Galicia; Alexander Kachkaev

Empirically Evaluating the Livability Of Local Neighborhoods and Global Cities

Dr. Christian Derix

Dr. Lucy Helme

Fabio Galicia

Dr. Alexander Kachkaev

Authors

Dr. Christian Derix, Global Leader
Dr. Lucy Helme, Manager of Data Analytics
Fabio Galicia, Design Researcher
Dr. Alexander Kachkaev, Data Analyst
SUPERSPACE @ Woods Bagot
75 Riding House Street
London W1W 7EJ, United Kingdom
t: +61 2 9249 2659
e: Christian.Derix@woodsbagot.com;
Lucy.Helme@woodsbagot.com;
Fabio.galicia@woodsbagot.com;
alexander.kachkaev@woodsbagot.com
www.superspace.woodsbagot.com

SUPERSPACE @ Woods Bagot
SUPERSPACE is a multi-disciplinary design team with 17 years' experience in design computation having pioneered many models of AI and AL, spatial analysis and data visualization in architectural and urban design. All algorithmic models are developed in-house via stand-alone programming environments for processing speed and easy adaptability, and are curated in an award-winning framework for spatial simulation.

CTBUH 2017
International Conference

Christian Derix will discuss this paper in the presentation **"Global Cities Brand versus Local Neighborhood Operations"** in Session 4F: *Branding the City,* Monday 30 October at 11:15 a.m.

Abstract

CIVITAS is a search engine for urban conditions, developed to allow stakeholders to identify qualities of livability and urban experiences that suit their tacit desires and explicit requirements. While using CIVITAS to study three global cities for bespoke end users in 2015–16, the authors interpreted the metric of "accessibility to amenities" to suggest that, while the global profile of cities varied, the local neighborhoods preferred by certain end users turned out to be very similar. Further studies were initiated across more cities and neighborhoods, with more diverse metrics in order to validate the initial suspicion. Metrics pertaining to urban structure and demographics were added to "amenity provision," and two types of comparative profiles were produced for insights. The findings are not as unambiguous as the initial data suggested for the initially targeted category, but another pattern emerged that supports assumptions in planning guidance for "livable" cities, and relates urban structure to density.

Keywords: Urban Planning, Big Data, Urban Design, Connectivity

Introduction

In 2008, the authors developed a proof-of-concept model to simulate sustainable urban densification. The two cities of Dubai and London were used as cases to demonstrate the difference of densification when a new tall building is inserted into the urban fabric. Two dependencies formed the basis for the simulation: land-use provision for commercial buildings and accessibility to the predominant transport mode. Dubai was then primarily using a vehicular transport system, while London primarily then relied on the underground transport system for commuting. The model would then generate the amount of area required to accommodate additional land uses that would support a new tall building with a set floor area. The multi-layered feedback model clearly illustrated the difference in levels of sprawl and densities seen in cities with either a (dense) public underground transport system like London or a car-dependent transport system like Dubai (see Figure 1).

Since that time, open-source urban data has become widely available. From 2014 onwards, the discourse about socio-spatial sustainability of cities has shifted from its design to its assessment, quantifying conditions and scrutinizing governance through the analysis of big urban data. Indicative of this transition are the growing numbers of online city indices that attempt to rank global cities according to "livability", "governance" or "economic opportunity," based on an ever-increasing mix of metrics. However, no notable new urban design guidelines have been established since then. Such indices of "livability" include the Mercer's Quality of Living Cities Index, The Economist's Global Livability Ranking, and Monocle's Quality of Life Survey. For "economic opportunity" there are annual reports, such as PwC's Cities of Opportunity, Knight Frank's Prime Global Cities Index, Savills' Tech Cities, JLL's City Momentum Index, the Global Innovation Index (GII) and ATKearney's Global Cities, to name but a few. Reports by UN Habitat, such as the ***Urban Patterns for a Green Economy*** series, have become nearly the single source that attempts to balance economic performance with livability and to deduce design objectives for sustainable cities, such as ***A New Strategy of Sustainable Neighborhood Planning: Five Principles*** (UN Habitat 2014).

The authors developed the first digital design chain for urban planning, called Smart

Solutions for Spatial Planning (SSSP) (Derix 2012), and began to complement their computational urban design and planning framework (based on SSSP) by starting a big urban data analysis and visualization platform called CIVITAS (Derix 2017). The purpose behind the initiative is to attempt to quantify otherwise discursive concepts of "vitality" and "liveability" in order to assess and design urban interventions that blend into the city or enhance socio-spatial sustainability.

CIVITAS: An urban search engine

CIVITAS aims to assess the nature of, and potential locations for development within a city. To generate a brief for a site and test the best symbiosis for development or use case that benefits both the land-owner as well as the community, one has to reveal the dynamics that inform the profile of a location. While there are many qualitative dynamics that are difficult to quantify, one can compute a series of spatial performances that correlate to social sustainability, such as those identified by urban planning guidelines of CABE's ByDesign or UN Habitat. Dynamics are expressions of the urban systems that define cities, and hence, the city has to be understood as a much larger organism than solely the site and its immediate context: "Places do not make cities. It is cities that make places" (Hillier 1996).

City to floor level

The platform is composed of three scales: metropolitan region, neighborhoods, and blocks (down to buildings and floors where feasible). Data from larger scales is passed to lower scales for integration; this allows for persistent investigation and a test-fitting of KPIs across scales that are not limited to zoned planning legislation. The composition of publicly available to proprietary data shifts with each scale towards more self-computed metrics. Despite the general perception of big data being ubiquitous, only 20–30% of data used in CIVITAS stems from public sources or client sources; most requires computation by SUPERSPACE.

Metropolitan scale

Most open-source data is found at the citywide scale, for which city governments have started to provide curated databases, such as NYC Open Data or the London Datastore. Three core categories of data at this scale include urban structure, land use density, and accessibility to amenities. For each category, there are some basic and site-specific metrics. A set of metrics is selected that represents the objectives of project briefs or client requirements, and is made available in the graphical user interface (GUI) of the online urban search engine, linked to the authors' proprietary urban database called "Urban Archive." The metrics within each category can now be weighted in accordance with the objectives, and an urban map visualizes the locations that comply with the weighting in real time. The model can also reverse-engineer location weightings for strategic planning and project briefing, and also allows the user to predict locations for future end-user allocation (see Figure 2).

Neighborhood scale

The metropolitan-scale model classifies sites and neighborhoods based on relationships of metrics. When neighborhoods have been

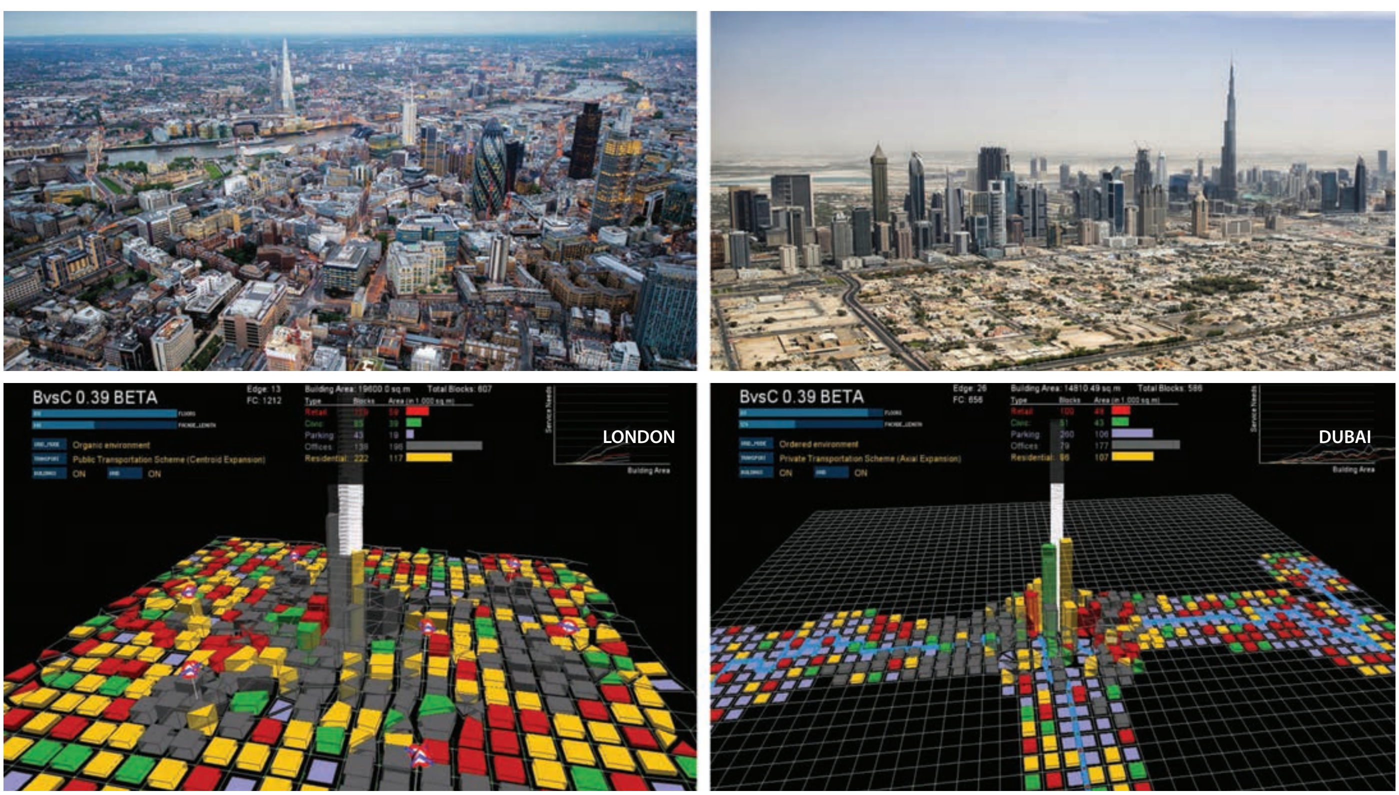

Figure 1. Densification and amenity provision simulation for two types of transport models – public (left) and private (right).

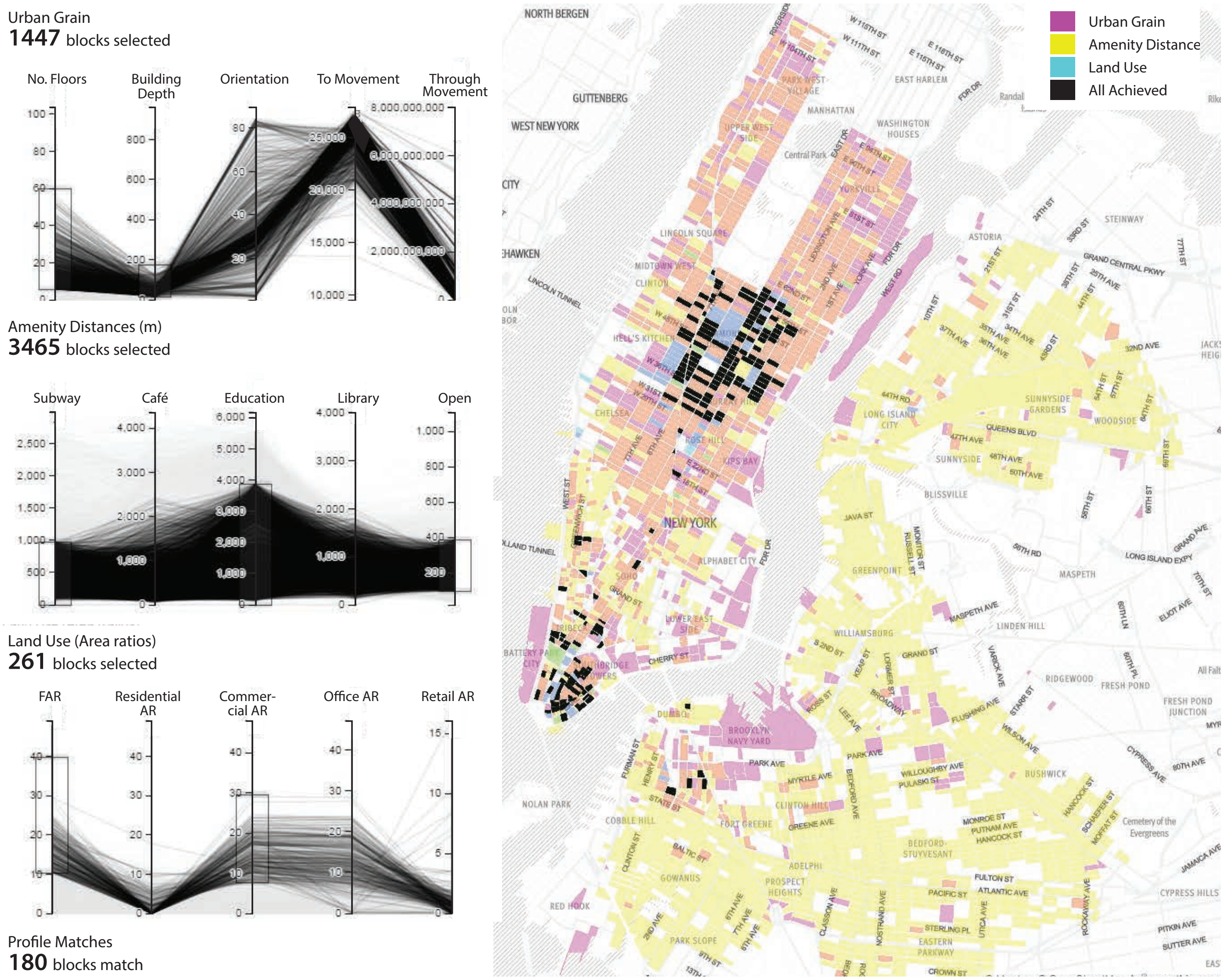

Figure 2. *CIVITAS Metropolitan* – the user interface of the online urban search engine used to identify neighborhood and block profiles, in this case showing the relationship of urban amenities to block densities in New York City.

identified, a series of spatial analytics at street scale generates another set of attributes per street, which profiles the neighborhoods in more detail. Cognitive qualities such as wayfinding and enclosures, as well as many spatial metrics such as land-use mix, amenity provision, building aspects, and footfall, are used to produce "place profiles" in 2D and 3D. The mapped profiles at this scale are stored in a database as encoded urban qualities and visualizations for further processing at the next scale, or used for master planning and placemaking.

Building scale

Value levels for metrics from the metropolitan (mapped at block level) and neighborhood scales (mapped at street level) are loaded into the building-scale model. Additionally, all buildings within a chosen range – usually the identified neighborhoods and development zones – are dissected and quantified for spatial, environmental and economic metrics. Again, depending on project or client requirements, a series of KPIs and sites are selected and loaded into GUIs, where the user can explore which building, and even which floor, within a neighborhood complies with desired objectives. At this scale, buildings and floors are trading off between neighborhood profiles such as amenity provision or accessibility, building performances, and organizational requirements such as utilization. A rankable shortlist is created, whose profiles' values are stored for benchmarking against further criteria (see Figure 3).

Urban Archive

All metropolitan-scale data is produced from another bespoke platform created by the authors' team, as Urban Archive, a queryable database, from which data sets and visualizations are exported. Urban Archive consists of a web-based GUI that allows the user to operate a private application programming interface (API) to activate a series of spatial analysis models. Eight basic metrics are generated for each major city in which the authors' firm and its clients operate. The database is equally storing the data from the CIVITAS Neighborhood and Building models, so that the metrics can be cross-referenced. Currently, Urban Archive comprises 10 cities, with new samples being added continuously.

Strategy to place

The three platforms – Digital Master Planning, CIVITAS, and the Urban Archive – act as a digital framework that can be applied to a variety of projects within the authors' firm, and as direct consultancy to clients. Applications range from site-investment searches to strategic planning, feasibility studies, master planning, and placemaking. The strength of this digital framework lies in interweaving simulations of planning and urban design procedures with robust data analysis across all scales to produce more rigorous and complex scenarios, integrate sensitivity analysis for community and urban resilience into the design process, de-risk planning responses, and combine currently disjointed insights and data from a variety of consultants into an integrated scenario-planning procedure.

Comparing Cities and Neighborhoods

Based on the three cities of London, New York, and Sydney and the spatial analysis of three

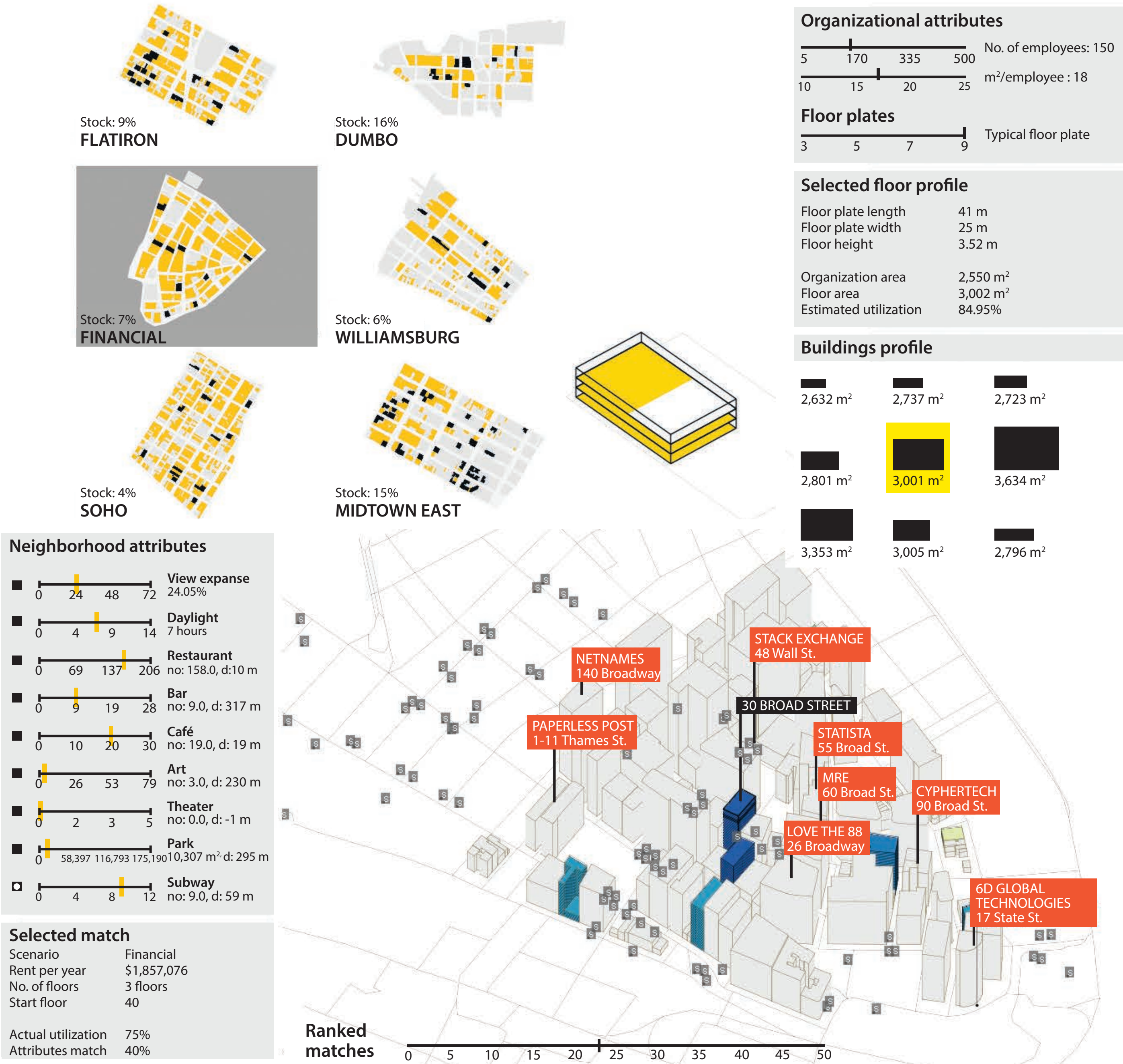

Figure 3. *CIVITAS Building* – two stages are conducted: a stock search within identified neighborhoods (top) and a building and floor search within a chosen neighborhood (bottom).

> **“Both types of neighborhoods, CBDs and Tech Districts, tend to conform more to each other (within each city) than across cities, and Tech Districts tend to replicate most of their corresponding CBDs’ values.”**

Creative Tech neighborhoods within those cities – Shoreditch, Flatiron, and Ultimo – it appeared as if the data for proximity to amenities was suggesting that those neighborhoods enjoyed similar profiles, despite being situated in three different global cities with disparate amenity profiles. It seemed as if the creative technology industry chose locations within global cities with similar utilization patterns. This observation was supported by research about creative tech companies, suggesting that one of the key objectives for office locations is a good mix of, and accessibility to amenities, with emphasis on specific land uses, such as cafés and educational institutions, to support desired talent pools (Spencer 2015). In other words, employees of Creative Tech companies prefer working in "livable" communities where this mix often occurs, although rental values and proximity to clients certainly play a role.

In this study, five key amenities were used to represent both the requirements of creative tech companies and to indicate community facilities: rail stations, higher education facilities, cafés (third places), cultural offerings, and libraries. It was found that average distances to the amenities within those neighborhoods were very similar (roughly 500 meters to stations, 300 meters to education, 100 meters to cafés, 300 meters to culture, and 250 meters to libraries). Average distances to those amenities vary much more from city to city, and could not be aligned, pointing to potential differences in urban structure, topography or governance (see Figure 4).

Hence, it was decided to expand the metric categories for this specific comparison beyond "access to amenities" to include aspects of urban structure and demographics, and to establish whether correlations at neighborhood scale keep holding across cities, while cities' profiles vary. The number of cities was increased to five: San Francisco, New York, London, Melbourne, and Sydney, with two types of neighborhoods to compare: central business district (CBD) vs. "Creative Tech." The expanded Creative Tech neighborhoods were: San Francisco's Mission, New York's Flatiron, London's Shoreditch, Melbourne's Fitzroy, and Sydney's Ultimo. For the London metropolitan area, only the City of London was considered as a CBD. Locations of CBDs established in the mid-20th century are all located in the historic centers of those cities, and as such represent a different age of urban structure. Apart from the comparison between CBDs, it felt relevant to establish how those historic CBDs compared to their host cities overall, and against Creative Tech neighborhoods.

Cities and Metrics

To assess differences across cities and neighborhoods, each city was assigned a profile based on 10 metrics, relating to morphological, demographic, and governance features:

1. Street density (total length of street in kilometers/square kilometers)
2. Median income (local currency)
3. Proximity to hospitals (distance in meters)
4. Average block area (area value of urban blocks in square kilometers)
5. Proximity to culture (distance in meters)
6. Integration/closeness centrality (connectivity between street segments)
7. Proximity to schools (distance in meters)
8. Density of amenities (number of selected amenities crowdsourced from Open Street Map/square kilometers)
9. Resident density (number of dwellers/ square kilometers)
10. Flow/between-ness centrality (through-flows on street segments connecting urban centers)

Two types of aggregated profiles were produced, in order to compare metric similarities and city differences.

Metrics profiles

Comparing metrics across cities, some similarities between neighborhoods arose: Although their individual numeric values

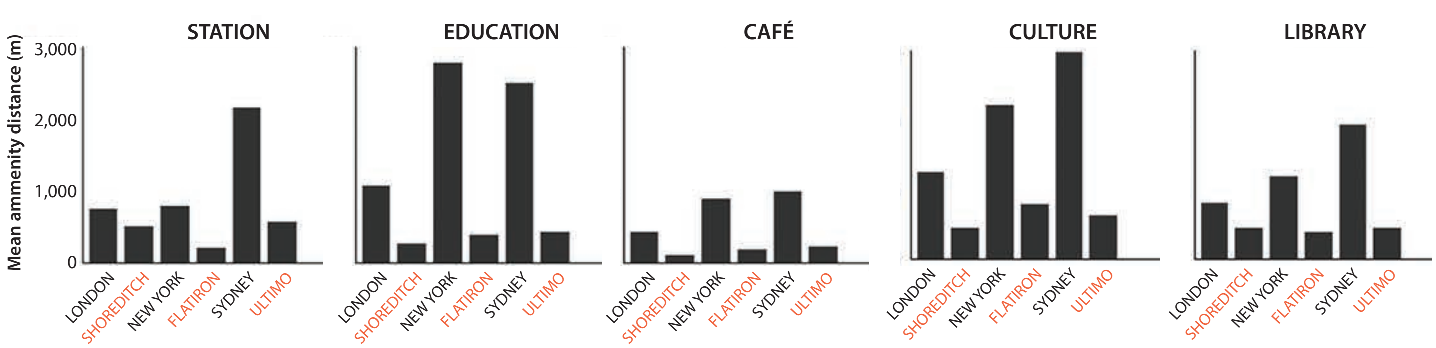

Figure 4. Proximity to amenities comparison between London, New York, and Sydney; and their creative tech neighborhoods. The first, third, and fifth bars show the average distance to each of the five amenities for each city, while the second, fourth and sixth bars show the average distances within neighborhoods.

might differ significantly, the variance between the neighborhood medians (color lines) and the city medians (black bar) seem to be similar. This holds true for the majority of the metrics, even when one city might in some cases be an outlier (see Figure 5).

City profile

In Figure 6, the profile of the city (grey) is plotted against the profiles of its CBD (orange) and Creative Tech (green) neighborhoods, and again the difference in the medians is assessed. The median values in CBD and tech largely occur higher on the scale, as compared to the median values for the whole city. Additionally, the differences between the CBD and Creative Tech neighborhood profiles appear very small for most metrics within each city.

The city profiles are visualized in such a way that the deviation above the city median line represents positive differences, and the deviation below the city median line represents negative differences. Hence, some values are "mirrored" across the city median line because their "smaller values" (such as proximity and block size) are considered "good."

Insights

There are some high-level insights that can be read directly from the visualized data, which are only briefly stated here, differences for both metric and city profiles show that the neighborhoods within each city perform similarly in relation to their host city, i.e.:

- CBDs consistently perform better on most metrics from the rest of the city
- Tech Districts tend to replicate most of their corresponding CBDs' values
- Both types of neighborhoods conform more to each other (per city) than across cities, and
- The deviation from the city median values appears to be replicated across cities, showing that the neighborhoods chosen by those types of users are similarly divergent from their host cities

Some of the above insights in more detail:

Grain vs. amenities density

Smaller block sizes normally exhibit a higher amenity density, several times higher than the city median. This also holds true for the tech neighborhoods. Amenities reflect points of interest crowdsourced in Open Street Maps, so this metric is subject to active mappers reporting those points.

Enhanced connectivity

The assumption that the CBDs (and Tech

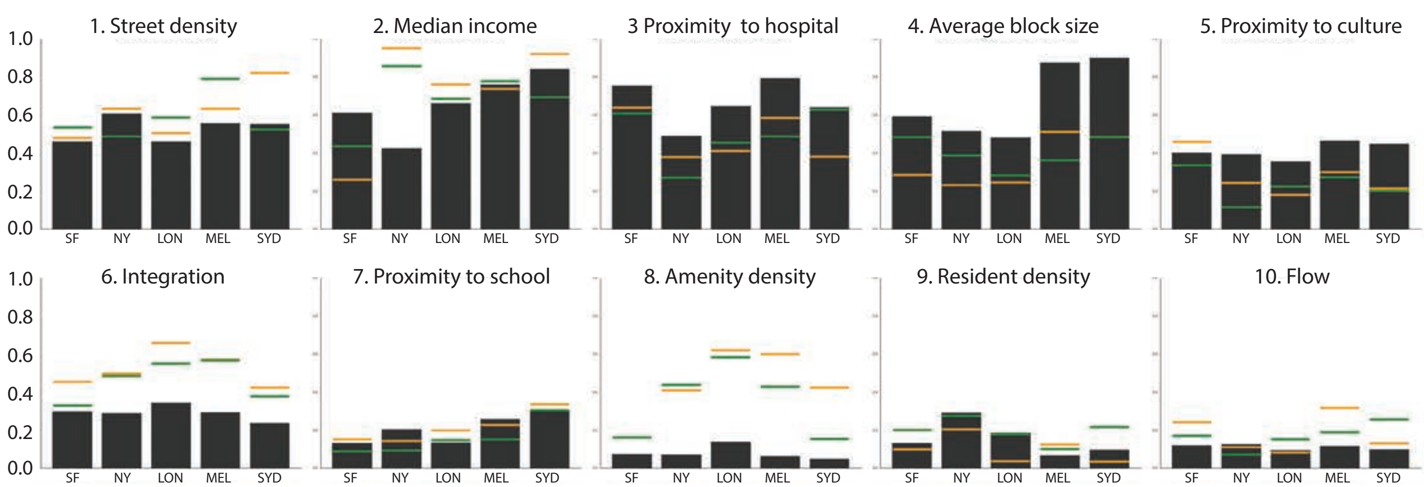

Figure 5. Five cities' medians (black bar) compared against each other and their CBDs (orange) and Creative Tech districts (green), per metric (left to right order of cities: San Francisco, New York, London, Melbourne, and Sydney)

Figure 6. The graph shows that, although the 10-metrics profiles across cities may diverge, the relationship between the city's global values and each of the analyzed neighborhoods tends to be similar. In other words, across each city, the Creative Tech district and CBD profiles seem to largely mirror each other.

districts) enjoy a preferential position within the urban street network is verified across the five cities: the integration values (closeness centrality) are clearly higher than the city medians (see Figure 8). Only the Creative Tech neighborhood in San Francisco does not have a higher street connectivity than the city. Integration of streets based on their connectivity also correlates to smaller block sizes and therefore amenity densities, showing that historic urban centers constructed before the automobile share similar morphological features that are aligned to sustainable city planning criteria. In other words, these urban structures are inherently "walkable". This supports the authors' earlier research into objectives for locations by Creative Tech companies, as stated by Spencer.

Utilization

The above values, however, do not represent actual utilization: a higher density of points of interest or amenities does not necessarily imply diverse or persistent activation in time; i.e., it does not suggest livability.

An earlier study regarding the flows of transport across London was used to assess the difference between neighborhoods that were believed to have highly mixed land uses and those with homogenous land-use concentrations, such as financial districts that tend to be active only during the week. Ten underground station profiles were compared by entry and exit counts across each day and hour across five types of neighborhoods in London. It was found that stations placed within the traditional financial district (City of London) showed high volumes during the week, with almost no visits in the weekend or at late hours. The only exceptions were areas that have tourist attractions like St. Paul's. Stations placed within the identified Creative Tech districts showed higher levels of activation at later hours in the day, as compared to CBD districts. They also appear to be well-activated during weekends. This points towards Creative Tech neighborhoods being more "livable" and perhaps significantly divergent in terms of demographics (see Figure 7).

Demographics

Despite having FAR values multiple times higher than the city median, CBDs' residential densities prove to be quite low (except for Melbourne). Drawing on previous research, new metrics associated with residential character were studied, such as proximity to schools. CBDs score similarly to the city medians, despite their central position in the urban fabric and their high degrees of connectivity. In all cases, Creative Tech neighborhood values are lower (shorter distances), meaning that they have better access to schools as compared to CBDs (see Figure 9).

When looking at residential ownership as another factor associated with demographics, very low ownership ratios were found in the Creative Tech neighborhoods, with CBDs scoring differently (high for London and New York, low for the other three cities). Creative Tech neighborhoods show results well above the cities' medians, in terms of percentage of rented properties. On top of that, density in terms of height and FAR is far higher in CBDs than in Creative Tech neighborhoods, yet with lower dwelling densities, hinting at much lower occupancy and activation in CBDs by local residents. Creative Tech neighborhoods therefore seem more vibrant, due to more residential activation and a higher land-use mix.

Conclusions

Based on an initial 2016 comparison of data on proximity to amenities in three cities and three of their Creative Tech neighborhoods (Shoreditch, Flatiron, and Ultimo), it appeared that the neighborhoods had more in common with each other than with their host cities. After expanding the research to compare more cities and neighborhoods with an increase in diverse metrics, the pattern weakened, but new findings emerged.

CBDs and Creative Tech neighborhoods within each city score similarly for metrics in regards to urban structure, but not for amenity provision and demographics. Similar grain seems to stem from historic structures, such as street connectivity and block sizes, while differences in amenity and demographics hint at fundamental differences in activation and livability. CBDs are clearly less "livable" than Creative Tech neighborhoods, where creative technology and other service-based companies like to locate, due to their employees' preference for vibrant community environments.

Across the individual metrics, both CBDs and Creative Tech neighborhoods appear less aligned than initially thought when comparing them across global cities. Yet, the deviation from their host cities is similar, showing that while slightly differently composed to their host cities, the neighborhoods are

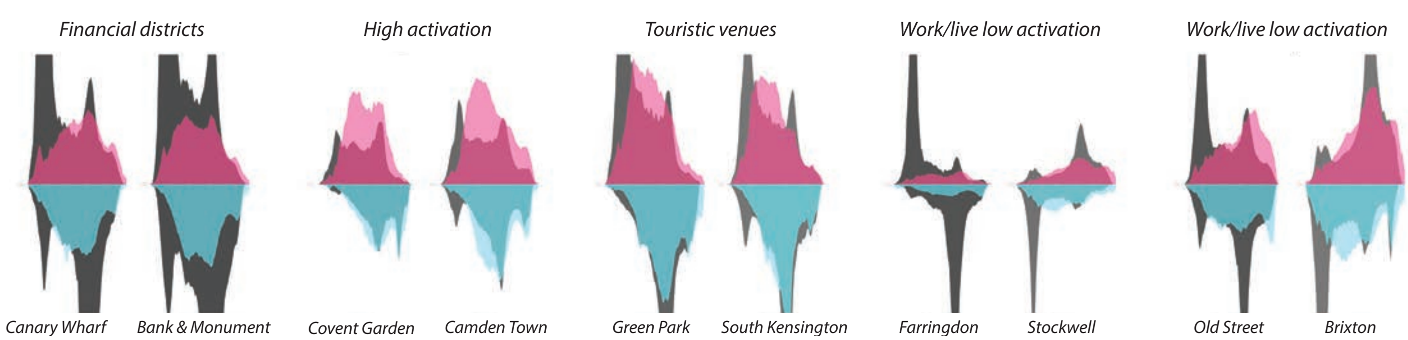

Figure 7. Pedestrian activity at several key London Underground stations in different types of districts. The graphs show total number of exits (upper part) and entries (lower part) throughout the day (morning to the left, night to the right) . Grey indicates working days; color: Saturdays.

similarly experienced in relation to their host cities. Additionally, the experience of daily patterns in those neighborhoods, even across those very different cities, will be similar, while they look different.

It is well known that gentrification might push smaller creative-tech and generally creative and service companies out of the types of neighborhoods analyzed here, where generally good livability conditions still occur, as compared to CBDs. With global intentions to create "innovation" districts with very similar spatial recipes, there is a danger that those conditions will disappear fast and that homogenization increase, despite the intention to be "unique". The key to "uniqueness" and "livability" appears to be a high land-use mix, generating diversified demographics, which in turn generate higher activation. ■

Unless otherwise noted, all photography credits in this paper are to SUPERSPACE.

References

COMMISSION FOR ARCHITECTURE & THE BUILD ENVIRONMENT (CABE). 2000. ***By Design. Urban Design in the Planning System: Towards Better Practice.*** London: Department of the Environment, Transport and the Regions.

DERIX, C. 2012. "Digital Masterplanning - Computing Urban Design, Urban Design and Planning." ***Proceedings of the Institution of Civil Engineers - Urban Design and Planning*** 165(1): 203–17. https://doi.org/10.1680/udap.9.00041.

DERIX, C. 2017. "CIVITAS – Urban Data Systems." In ***Computing the Environment: Digital Design Tools for Simulation and Visualisation of Sustainable Architecture,*** edited by Terri Peters & Brady Peters. Chichester: John Wiley & Sons.

HILLIER, B. 1996. "Cities as Movement Economies." ***Urban Design International*** 1(1): 41–60.

SPENCER, G. M. 2015. "Knowledge Neighbourhoods: Urban Form and Evolutionary Economic Geography." ***Regional Studies*** 49(5): 883–98. https://dx.doi.org/10.1080/00343404.2015.1019846.

URBAN TASK FORCE. 1999. ***Towards An Urban Renaissance: Final Report of the Urban Task Force.*** London: E & FN Spon.

UN HABITAT. 2014. "A New Strategy of Sustainable Neighbourhood Planning: Five Principles." Accessed August 2017. https://unhabitat.org/wp-content/uploads/2014/05/5-Principles_web.pdf.

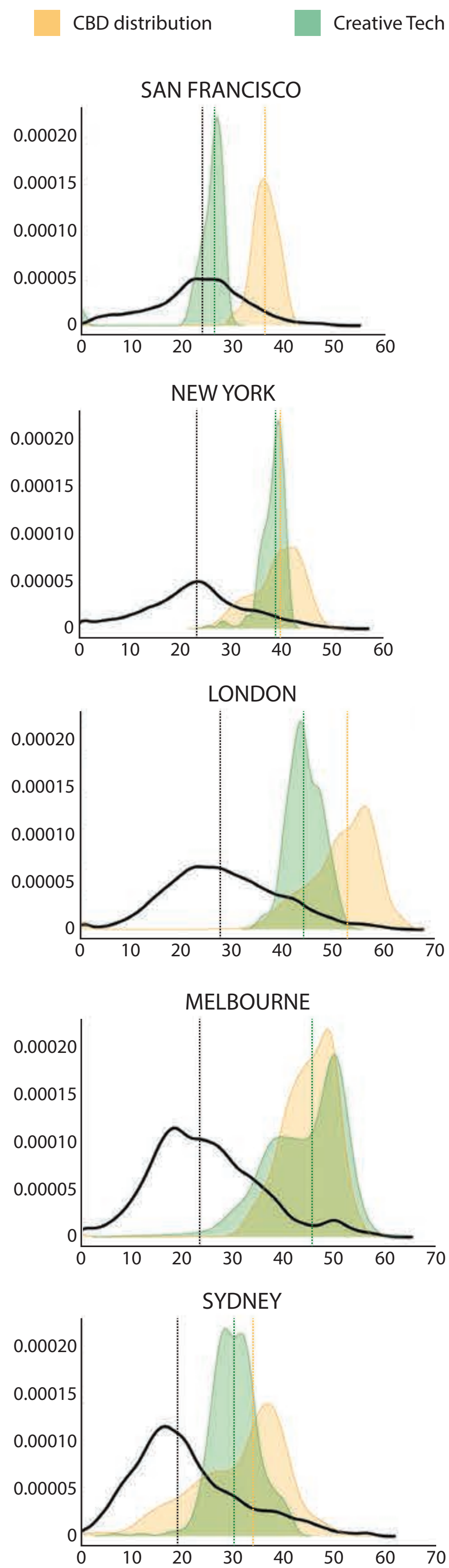

Figure 8. Integration: connectivity between street segments called "closeness centrality." The graphs show distributions of closeness centrality (*x*-axis) for the city, CBD, and Creative Tech districts; and number of streets (*y*-axis – units expressed as normalized density)

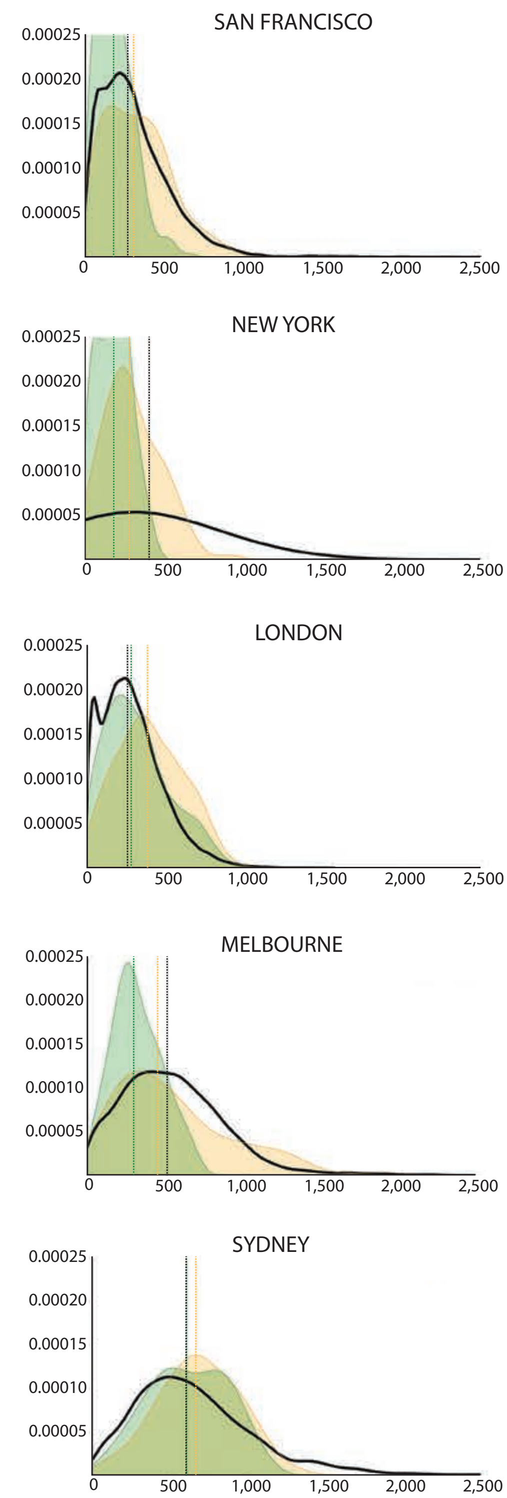

Figure 9. Proximity to schools: distributions of proximities in meters (*x*-axis) for the city, CBD, and Creative Tech districts; and number of blocks (*y*-axis-units expressed as normalized density).