2018

**Fluid Urbanism: How Information Steered Architecture Might Reshape the Dynamics of Civic Dwelling**

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Fluid Urbanism: How Information Steered Architecture Might Reshape the Dynamics of Civic Dwelling

Abstract
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Keywords
bottom-up urbanism, mobile architecture, self-organization, urban dwelling, fluid urbanism

Disciplines
Architectural History and Criticism | Architecture | Construction Engineering | Environmental Design | Urban, Community and Regional Planning

Comments
This article is published as Wohl, S., Revariah, R., Fluid Urbanism: How Information Steered Architecture Might Reshape the Dynamics of Civic Dwelling. The Plan Journal, 2018, 3(2);401-426. Doi: 10.15274/tpj.2018.03.02.8. Posted with permission.
Fluid Urbanism: How Information Steered Architecture Might Reshape the Dynamics of Civic Dwelling

Sharon Wohl, Reny Revariah

ABSTRACT - This paper speculates on how new forms of dwelling might be re-conceived as more nimble, flexible components: ones capable of deploying to different sites and atmospheres, while simultaneously providing more broadly distributed access to amenities that otherwise remain limited to the privileged few. Specifically, it examines the notion of a mobile dwelling architecture that could be deployed to various sites across the city - each site being characterized by particular “niche” offerings. Here, rather than dwelling units being considered as static entities within the urban fabric, they are re-considered as nimble, deployable agents - able to relocate to different sites and settings in accordance with different parameters that are customized through individual cost-benefit analyses and feedback dynamics. Accordingly, over time, bottom-up, self-organizing “niches” of fit inhabitation emerge. The paper associates this kind of designed environment with the dynamics of complex adaptive systems - where emergent global features arise from the bottom-up. Here, a kind of “swarm” urbanism is deployed: one adjusting over time in response to atmospheric variables.

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The information age brings with it both promise and peril. As digital interfaces allow an increasing number of goods, services and jobs to be brought directly into our homes, there becomes less and less reason to go out and experience the physical world. Yet, participating within the
urban sphere and interacting with others outside our inner-circle is key to maintaining a sense of civility and meaning. How might architecture leverage the power of new information technologies to create new connection possibilities, to promote interaction with others, while providing a more equitable allocation of services and amenities?

INTRODUCTION

To consider these questions, this paper focuses upon a speculative design proposition, Plugabble. The project, conceived as part of an urban design studio, imagines how nimble, autonomously mobile dwelling-units might serve as deployable self-organizing agents within a bottom-up urban system. The project explores how such units, coupled with new modes of living that incorporate aspects of the access economy, could align customized civic amenities and resources with individual home-owner needs. Here, rather than resources being scarcely distributed and inaccessible, dwelling units themselves deploy to access resource sites. Consequently, the mobile dwelling architecture provides more flexible and democratic access to highly valued civic amenities, with these cycling amongst different home-owners at different times, and in accordance with personalized and optimized variables. The paper reflects upon the implications of such a fluid urbanity, paying particular attention to how it alters the perception of dwelling while also affording more contact amongst those normally segregated within static and permanent neighborhoods. Further, the study suggests a novel way of engaging parametric design thinking - one wherein physical outcomes are steered in accordance with parameterized variables in modes that are enacted in situ rather than calculated within models.

CONTEXT

Historically, infrastructure has been critical in defining the nature of urban development. Be it the river-routes that formed trade channels constraining settlement, the rail-lines defining where frontier towns would be situated, or the freeways marking a shift from urbanization to sub-urbanization, different infrastructural regimes have played a key role in determining where and how we live. As we move into an age increasingly mediated by digital infrastructures and the flows these channel, we ask the question: what kinds of worlds will these new regimes make possible, and how will these be steered to ensure "best" urban practices? What might "best" even mean within this context?

In order to address such questions, an interdisciplinary graduate studio (jointly taught at Iowa State University) reflected upon traditional urban challenges such as unemployment, poverty and inequity in light of new infrastructural technologies. The studio posited that such technologies will create novel opportunities pertaining to small-scale entrepreneurship,
the sharing economy, the Internet of Things (IoT), new transport options (including driverless cars) and new logistical operations. Accordingly, cities are poised to afford new kinds of behavioral and lifestyle options.

Taught in the spring of 2018, the studio engaged the Omaha (Nebraska)-Council Bluffs (Iowa) metro area as a “test bed” to study the potential implications of coming infrastructural shifts. The metro region - an area comprising a population of approximately 860,000 that anticipates a 42% increase in growth by the year 2050 - was chosen as it typifies urban conditions found throughout the Midwest. Here, cities were initially established as part of trade routes, first reliant on rivers channeling flows of goods, with a gradual shift towards the infrastructure of rail to deliver flows more reliably and economically. Additional infrastructural layers gradually made new modes of life possible: the power-grid shifted daily rhythms so as to extend the workday into the evening hours; telecommunication lines enabled physically distant transactions to occur with ease; highway and sewage infrastructures helped spur massive suburban expansion. These infrastructures - carrying people, goods, and ultimately ideas - formed the skeletal framework upon which lifestyles and livelihoods were made. More recently, shifts in shipping and manufacturing protocols have moved major flows off-shore - leaving many Midwest towns struggling to fill the void. The Omaha-Council Bluffs metro, like many in the Midwest, has suffered massive upheavals over the past half century, resulting in unemployment, vacant lots and, for many, few economic options.

Omaha’s Metropolitan Area Planning Agency (MAPA), is a key organization involved in addressing the challenges of the region. Moving forward, MAPA has identified a number of key urban goals, including providing a more balanced housing stock, improving access and availability of jobs, stemming the exodus of young professionals and graduates, increasing equity, creating healthier environments, and reducing crime. The studio considered these ambitions in light of the novel capacities afforded through an increasingly digital and autonomous infrastructural age. It examined how new infrastructures might disrupt space, time, and information transfer, creating new efficiencies within the region that could help reignite communities in terms of employment, housing, and transport. Solutions to the fundamental urban issues the metro faces were re-envisioned - often through shifts from traditional bricks and mortar infrastructures into forms that inhabit virtual and informational space.

VISIONING

Students began by imagining what impact new technologies might have on people’s day-to-day lives. Amongst their findings, they speculated that many traditional urban amenities would be replaced by virtual platforms that bring goods, jobs, and services directly into people’s homes. While this certainly brings about a greater sense of convenience, students also
highlighted the potential negative consequences - as more and more goods and services are accessed from within the confines of personal space, there becomes less and less need to go out and experience the world. Thus, alongside the convenience of home-based lifestyles are the risks of sedentary, unhealthy isolationism, as well as an erosion of the public sphere. Accordingly, a number of students speculated about what architectural mechanisms might be deployed to lure people outside of their inner (and increasingly convenient) home-based enclaves to participate in maintaining both their personal well-being, and that of the broader public good.

The bulk of this article focuses upon one such investigation - Pluggable. Developed by Master of Urban Design student Reny Revariah, Pluggable envisions how people might dwell in the coming digital era by operationalizing a new kind of fluid, shifting, and atmospheric urbanism. The project builds upon the premise that our needs and desires do not remain fixed, that people enjoy variety. By offering the capacity to “plug into” a multiplicity of “atmospheres,” the project tackles issues of boredom and social isolationism, while also encouraging interaction within a highly curated and lively public sphere. The project further considers how a more equitable distribution of urban amenities might be leveraged in this speculative future. Specifically, Pluggable engages autonomous technologies and information transfer to enable traditionally static architectural elements to be mobilized. This is formalized in self-driving dwelling units that are deployed and recombined at different sites offering different atmospheric settings.

PROPOSITION

“Kate wakes up on Friday morning and looks out the window of her tiny home. She loves her small living space and finds that it easily accommodates her needs with its cozy living and kitchen area, dining nook and sleeping loft. Over time, she has carefully decorated it to suit her tastes, but today it is the view outside her window that she ponders. It is bleak. She looks directly onto a brick partition wall, one closely abutting her dwelling site. The sense is one of claustrophobia and, turning away in distaste, she moves to brush her teeth. After a quick shower, she glances at her watch - less than 15 minutes before she needs to head for work. It has been a short night at home - her deadline meant arriving just past midnight the previous evening, and she will be back at the office in time for the 8:30 am presentation. Just enough time for a coffee before she catches her Uber to work. The bleak view catches her attention again, momentarily. At least she needs to only tolerate it for a few more minutes before she leaves. She smiles to herself as she looks out at the brick wall. The money she has saved this past week living with this view will more than pay for the...
beautiful lakefront site she has already selected and reserved for the weekend. The past late nights at work have given her little chance to be at home but, with her deadline today, the weekend promises to be one of luxury and self-pampering. She closes and locks her home - her sweet autonomous home that will also soon leave the site - making its way across town to await her arrival on the lakefront that evening.” (Speculative musings by a future resident of “Pluggable.”)

Project Overview

Pluggable envisions a new housing typology enhanced by autonomous mobility technologies - ones enabling home units to autonomously relocate from site to site based upon shifting occupant needs. Pluggable leverages two emerging technologies: autonomous vehicular movement (operationalized at the scale of the tiny house), combined with fidelity of information transfer (enabled by apps), in order to consider a new mode of urban living. While people are away at work, their home self-drives to a new site - one tuned to meet their needs for that particular day.

Here, the “tiny house” precedent is re-imagined so as to be tech-enabled while, simultaneously, the economic benefits of small-scale living are placed alongside high-end amenities made more viable through the access economy. The access economy (often conflated with the sharing economy), enables a greater number of people to gain access to resources that otherwise would sit idle. While the sharing economy implies a partnership amongst individuals - sharing their resources in a common pool as part of a more collective endeavor - an access economy does not require individuals to share personal goods amongst each other. Instead, a third party manages access to a good that people then procure on an on-demand basis, for a fee. Costs associated with acquiring and maintaining a particular resource are then distributed amongst a broader public, making the price of access lower for all. As an example, Netflix provides a host of users with access to movies held within their database. This does not require that individuals coordinate sharing movies amongst each other. It does mean, however, that individuals do not need to “own” a personal movie collection in order to have access to a wide-array of films. In a similar vein, Zipcar does not involve individuals sharing their personal car, but it does allow individuals to gain access to a third party owned shared car on an as-needed basis. While Netflix imposes a flat fee for access regardless of the movie (new release or classic), Zipcar adjusts fees based on the type of car procured, with “regular” cars being less expensive than “luxury” cars. Such platforms allow resources that would otherwise be latent (movies idle on a shelf, cars idle on a driveway) to be deployed. Further, by delegating management to a third party, such platforms reduce the personal transaction costs normally associated with coordinating asset sharing (Fig. 1).

In Pluggable, limitations on personally owned square footage (tiny homes) are counterbalanced with amplified access to shared amenities. Accordingly,
the homes themselves are modest - ranging from 300 to 500 sq. ft. [27.9 to 46.5 m²], with additional square-footage possibilities provided by optional non-plumbed side extensions (that transport separately). Rather than each home (and any extension) having its own costly mobility system, transport of dwelling elements is enabled through a self-driving (autonomous) deployment system. Autonomous bots - conceived as similar to those used by Alibaba to sort warehouse pallets in China 4 - "plug into" a house only when transport is required. Navigation is assisted by drones equipped with a 360° camera and LiDAR technologies that deploy and couple to dwellings on an as-needed basis. Piloting software processes information received from the drone to guide the self-driving bots, enabling them to transport safely the dwelling units to new sites. Upon arrival, the bots deposit the dwelling onto a rented plot, aligning it with sewage and water infrastructure. They then de-couple from the dwelling - redeploying to other sites where navigation infrastructure is needed (Fig. 2).

While the designer envisioned homes as having an array of refined architectural characteristics, the focus of the project is much less on the details of the dwelling design (which are intended to be personally variable), and much more related to the overall dwelling strategies and their associated societal impacts. Thus, while the dwellings of Pluggable are visualized (and some architectural details suggested), the project relies less on the nature of the architecture in and of itself, and more on how new infrastructures and protocols enable new regimes of dwelling to occur.

Here, the most important shift is that while individuals maintain ownership of their dwelling units, the imbrication of home-ownership and land-ownership is de-coupled. Accordingly, "home" is something one owns, whereas "land" is something one accesses. This de-coupling allows individuals to gain access to a range of living options - each characterized by site-specific atmospheres. Pluggable conceives of a number of "niche" atmospheres branded to encourage experimental "sampling" of different
Figure 2. Mobility system (left) and architectural elements (right).
lifestyle offerings. While the number of such offerings are endless, the concept is illustrated using three atmospheric niches: a “chill” lake zone, an “active” forest zone, and an “educational” (edu) garden zone. Each is enhanced by ancillary amenities tied to its particular “brand.” Hence, the chill zone offers access to docks, boating, swimming and fishing, the edu zone is home to a community greenhouse, library and garden plots, while the active zone features trails, rec center, and games areas. Physical constraints of tiny home living are thereby mitigated by providing shared access to a range of site offerings. The presence of these amenities allows home-dwellers to experience changeable physical atmospheres, while also engaging in a shifting array of daily activities.

The project speculates that the lure of these distinctive atmospheres provides the impetus to draw people away from the sedentary isolationism associated with home-based convenience - providing a perpetual grab-bag of novelty that begs to be sampled. As will be discussed later, this desire for perpetual novelty is particularly germane in the context of a post-millennial world, where individuals have grown accustomed to constant stimuli and instant gratification (Figs. 3, 4).
That said, not all Pluggable sites are created - and gratify - equally. In addition to offering access to different amenities and atmospheres, each dwelling plot is subject to better or worse site conditions. Some plots afford prime views, while others are relegated to the periphery; some are peaceful, others noisy; some are public, some more private. These differentials result in access to plots being provided at varying price-points - with some more affordable than others.

However, unlike in the current real-estate market, this differential does not create a hard line between the "haves" and the "have-nots." In the present real-estate market, access to the "best" sites is tied to principles of ownership, implying access (or lack of access) 365 days a year. By de-coupling home ownership from site ownership, Pluggable enables individuals from diverse socio-economic backgrounds to gain access to specialized site amenities on a temporary, as-needed/as-viable basis. The plots available within different atmospheric sites can thereby cater to different kinds of lifestyle needs and capacities - from low-end to high end - chosen by individuals based on their requirements and resources at any given moment in time. Hence, unlike in mobile home environments (which also de-couple site ownership from dwelling ownership, but in a much less nimble manner), Pluggable offers occupants the capacity to procure temporary access to exclusive lifestyle atmospheres and amenities that, normally, are only available to the privileged few (Figs. 5, 6).
In order to achieve this flexibility, Pluggable makes use of information technologies to coordinate dynamic site allocations. Using a smartphone app, residents of Pluggable access a booking platform. This provides detailed information about available lots, such that individuals can designate their day-to-day desires by assigning “weights” to an array of variables. These variables might include the neighboring conditions (such as “prefer play-structures for kids to play on”), personal trade-offs (such as “do not mind poor views if close to spa”) and cost-benefit analysis (such as “can only afford lakefront plots a few times a year”). The parameters chosen are calibrated to highlight the applicable supply of lots, with new parameters chosen and weighted on a daily basis in accordance with shifting needs and desires. Accordingly, homeowners can wake up in the morning residing at one plot, go to work, determine their needs for that evening, select where they want their autonomous home deployed to, and return to that site with their homes waiting upon arrival.

In this fluid urbanity, residents of Pluggable gain access to a variety of housing atmospheres at a variety of price points, both of which can be calibrated on a daily basis. User preferences (and the prices associated with lots) can and do shift over the course of time. That said, real-time access to finely tuned information helps curate the dynamic interplay between individual needs and individual plot prices - with these finding daily
equilibria. While this fluid shifting is a key component of the system, it is also anticipated that people will, over time, return to "preferred" plots that meet their needs the majority of time (while retaining the option to inhabit other atmospheres periodically). Accordingly, rather than the decision to dwell in a given location being constrained by the limits of options available at the time when a home and lot are purchased, individuals can tactically test a variety of dwelling niches prior to determining more long-term fits (Fig. 7).

Related Precedents

Before moving into a discussion of how Pluggable alters dwelling options, it is worth contextualizing the scheme in relation to other forms of related housing: manufactured homes, RVs, tiny homes, and micro-apartments.

While the notion of a self-driving home may suggest immediate comparisons to traditional "mobile home" typologies, these are inaccurate. Mobile homes (officially referred to as "manufactured homes"), are ones constructed off site in factories under controlled conditions. This allows these homes to be built at substantial cost-savings to the consumer (generally 50% less per sq. ft.). This reduced cost puts the possibility of home-ownership into the hands of those who would otherwise not be able to enter the market. Ten percent of the US housing market is comprised of...
such homes, with the majority of these purchased by those in lower income brackets. While there are a small number of “high-end” manufactured home parks (notably in California, where homes near ocean views cost substantially more), such elite situations are the exception rather than the norm.

Accordingly, the most salient feature of these homes is, in general, the low-cost of their acquisition. The market is predominantly composed of lower income owners, with these purchasers choosing mobile homes because it gives them access to home-ownership unattainable in the “regular” housing market. It is this feature, not the home’s mobility, that drives the industry. Most homes are, in fact, moved only once: from the factory to the housing site. It is also this low-income characteristic of ownership that steers the general perception of mobile homes as being negative, with the populations often marginalized. Municipalities typically limit where such homes can be located, in response to the NIMBYism (Not-In-My-Backyard) of homeowners inhabiting more “traditional” lots.

As in Pluggable, the land upon which mobile homes are located is generally not owned by the homeowner. This gives the landowner of mobile home parks a huge amount of advantage over the homeowner. They are able to impose new fees, raise costs, or limit amenities. While the homes are theoretically “mobile,” homeowners actually have very little leverage in response to such tactics: the cost of moving a home - estimated at $2,000 per move - is prohibitive for these low-income dwellers. Accordingly, those residing in this form of housing are the least likely to have the resources available to change locations if there is a need, putting them at the mercy of park land-owners.

RVs [Recreational Vehicles - ed.] are somewhat similar to Pluggable, in that they are easily moved (though not autonomous). That said, RVs are more readily comparable to short-stay vacation typologies, rather than housing typologies. For most owners, RVs are not a housing solution, but a luxury camping solution. RV parks are typically located in campgrounds, and RV owners use their units as temporary accommodation that supplements their permanent home. The units are predominantly owned by retirees (93% over the age of 50), with incomes exceeding $50,000. While there are instances of individuals living full-time in RVs, these are the exception (often brought on as a temporary solution to economic hardship) rather than the rule. In keeping with their function as vacation dwellings, the majority of RV parks are located outside of city centers and urban job opportunities.

Tiny homes, unlike RVs, are intended for long-term dwelling and do not carry the same stigma as associated with manufactured homes. Those living in tiny homes often choose this as a form of intentional lifestyle, but still wish to be located in cities. However, many municipalities have restrictions on the minimum size of home that can be dwelled in on a
Figure 7. Overview of Pluggable.

private lot. Accordingly, tiny homes are often “camped” in temporary locations belonging to another property owner. Those choosing tiny homes are typically individuals voluntarily wishing to downsize, not as a result of economic hardship, but as a lifestyle choice that embraces voluntary simplicity. Mobility, per se, is therefore not integral to the home’s appeal, and those choosing to live in such dwellings often align themselves ideologically with eschewing high-end amenities.

Conversely, the rise in urban micro-apartment loft living, has been driven by the preferences of young urbanites, willing to sacrifice personal living space in exchange for the feel of living in a luxury hotel or spa setting. While micro-loft living is not mobile, the target users are young urban professionals who spend little time “living” in their homes, but want access to luxury when they have free time. Accordingly, such units provide resort-like settings for their communities - lounges, game-rooms, pool facilities, and café workspaces - all designed with high-end architectural detailing. Unlike shared amenities in older apartment buildings (which often had similar programs, but tended to be low cost provisions), these are intended to offer luxury living. The market for such exclusive high-end micro-living units is expanding, particularly in cities where urban housing is expensive and commutes are long.
In many ways, Pluggable’s orientation is closest to this last example. While urban micro-units are not mobile, the lifestyle on offer is the most similar in scope. The key difference is that Pluggable adds a mobility and variety dimension to the kind of amenity/luxury-oriented lifestyle that such micro-units offer. Here, the scope of amenity provisions is massively expanded and owners pay for access to shared amenities only when they actually need them.

DWELLING AS A COMPLEX ADAPTIVE SYSTEM

An analogy can be made between the dynamic interplay of the autonomous homes and their plot “niches” and the dynamic interplays at work in a complex adaptive system. In Pluggable, dwelling units behave as populations of autonomous deployable agents within a self-organizing, complex adaptive housing system - one that gradually enables “fit” dwelling regimes to emerge over the course of time, while maintaining adaptive capacities. In order to better understand the nature of such self-organizing regimes, this section detours into the science of complex systems: ones that generate fit regimes through the bottom-up actions of multiple independent agents.

The Roots of Complexity

In 1986, a bulletin circulated by the recently formed Santa Fe Institute announced an upcoming meeting to discuss Complex Adaptive Systems (CAS). This is perhaps the first “official” use of the phrase, referring to a class of systems inspiring inter-disciplinary research at Santa Fe. While the terminology was new, the principles being described were an extension of a broader area of inquiry that had slowly been formulating over the course of previous decades. These foundations of CAS included both cybernetics and systems theory, each of which aimed to unpack systems characterized by interactions and feedback processes, whose dynamics could not easily be captured by the standard cause and effect models that had been so successful in describing a host of systems. Despite the successes of standard models, there was a growing awareness that a broad range of systems - including those as diverse as flocking birds, stock-markets, forest-fires and the human brain - defied any sort of standard description. Research at Santa Fe argued that while, at first glance, such multi-variable systems appeared to be of entirely different orders, they are, in fact, governed by similar meta-dynamics - those involving complex adaptation.

CAS, though not subject to a universal definition can, in general, be understood as systems comprised of interacting agents, information signal transfer amongst these agents, and a source of external energy or resource driving the agent-based system. These interacting factors produce emergent and “fit” organizational regimes. Such systems are further characterized by non-linear feedback loops, whereby small shifts in initial
conditions can lead to large shifts in overall system behaviors. Accordingly, CAS do not unfold in clockwork-fashion towards a predicted outcome. Instead, history and time play a role, with behaviors unfolding in multiple possible trajectories. We thus speak of such systems as having multiple-equilibria or “end state” possibilities.\(^\text{19}\)

A useful illustration of CAS dynamics can be found in the example of ant trails. Here, individual ants are agents in the system, food is the resource driving the system (by creating a differential), and pheromone deposits (which ants leave upon discovering a food source) the source of information signal within the system. As individual ants randomly discover food sources, they deposit pheromone signals that steer the random trajectory of ants in the immediate vicinity. As ants are attracted to the pheromone source that leads them towards food, they amplify (weight) the pheromone signal, which in turn attracts more ants to the source. Over time, trails leading towards “fit” (or viable) food sources emerge.\(^\text{20}\) The trail is a global, emergent phenomena, generated through bottom-up ant behavior without need for top-down control. It persists as long as the food source is present and then dissipates to reconfigure elsewhere as new sources are identified. Furthermore, since the ant’s environment may contain a multiple array of viable food sources, the emergence of trails is a contingent process - subject to initial random fluctuations.

**Complexity in Planning**

While CAS research was initially spearheaded by those in biology, physics, and economics, it soon came to be of interest to urban planners. While master-planning schemes might be based upon ordering ideals - the grid, for example - planning failures were demonstrating that top-down designs were often unsuccessful at generating meaningful order. Gradually, and in light of the failures of such top-down schemes, planning theory came to question methodologies that aimed to control settlement and associated spatial patterns.\(^\text{21}\)

Early on, Jane Jacobs cited cybernetic theories when suggesting that cities be considered as complex entities - ones not easily managed through top-down control.\(^\text{22}\) CAS dynamics seemed to offer potential clues as to how such environments - comprised of multiple variables - might be understood. Planning in such contexts is difficult precisely because of the many variables at play. However, as computing power became cheaper, a growing body of urban complexity research began to build computational models aiming to code these variables, set rules for their interactions, and study simulation outcomes.\(^\text{23}\) These models held the promise of tackling multi-variable problems, with computational simulations seemingly providing a logical way to engage urban complexity. Simulations could act as planning tools, with models providing predictive platforms used to inform plan decision-making.
Despite the popularity of such models (particularly in computational geography), their overall impact on planning has remained somewhat muted. For many, models are perceived as highly technical and specialized - relegating such work to the planning margins. Furthermore, even within the field of computational geography, the insights gained by such models remain contested. While models are intended to be parsimonious with the conditions modelled, it is impossible to know if all relevant variables are being considered and if the model’s “rules” are, in fact, accurate. Furthermore, models are limited by the fidelity of their data, with model design tied to the availability of datasets. Accordingly, although computational geography is one of the first fields to engage with urban planning from a complexity perspective, its impact on planning practice remains limited.

More recently, parametric architecture has been popularized as a way of engaging complexity. Here, in work disseminated by practitioners such as Patrik Schumacher and Tom Verebes, different spatial, economic, and socio-political variables are coded as parameters that are parsed to generate architectural outputs. The physical features of the architecture shift dynamically as variables are altered and tuned to correspond with particular input conditions. While presenting evocative imagery, the execution of a parametric design requires a “freezing” of these models at certain assumption/input states. This freezing is the exact antithesis of the kind of fluidity and responsiveness that is characteristic of complex adaptation. That is to say, in typical parametric approaches to architecture, “adaptation” only occurs within the model - not within the architectural environment itself.

**Deploying Complexity on the Ground: Pluggable**

Pluggable would seem to offer another means of approaching planning in a complex environment. Here, the designer relinquishes top-down control all together (whether informed by models or not), and instead seeks to curate physical situations that have the inherent capacity to self-organize in situ. In Pluggable, individual housing units behave as the agents in the complex system, seeking to inhabit their “best” possible housing niche where they can exploit a particular range of site resources. “Best” in this case is not a fixed feature - what is best one day may not be best the next. But the system is adaptive: housing “agents” redeploy from site-to-site, plot-to-plot, steered by the information gleaned by the smartphone app that signals the availability of resources fit for the end user.

Individual housing plots adapt in tandem with the individual housing units. These are also agents in the system, each seeking to achieve the “best” balance between their occupancy and rental rates. Accordingly, housing plot agents behave as competitive entities - adjusting their prices to maximize their occupancy while also maximizing their profits. Plots can employ diverse strategies to become “fit” when carving a niche for themselves.
Some may “specialize” in offering low cost, low amenity offerings - a niche occupied when home-dwellers are simply seeking a cheap place for the night. Others may offer high-end amenities at price points yielding high profits on days when occupied. These plots may appeal to wealthier individuals able to afford access on a recurring basis, or serve a rotating clientele of individuals from diverse socio-economic backgrounds. Other plots might serve a “middle ground”: providing reasonable amenities at reasonable costs, but also offering different kinds of amenities for different user needs. Collectively, diverse plot strategies create a rich ecology of potential plot offerings, serving a diverse range of occupant needs while accruing the income required to invest in communal site amenities.

Hence, in the complex adaptive system that is Pluggable, two agent classes - autonomous housing units (with their occupants) and individual housing plots (with their associated amenities and price points) - co-evolve to generate an emergent fit distribution pattern of housing scenarios tailored to individual needs. The smartphone app serves as the link between these agents, providing real-time data that enables housing units (niche seekers) to be matched with housing plots (niches). Niche seekers indicate their preferences according to a series of independently weighted parameters (price, location, amenities, neighboring conditions, etc.). Over time, feedback helps steer the overall system towards more optimized settlement regimes - tuned to individual requirements while extracting the most potential value out of each available plot. These dwelling regimes combine a certain degree of stasis (as certain dwellers opt to stay put), while also accommodating shifting dynamic aspects.

Unlike in parametric architecture, the emergent pattern of settlement is not based on forecasting how variables interact. Instead, it is based on individual, enacted experiences and the feedback associated with these. This enactment may yield unexpected results: an individual might realize that their desire to occupy a gardening plot is not matched in fact with the action of gardening - and adjust their parameters accordingly. Concurrently, the expected value of a plot may not align with that plot’s desirability on a particular night, but can be adjusted based on shifting demand, in real time (Fig. 8).

The system differs fundamentally from today’s home-ownership market-driven decision-making. In the current model, there is a taken-for-granted imbrication between home-ownership and site-ownership. Consequently, individuals are required to conduct their domestic lives in ways that cater only to their average daily needs and economic capacities, rather than their exceptional requirements. This makes sense because, until recently, it has been difficult - if not impossible - to track and align shifting needs with shifting dwelling opportunities. But new information infrastructures change all this: offering the capacity to dynamically monitor fluid interests with pinpoint accuracy. Information can be re-calibrated daily, with a fine level
of granularity. Consequently, in contrast to current market-driven housing prices, the time-scale at which occupants calculate cost/benefit trade-offs for how they dwell is dramatically altered from the scope of years to the scope of days (Fig. 9).

Accessing “the Long Tail”

Today, hosts of apps are moving us away from “settling” for the normative to “targeting” the specific. A recent project, for example, crowd-sourced the characteristics of various movement routes through cities according to different fitness metrics. Rather than defaulting to one normative criteria for movement - the shortest route from "A" to "B" -, various routes were codified according to diverse criteria: the quietest, most beautiful, and happiest. Organizing routes based on different atmospheric criteria recognized that route desirability shifts not only from individual to individual, but also from day to day. A growing array of apps tuned to such specific performance criteria (through parameters), and deemed reliable (through reviews), allows individuals to customize their experience of the urban in ways that accommodate their personal requirements - rather than being "shoehorned" into normative standards.

In the case of dwelling, people, in general, live in a neighborhood geared to suit their standard resources and needs. This, despite the fact that there are times when one would willingly splurge on excess, and others when one would forego nominal comforts. Nonetheless, we are constrained to selecting housing options that remain fixed: paying to maintain access to experiences we are not using at a given time, while missing out on ones we desire at another. We are also required to make inflexible decisions regarding trade-offs between different desires. Thus, one may wish to access diverse amenities such as a hot tub, a pool table, or a workshop. But in today's ownership model, individuals need to navigate the trade-offs between these desires and their financial means. Accordingly, even if one were to determine that, overall, one desires a hot tub 50% of the time, a pool table 20% of the time and a workshop 30% of the time (the
fulfillment of each desire totaling 100%), one cannot dynamically enact these variables. Instead, one must relinquish one set of desires to furnish another - which will lay latent a large percentage of time. Only in exceptional cases people are wealthy enough to secure ongoing access to all.

Chris Anderson describes this full breadth of differential offerings as "the long tail" - a distribution pattern that describes systems characterized by resources that are in high demand in most instances, but also recognizes a huge scope of offerings that, though small, are functionally necessary to meet demand the rest of the time. Anderson argues that highly tuned niche offerings in this long tail have viable markets that, until now, have
gone untapped due to the difficulties in pinpointing where and when its offerings are required. Information technologies change all this, providing detailed access to the long tail of highly tuned offerings that appeal only to the few or only for a brief time, but are nonetheless viable if there were a way to match the desire to the offering. Anderson writes that: “Many of our assumptions about popular taste are actually artifacts of poor supply-and-demand matching - a market response to inefficient distribution.” He argues that a generic supply of standard artifacts may satisfy the norm but, in the end, no one is actually getting what they want. Instead, they are getting what the market has the capacity to supply with its coarse information availability. Anderson argues that new information technologies are now providing unprecedented access to this long tail of atypical and variable niches.

One of the “fingerprints” of CAS is this long tail distribution. Its appearance demonstrating that a system carries with it the capacity to manifest a broad array of singular and distinct offerings. The long tail sits in marked contrast to another well-known distribution pattern: the bell curve. This pattern is indicative of systems highly weighted to the average or the normative, with departures from this norm occurring only seldom and at the margins. In Pluggable, rather than housing patterns satisfying such developer bell-curve norms, the dynamics necessary for accommodating the long tail are in place. Pluggable establishes a broad landscape of variable affordances and then allows homeowners to explore that landscape. Rather than defaulting to fixed housing choices for the average, this fluid and dynamic urbanism is able to accommodate shifting patterns, means, and desires.

IMPLICATIONS/DISCUSSION

From Settling to Sampling

What might this domestic nomadism imply? Is it to our benefit to pursue such an urbanism, or would such unsettled settlement bode ill for the future? Long before autonomous vehicles seemed possible, Archigram envisioned a futuristic nomadic vision of architecture in its Walking City proposal (1964). But whereas Archigram’s city moved from location to location in search of scarce resources in a post-apocalyptic world, Pluggable assumes that a wealth of differentiated resources are available at different locations, with individuals partaking in the consumption of these based on desire. This smorgasbord of urban living defers commitment to one set of tastes, instead focusing on seamlessly navigating from site to site and lifestyle to lifestyle - a “sampling” rather than “settling” mode of domesticity.

Rather than valuing permanence and laying roots, this urban nomadism values experience and novelty. While this domestic arrangement might
seem counter-intuitive for a generation accustomed to the idea of fixed dwelling and home ownership, it would seem that the latter sits in closer resonance with the characteristics of the emerging digital world. This world is characterized by short attention spans: the ability to surf between tasks and web pages and applications, carried along by the impulses of the moment rather than settling into the task at hand. In this world, the stasis of anchored dwelling would seem to be an outdated, outmoded form of existence - as counter-intuitive as being tethered to the physical phone lines of yesteryear. Like surfing the internet from site to site, Pluggable's inhabitants similarly surf through the city - stopping for longer stays at sites that attract, moving on when boredom sets in. For an "iGeneration," raised on attention spans tailored to sound bites and video clips, the trade-off between lack of permanence in favor of continuous novelty may not feel like a trade-off at all.

Other cultural norms are being challenged by this same generation, who increasingly seeks the benefits of access un-encumbered by the responsibilities of ownership. This shift is most obvious as it pertains to vehicular ownership. Particularly in larger urban centers, many young people are foregoing car-ownership to instead access the flexibility provided by services such as Lyft or Uber. These post-millennials are shunning the hassles of maintenance, parking, and insurance, embracing instead a lifestyle that ensures access to a broad fleet of options available on an as-needed basis. Hence, while Pluggable violates current norms that tie home ownership to site ownership, this radical de-coupling would seem to align with broader cultural shifts.

It is worth highlighting that the willingness to partake in this access economy is being popularized not so much because of a rise of collective communal sensibilities but, instead, by virtue of technological transformations that ensure the reliability of shared resources without the hassles of collective management (that earlier sharing models required). Information technologies mitigate the coordination problems inherent in allocating shared resources amongst multiple-parties. App platforms that crowd-source, manage and reliably curate resources instill the trust regimes that previously needed energy, time, and face-to-face encounters to forge. Once these trust regimes are in place, people are free to explore a broader range of options, secure in the knowledge that risks associated with the unknown have largely been mitigated or removed. This is why individuals who would never have dreamt of overnighting in a stranger's apartment room (advertised on a public bulletin board) are now more than happy to meet their vacation needs using Airbnb. Consequently, people are given opportunities to sample a broader range of experiences - whether through online dating, traveling to remote locations, or enjoying music and movies they never would have been exposed to in the mainstream media. Sampling becomes ubiquitous and, eventually, normative. Pluggable taps into this zeitgeist.
Access, Civility and Encounter

While remaining anchored in place might have its own set of benefits - the establishment of long-term relationships, the commitment to place, the building of memories and associations - perhaps some of these benefits are over-stated. With permanence comes inflexibility, the reinforcement of stereotypes and pre-conceptions and the fear of otherness. Indeed, one of the major consequences of the developer model of housing is that it establishes housing monocultures marketed to people within a given socio-economic demographic. While gated communities are the most extreme example of this phenomena, invisible economic gates surround most neighborhoods.

These socio-economic gates are fundamentally disrupted in Pluggable. While the more expensive plots do remain somewhat exclusive, general access to these sites is not precluded. Instead, the constraints on experiencing multiple forms of urban living are loosened and made more fluid. The nomadic dweller is able to select budget allocations that suit shifting needs, annually sampling, for example, 10% “high-end”, 80% “average” and 10% “baseline” living. In those moments when urban dwellers choose to move outside the confines of their “normative” niche, they rub shoulder to shoulder with others and, equally, “others” rub shoulder to shoulder with those not normally granted access to high-end privileges.

In a time when differences are becoming increasingly polarized - rural/urban, republican/democrat, immigrant/native-born -, urban nomadism might offer a softening of such distinctions. Casual encounters amongst strangers, sharing a fishing dock, socializing around a play structure, planting together in a greenhouse, hold the capacity to provide the social glue necessary to maintaining a civil society. Fostering such encounters becomes even more critical if we continue to increasingly isolate ourselves within digitally mediated filter bubbles.31 The opportunities to shift locations, shift activities and shift encounters can provide people with more opportunities to interact with a broader range of individuals - extending civility outside their comfort zone, cushioned by the security of the transitory nature of such encounters.

Today, only a privileged few have access to the “best” sites - waterfront estates, forested acreages, sprawling ranches. The vision of what the “good life” entails is something that the majority can only see from afar. Such distinctions are absolute: one either does or does not have the resources needed to access to these privileged sites. Pluggable does not erase these distinctions, but instead blurs them. One might gain access to such resources 2% of the time, 12% of the time, 22% of the time - the boundaries for entry do not disappear, but they become more fluid and dissipative. Furthermore, upheavals created by shifting circumstances such as the break-up of a marriage of the loss of a job need not result in absolute displacement (foreclosure), but instead a less disruptive shift in ratios of access.
CONCLUSION

I wish to acknowledge that aspects of Pluggable that highlight the "good life" as a kind of normative goal would seem to endorse notions of urbanity in their least enlightened form - that the trappings of "spa access" and endless consumptive lifestyle options are the precise opposite of what we should be striving for in designing for a more just, civil society. Furthermore, the scheme can be read as embracing the same principles as that of neo-liberal economic competition - principles that run counter to current critical sentiment within the broader urbanism discourse.

While the scope of this paper does not permit me to engage in a more nuanced discussion of these aspects, I wish to offer that, despite the many criticisms of the neo-liberal project, there are currently few alternatives on offer. It is true that certain feature of CAS dynamics do bear close resemblance to the competitive economic optimization principles of the neo-liberal project. That said what, exactly, is being optimized? Pluggable provides a mechanism to help drive forward consumptive material enhancements - the "good life." But it also places on offer many different forms of optimization criteria - a large number of which pertain to values that are both civic and deeply personal in nature. We live in a time when many of us feel isolated. Despite unprecedented access to entertainment and goods, we seem to lack opportunities to engage in meaningful activities and encounters. Families are often fractured and job instability require us all to become urban nomads as we relocate for work - increasingly finding ourselves dwelling amongst strangers. A more fluid, contingent and variable urbanity may offer us access not only to the "good life" but also to new potentials, friendships and discoveries about ourselves that we might previously have been too constrained to explore.

Much of the critical academic discourse on futuristic "smart" urbanisms has focused upon the risks of an increasingly surveilled and monitored society. These dystopic visions raise the alarm that we, as individuals, will be turned into monitored data-sets that are mined by powerful sources to garner profit and control. While it is crucial to highlight and contest such futures, it is also important to remain cognizant of other, more emancipatory potentials of "smart" infrastructures. Curated carefully, information infrastructures may sidestep the "big data" controlling environments that many are cautioning against. Instead, "small data" - the individually curated needs that fuel individual lives - can be mobilized to enable new and tailored existences. Pluggable creates a vision of what such bottom-up mediation of information technologies might offer. Not so much the "big-data" global optimization of a command and control technocracy, but instead a "little-data" local optimization that stimulates heterogeneity.

In another vein, Pluggable illustrates how certain taken-for-granted urban assemblages - "home ownership + site ownership = domesticity" - might
be more contingent than we imagine. Reading Gilles Deleuze and Manuel DeLanda would suggest that, as assemblages become de-stabilized and de-territorialized, novel regimes are made possible. If, in these moments of de-territorialization, we are provided the chance to experiment and to explore, then (perhaps) these lines of flight can lead to unexpected discoveries on ways to dwell differently amongst one other. As the tight lines that keep dwelling in stasis are loosened to become more malleable and fluid, individuals are given a greater breadth of freedom to navigate their way through novel territories - ultimately determining what kind of domesticity to engage and enact. It remains to be seen whether, given this option, a more civil or more divisive society emerges.

Notes

6. Ibid.
26. Daniele Quercia, Rossano Schifanella, and Luca Maria Aiello, “The Shortest Path to Happiness: Recommending Beautiful, Quiet, and Happy Routes in the City” (proceedings of the ACM Hypertext conference, Santiago, Chile, September 2014).
Acknowledgment

The authors would like to acknowledge Professor Mira Engler, who co-taught the urban design studio in 2018 alongside Sharon Wohl. Professor Engler was responsible for developing the studio concept and pedagogy with the author, as well as providing ongoing studio critiques for the Pluggable concept. Deep appreciation is also extended to Steve Jensen, former lead planner for the City of Omaha (Nebraska), for his help in developing the studio syllabus, his input on student work, and his coordination of site visits. Finally, appreciation is extended to Omaha by Design, who hosted a curated exhibition of the student work in the spring of 2018.

Credits

Figures 1-9: images by © Reny Revariah.

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