Data Urbis: Digital Processes of Analysis and Intervention in Contemporary Cities

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ABSTRACT
According to a 2008 report on world urbanization published by the United Nations, the number of people living in cities has surpassed the rural population for the first time in history. Furthermore, current projections (United Nations, 2008, 3) show that the majority of growth will occur in cities in the developing world, a tendency which will significantly contribute to the increased complexity of the urban environment. This paper is concerned with critically reflecting on the role of computation in the emergence of recent practices and strategies which intend to successfully confront the intricate performance of present and future metropolises.

KEYWORDS: digital design, cities, computation, urbanism; planning

The presence of digital technologies in urbanism is not foreign to designers, architects, and planners. However, since the inception of CAD in the late 1970s and early 1980s, the profession has, for the most part, approached the use of these tools with reservation, envisioning the computer as a powerful drafting and visualization instrument that bears the promise of ever-increasing efficiency in the process of representing projects.

In the early 1990s, advanced academic circles and design practices in architecture were engaged in rigorous research on the opportunities of using certain animation and motion graphic software packages that were popular at the time within the film industry. The fascination with these technologies was propelled, on the one hand, by access to increased computational power, and on the other, by a growing interest in issues of time, emergent systems, and self-organization, which had been motivated by the dissemination of the works of Bergson, Prigogine, and others. The city, understood as a field (Kwinter, 2001, 67) rather than a homogenous space, became the ideal research laboratory to conduct these experiments. By employing tools such as Maya particle systems designers attempted to simulate in the virtual world of the computer the complex behaviors observed in urban systems.

Given the urgency of addressing the problems of growing metropolises as well as of new urbanizations, it is crucial at this point to examine and debate the role of computation’s creative potential as a more appropriate means of operation to face these challenges. In this paper, I present a brief review of three contemporary methods for urban analysis and planning, which move away from traditional practices and theories, namely: diagrammatic urbanism, scripted urbanism, and virtual urbanism. Additionally, I reflect on how digital tools are actively used in these processes, yielding more responsive interventions in tune with the current conditions of the city.

Flows and Diagrams
“What matters is not agriculture per se, but the great increase in the flow of matter-energy through society, as well as the transformations in urban form that this intense flow makes possible” (De Landa, 1997, 28). In 1999, the International Foundation for the Canadian Centre for Architecture (IFCCA), headquartered in Montreal, organized a major urban design competition that challenged participants to devise new ways of thinking about cities and their future. The brief asked for proposals for the planning of Hudson Yards, an underutilized area located on the west side of Manhattan characterized
by the presence of heavy transportation infrastructure (Mus- 
camp, 1999). Among the five teams invited to submit designs, 
was the Amsterdam-based firm UN Studio, led by Ben van 
Berkel and Caroline Bos. For them, the IFCCA competition was 
an opportunity to continue testing proposals “to move away 
from the traditional interpretation of the urban planning pro-
cess as a shifting around of volumes and to adopt a new ap-
proach based on new techniques and a new cooperative work 
strategy” (van Berkel & Bos, 2000, 46).

The origins of this alternative approach to urban design can be 
traced back to a master plan for the design of a 160,000 m² 
transportation-oriented development in the city of Arnhem, in 
the Netherlands. For that project, UN Studio had expressed the 
need to respond in creative ways to the challenges and oppor-
tunities posed by issues of interconnectivity, communication, 
and flows in postindustrial global urbanization. The solution 
was a process they referred to as “deep planning”.

Deep planning is a method which relies primarily on animation 
techniques to produce 3D analytical graphs of movements, ac-
tivities and frequencies of use in the urban field. The process 
tracks flow through time, allowing a team of designers to visu-
alize areas of overlap between programs, to examine interre-
lations across multiple categories, and to access information 
originating from diverse sources. This offers a comprehensive 
visual reading of the configuration and behavior of the city 
through a specific period of time. To actualize the data and 
translate it into architectural components, UN Studio employ-
es used “operational diagrams”, devices which are capable of 
encapsulating the performance of a site to evoke explicit spatial 
and structural organizations (van Berkel & Bos, 1998, 22). In 
the case of the master plan for the center of Arnhem, for example, 
UN Studio utilized the Klein bottle diagram (Fig. 1) as a referent 
to investigate opportunities in the spatial arrangement of the 
station area, expressing the fluidity of the continuous circulation 
trajectories on the site, while identifying connections between 
movement and other programmatic elements of the project.

Arguably, one of the most advantageous characteristics of the 
use of deep planning over more traditional planning methods 
to address the current urban complexity, is the incorporation 
of the notion of time as an element of consideration in the gen-
eration of design proposals, allowing for a dynamic analysis of 
movement in connection to the territorial performance of an 
area in the city. Moreover, with advanced modeling and anima-
tion software packages designers can observe and study the 
fluidity of these phenomena instead of perceiving them in a 
frozen state; this enables them to scan areas of potential inter-
action, which can be integrated later into diagrams and spa-
tialized into innovative urban interventions. Computation, as a 
time-based relational generator, becomes an essential tool to 
make this achievable.

**Scripted Territories**

“The catalogue of forms is endless: until every shape has found 
its city, new cities will continue to be born. When the forms ex-
haust their variety and come apart, the end of cities begins” 
(Calvino, 1974, 139). Design endeavors based on scripting, which 
use computer coding as the cornerstone of the process, require 
designers to formulate all architectural and urban elements in 
a project as parametrically programmable entities. The code 
translates the behavior of particular systems into geometric 
forms by defining distinct relations and rules of operation, or 
protocols. Despite the fact that a number of scripting languages 
have been available to designers for quite some time now—in-
cluding C++, RhinoScript, and MEL, to name a few—it is fair to 
say that only until recently, with the release of the Grasshopper 
plug-in around 2007, these techniques became pervasive and 
accessible by a wider group of practitioners. Grasshopper is an 
affordable graphical scripting editor, developed to work within 
Rhino’s 3D environment to provide an intuitive platform to ex-
plore parametric design while eliminating the need for learning 

In the last decade the Architectural Association in London, 
more specifically its Design Research Lab (DRL) program, has 
pioneered a series of research studies on the dynamic charac-
ter of cities, and on how architects can retool and operate to 
articulate this complexity using a variety of methods, including 
scripting. The research has been conducted simultaneously 
through a series of explorations carried out by a handful of ar-
chitecture offices; however, perhaps the urban design projects 
developed at Zaha Hadid Architects (ZHA) are those that bet-
ter illustrate this new approach (Fig. 2). Patrick Schumacher, 
partner at ZHA and co-director of the DRL at the Architectural 
Association, has been one of the strongest supporters of a shift 
towards a more script-oriented practice of urban design and 
architecture, arguing for “parametricism” as a new style in ar-
chitecture (Schumacher, 2010, 266).

In 2006, ZHA won a competition for the Kartal Pendik master 
plan, a new city center on the east bank of Istanbul. The 555

![Figure 1. Klein bottle diagram by UN Studio](image)
hectare site, characterized by the presence of heavy transportation infrastructure and dilapidated industrial buildings, needed to be reactivated by the introduction of new urban elements, which included a central business district, residential developments, and cultural facilities. In order to tie Kartal Pendik back to the surrounding context, the project relies on scripts to create the conditions necessary for the emergence of a flexible set of urban typologies that gradually articulate the new soft fabric of the city with the requirements and complexity of each individual district. The transition between the old part of the city and the new development is achieved through a network of interconnected public spaces and the progressive densification of volumes, both parametrically fine tuned by scripted definitions (Fig. 3).

At the scale of the city, scripting is enabling designers to calibrate the way in which these relations inform urban space, using geometric grammar as the tool to introduce significant differentiation. Through the simultaneous production of a diversified population of buildings, morphological repetition can be avoided, permitting the architecture to be affected by the variation of contextual conditions. It could be argued then that, to a certain extent, the script functions in this case as an abstract diagram, disembodied from any literal representation of a specific shape or form, but capable of outputting a series of more responsive spatial arrangements and meaningful typological transformations (Fig. 4).

The City on the Cloud: Virtualizing the Urban Experience

"Each familiar species of public space had its actors, costumes, and scripts. But the worldwide computer network—the electronic agora—subverts, displaces, and radically redefines our notions of gathering places, community, and urban life" (Mitchell, 1995, 8).

During a press conference in Bengaluru, India, in early 2009, Cisco Systems unveiled its “Intelligent Urbanization Global Blueprint”, a program that is part of its “Smart+Connected Communities” initiative. John Chambers, Cisco’s Chairman and CEO, announced that “in a world where all things are becoming connected, the network has become the next utility, enabling holistic, intelligent and environmentally sustainable creation and management of cities, industries and public services” (Cisco Systems, 2009).

Cisco is not the only technology company who is considering the business of urbanization as one of the largest market niches over the next years. IBM, with its Smart Cities program (IBM, 2010), Hewlett Packard, with City 2.0, and others, are identifying an opportunity to use their portfolios of products and technologies to create formulas for an array of systematic problems affecting contemporary cities, from public safety to transportation, buildings, energy, healthcare and education.
The breadth of the solutions is not limited to addressing the problems of existing cities. Cisco, for example, is participating in the creation of New Songdo, in Korea, one of the new planned instant-cities currently under construction in Asia. Proponents envision this 300,000 person community as a sustainable city completely wired with Cisco’s digital infrastructure. All utilities and services are planned to be linked and monitored in real-time through multiple sensors controlled by a main operating system that, in theory, will increased efficiency in the management of the city’s resources. In addition, all homes, offices, and other types of real estate, will be furnished with, among other things, points of access to Cisco’s TelePresence videoconference systems in order to offer permanent connectivity—the possibility of attending meetings, classes, appointments, and cultural performances by virtualizing these activities.

There has been very little debate about the consequences that initiatives like New Songdo will have in the way people experience living in the new instant-cities. However, it is interesting to highlight that the primarily concern in this approach is not the production of a new form or type of urban space, at least not directly, and not in the conventional sense of the word. Nevertheless, when compared with the first two strategies reviewed in this paper, it is provoking to speculate about the impact that the virtualization of urban experiences will have in the redefinition of traditional public space, and the social and cultural behavior of cities.

**Conclusion**

In this paper I have reflected on the importance of investigating more appropriate processes to interrogate the challenges posed by the growing complexity of contemporary metropolises. Additionally, I have attempted to demonstrate the significant role digital technologies and computation have had in the development of new strategies for shaping cities, revealing how these methods are yielding a new kind of urban sensibility and coherence. Just as advanced fabrication technologies have recently provided designers with a more direct way of connecting with the materiality and constructability of architecture, perhaps in the case of the urban interventions computation is today providing us with the mechanisms necessary to reach a deeper understanding of the behavior of our cities, and of what ultimately constitutes their urban “matter”.

**References**


