NETWORK Structures and Emerging URBAN FORMS

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In the Internet age networked structures have become the organizational model of cultural and technological production. A network is an abstract organizational model that is concerned only with the structure of relationships between things, be they objects or information. Social networks that resulted from technical infrastructure have generated new categories of public commons. In the last twenty years the increasing emergence of telecommunication networks and the understanding of network structures in relation to space have situated network forms within the discussion of future urban environments. Many questions arise by thinking about how these networks inevitably affect almost all of our daily activities.

INTRODUCTION

Manuel Castells states in his book The Rise of Network Society: "The network society itself is, in fact, the social structure which is characteristic of what people had been calling the information society or post-industrial society." The relationship between networks and contemporary society underlines the importance as well as the opportunities given by forms of networks to establish conditions for mutated concepts of social-cultural space.

In this context network society is understood as defined by Jan Van Dijk as "a society in which a combination of social and media networks shape its prime mode of organization and most important structures at all levels (individual, organizational and societal)." Similar positions are also offered in James Martin's book The Wired Society: A challenge for tomorrow. The decreasing supremacy of the street or the plaza as the main meeting point and space has led to a development of what William J. Mitchell calls "electronic agoras." He argues that the worldwide computer network—the electronic agora—subverts, displaces, and radically redefines our notions of gathering, place, community and public life.

The network has a fundamentally different physical structure, and it operates under quite different rules from those that organize the action in the public places of traditional life. It will play a crucial role in the twenty-first century urbanity just as the centrally located, spatially bounded, architecturally celebrated agora played in the life of the Greek polis.

Michael Batty and Andrew Hudson-Smith argue in their essay "The Liquid City" that in the nineteenth century energy was the catalyst to expand cities and the connector between physical territories that were otherwise isolated. The shift from energy to information, from "atoms to bits" as eloquently phrased by Nicholas Negroponte, is changing cities in ways that are not visible at first sight. Globally the effect of such communication is that cities are starting to merge into one another, if not physically, then digitally.

Two questions arise: 1) How do information-based environments affect traditional urban typologies? 2) How are designers able to shape the agency of networks? The direction for answering the first questions is: If in the past, until the end of the nineteenth century, cities were usually physically connected and able to expand and conquer new territories, they are now witnessing the shirking and replacement of some obsolete urban functions with others that enable the expansion of the digital network. This network expands by capturing the various flows of exchange in the city. The city begins to grow from a series of nodes that are all connected reversing the mono-centric condition to the polycentric form. The future is likely to reflect, through the physical form, the many levels of complexities and opportunities of the network itself, where overlapped, multi-layered, simultaneous and metabolic conditions will be the operative terms used to re-think future urban development.

An answer for the second question can be found in Lee Stickells' essay "Flow Urbanism": "The interest in flows can be positioned within a wider discussion regarding the nature of the contemporary city and the emerging tensions between its fragmenting physical fabric and multiplying electronic socio-economic networks." Within the logic of space developed through flows as the physical entity of network forms, Paul Virilio argues for a transfiguration of architectural materiality given an increased level of connectivity. "The old agglomeration disappears in the intense increase of telecommunications, in order to give rise to a new type of concentration: the concentration of domiciliation without domiciles, in which property boundaries, walls and fences no longer signify the permanent physical obstacles."

As the city is continuing to spread into physical and non-physical nodes and links, this diffuse vast plane can be described as Rem Koolhaas'

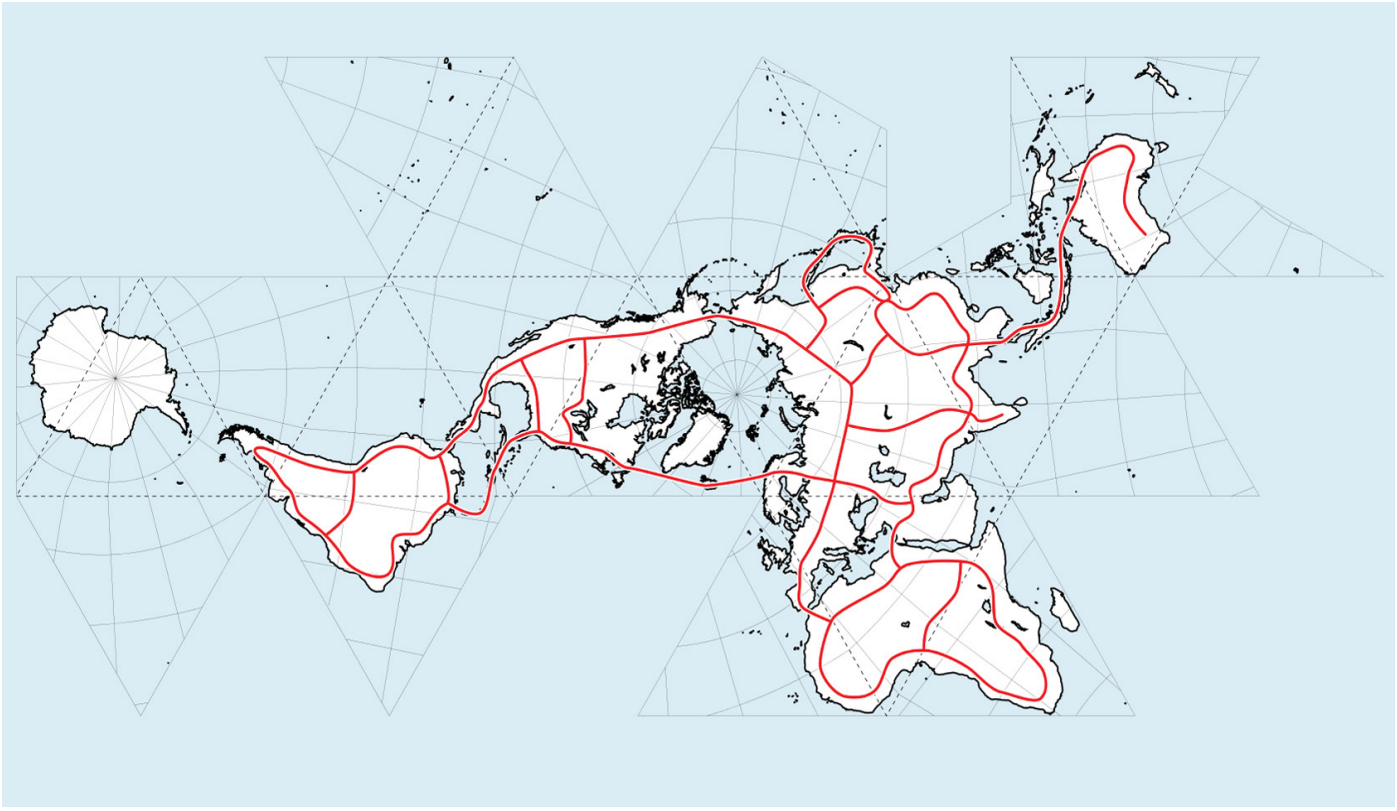


Figure 1: Vision of global electrical network, Buckminster Fuller, 1938

generic city. Koohlaas describes the contemporary process of urbanization: "if there is to be a "new urbanism" it will not be based on the twin fantasies of order and omnipotence; it will be the staging of uncertainty; it will no longer be concerned with the arrangement of more or less permanent objects but with the irrigation of territories with potential; it will no longer aim for stable configurations but for the creation of enabling fields that accommodate processes that refuse to be crystallized into definite form. It will no longer be obsessed with the city but with the manipulation of infrastructure for endless intensifications and diversifications, shortcuts and redistributions—the reinvention of psychological space."

Koolhaas envisioned urban forms moving into a space that embodies the flux and the formal qualities of the infrastructural network. Smooth space envisioned by Gilles Deleuze and Pierre-Félix Guattari embodies the agency of the network dissolving urban typologies conceived as objects. "The smooth is the continuous variation, continuous development of form and the points are subordinated to the trajectory." Flat space, horizontal and distributed are the spaces of encounters. The taxonomy of the city as square, street, park, and so forth is subverted by the logic of non-hierarchical forms. Here is what the network physically could embody, because network topologies engender forms of horizontal encounters and node densification rather than supremacies of spaces. The city is determined by diffuse systems of relationships overwriting hierarchies.

The spatial distribution of networks is reflected in the pattern of city-growth that mimics network morphologies. Polycentric and distributed cities are evolving into constellations of nodes connected by both high-speed transportations and digital networks. New socio-spatial realities emerge encompassing the metropolitan and the global scale. As a result, governors and city mayors, educational institutions, e-entrepreneurs, the information technology industry, community developers, planners and urban designers among others have come together to reinvent locales as more livable, sustainable and vibrant digitally connected communities. The rallying cry of these coalitions is often a denunciation of urban sprawl and its consequences, including central city decline, lack of affordable housing, long commutes, traffic gridlock, fast-disappearing open space, environmental pollution, dependency on cars and mass-produced and boring development patterns.

SOCIAL PRODUCTION OF SPACE THROUGH THE NETWORKED PUBLIC

Buckminster Fuller and Marshal McLuhan imagined how information technology might impact architecture and urban space long before the arrival of the Internet. Both imagined the consequences of information networks on the built environment. In 1938 Fuller suggested a world-wide energy network and a housing project based on the telephone network. In 1962, McLuhan coined the term "global village" and predicted in his book The Gutenberg Galaxy: The Making of Typographic Man the Internet thirty years before its arrival. The argument was that the digital network would be a catalyst to create a worldwide

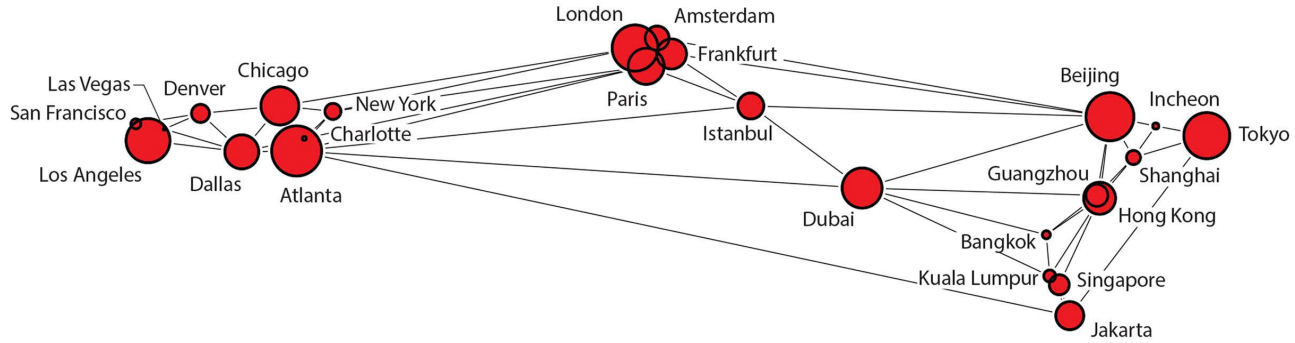
community. By the 1990s the Internet became global and started to be incorporated into general daily life. The invisible infrastructure of digital networks has been realized and is constantly feeding us with new information. The focus has been partially shifted from the physical city to the immaterial infrastructure attributing to the information network the ability to instigate new forms of social and cultural experiences.

The boundaries between invisible digital networks and the physical city have blurred. An understanding of the urban environment as a network is suggesting new hybrid conditions that are both inter-scalar and metabolic. Over the past few years the collapsing of such physical networks with non-physical has led to a new condition, an urban experience defined by hybrid networks that are both, partly physical and digital. These networks are transferring parts of the physical urban experience to inform new digital layers of information. Such networks have become active agents in the experience of everyday life and an important parameter for any form of spatial practice. Daily activities are informed and influenced by them as people move towards a new type of publicness that has new needs and modes of physical and non-physical encounter, a public that will enable the continuous mediation between the digital and the physical space. Architects, urban planners and designers should engage these dynamics through a design perspective as the physical city is re-imagined as a sentient being in a continuous state of flux.

Network technologies might contribute to the dispersal of private activities throughout public space while they are also able to promote and stimulate collaborative public forms. Free hotspots, currently implemented in many cities throughout the urban fabric, are one example. Such public open nodes dispersed throughout the city will be useful on multiple levels such as enhancing city management, public safety and stimulating economic growth and providing new platforms for social interactions. At the same time, the mobile device has led to a personalization of public space.

Bike-sharing systems demonstrate how citizens interact with hybrid networks that are constructed from both the digital and physical. One of the largest networks of bike-sharing stations is in Paris; it is called Velib. By using smart phones people can search for the closest station and check for available bikes to be taken for biking through the city and—at the same time—the system is creating new bike-sharing communities. This type of system is quite common and now shared by major cities throughout the world.

Network of goods and people



Network of data and communication

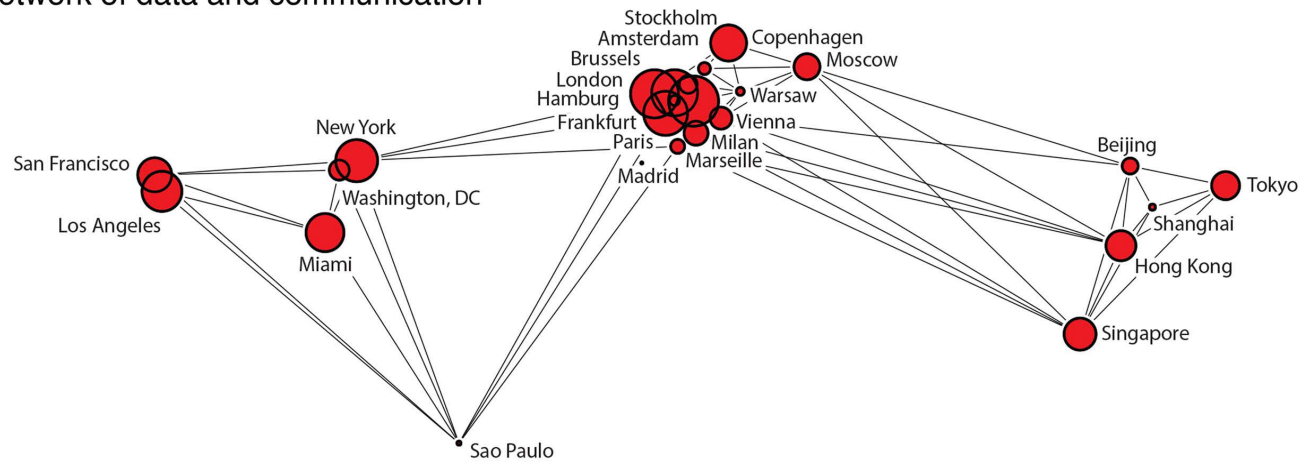


Figure 2: Network diagrams based on a 2015 anlysis by Mc Kinsey Global Institute

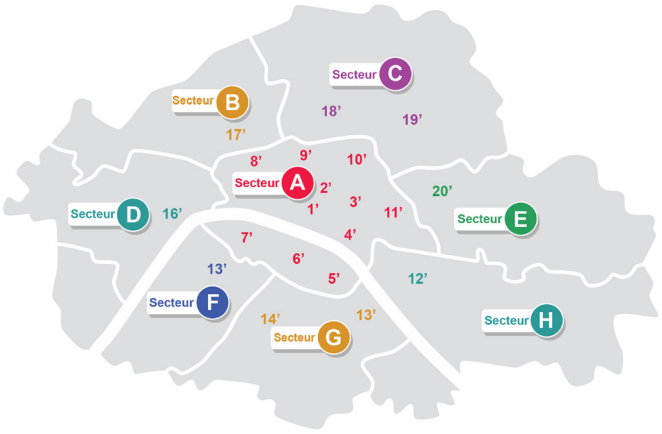


Figure 3: Map of Velib, a bike sharing system of Paris.

MapMyRun is another prototypical example of such a system. It is a mobile app that enables citizens to track their running route, time, distance, speed, pace and calories in real-time for their urban fitness activities using GPS integrated in their mobile device. It suggests a route to run but also invites individual runners to share their routes. The individual is not just following a map but is becoming a map-maker for others; the sharing of information instantly creates new communities and influences how the physical space is experienced.

As an individual device the "computer" is going to be superfluous, in its place all of the surrounding and everyday objects will be equipped with digital technologies. Cities will become an ecosystem of mutually communicating objects, buildings and virtual environments. These ecosystems will generate new communities and a new form of public. Objects, people and places will become increasingly connected through network forms while becoming active agents in the process of urban production.

LOCAL AND GLOBAL ACTIONS AND AGENCIES

The sentient city emerges from the continuous hybridization and the layering and overlapping of physical and digital systems. The word "sentient" implies a system that is conscious or aware and able to respond. Applying this concept to urban scale, one can envision a model that uses digital networks to integrate physical space and technology at a social level to produce a new system of relationships that encompasses shared knowledge, collective actions and coordinated interactions between individual actors and the collective.

The systems that make up the sentient city are able to learn and will become "smart." Carlo Ratti, director of the MIT-SenseLab, describes in an interview with Wired magazine how citizens will become the vehicle of such networks: "By receiving real-time information, appropriately visualized and disseminated, citizens themselves can become distributed intelligent actuators, who pursue their individual interests in co-operation and competition with others, and thus become prime actors on the urban scene. Processing urban information captured in real time and making it publicly accessible can enable people to make better decisions about the use of urban resources, mobility and social interaction. This feedback loop of digital sensing and processing can begin to influence various complex and dynamic aspects of the city, improving the economic, social and environmental sustainability of the places we inhabit."

Over the last years the worldwide web has been the terrain for public debate and collective organization. Through the Internet, numerous protests and movements originated and instigated by the open network enabled individuals to organize themselves as groups to take action and to subvert top-down rules. Open processes of collective self-organization have increased; the agent being the network, the actuator is the individual citizen. The 2012-13 Egyptian protests are one of many examples. As the military closed Tahrir Square from demonstrations social media pages such as "We Are All Khaleed Said," with more than 1.6 million followers were used to organize protests and campaigns elsewhere in Cairo with thousands of people participating. Another example is the increasing number of non-political events such as flash mobs performances organized through social media. Masses engaged at that very large scale through social media networks are more and more affecting the meaning of public space.

Bruno Latour argues in his book Reassembling the Social: An introduction to Actor-Network Theory that the network has the capacity to perform. The network of a sentient city is made up of humans, objects and digital technology in which the actuators and actors are not only humans but also technologies. Latour claims that not only humans have agencies in the creation of the urban spaces, but also technologies. In this framework, both human and non-human are performing, acting and creating the script of the public realm. The notion of agencies that applies to objects, infrastructure and other networks becomes the trajectory necessary to understand the mutual influences between actuators, actors and agents in the socio-technical space.

For architects and planners, this capacity of defining new actor-agents relationships to reactivate the public space expands the possibilities in designing public spaces in cities. In such a design process it will be necessary to understand what an object does, its role in the space and how the form itself will become a spatial agent, an action. The urban environment grows or changes because of the active forms within it. Sociologist Manuel Castells argues, "Everything we do, from when the day begins until it is over, we do it with Internet. The connection between in-situ and virtual is established by us. There are not two different societies; there are two kinds of social activities and relations within ourselves. We are the ones that have to search the best way to arrange and adapt them."

As the network offers different forms of social space, a variety of web-communities are created, proposing different models that could replace, integrate or expand traditional models of public encounter and gathering. These new models will not threaten the importance of public space but, on the contrary, foster new models of public-spatial organization through a more hybrid urbanity.

The Internet provides the tools and technology needed to claim the public that is leading towards models where the collective is empowered in the construction of the common and the shared. Participatory processes are enabled, and the Internet is the catalyst. If the construction

of the public space is inherently collective, the network is then able to accelerate the process. This requires considering the parameters and potentials offered by hybrid networks when producing scenarios for cities and public spaces. Hybrid networks provide opportunities for public empowerment and for the citizen to transform public space. The currently dominating top-down urban systems will be over time increasingly confronted by local bottom-up actions. In this way the sentient city of hybrid networks can overcome homogeneity and promote a different mix between public and private activities and urban spaces.

Michael Batty and Andrew Hudson-Smith argue for the catalytic potential of bottom-up in their essay "The Liquid City": "Our understanding of how cities function is predicated on action from the bottom up. Cities are built by actions exercised by individuals on behalf of themselves or larger collectives, agencies and groups mainly configured as local actions. Global patterns emerge, best seen in how different parts of the city reflect the operation of routine decisions which combine to produce order at higher and higher scale."

Mimi Zieger states that tactical urbanism uses the city as a site of experimentation, deploying pop-up parks, vacant retail reuse, or unsanctioned street furniture as ways to reprogram the urban realm. The practice traditionally takes an activist position in relationship to environmental, political, cultural and economic factors. However, as the practice is increasingly being absorbed into mainstream thinking on cities, it is critical to look closely at both the underlying assumptions and resulting effects.

According to Dan Hill, the use of digital and interactive technologies should focus on transparency, open processes and open access to information, as these aim at a more human understanding of the city. The changes derive from the user, from the system of networked and coordinated actions that have the potential to reprogram the software of the city.

In recent years a wide array of projects has been developed with the aim of experimenting with digital-tactical intervention. Although situating and acting locally, these can become prototypes that through the network acquire global relevance for the issues and processes implemented. Such projects propose the integration of the network within design parameters and act as bottom-up models to demonstrate the potential of information as a catalytic value added to the physical layer.

How the integration of information between citizens and systems can be organized is demonstrated by the Amphibious Architecture project. This project was developed by David Benjamin and Soo-in Yang with Natalie Jeremijenko and sponsored by the Architectural League of New York in 2009 for the "Toward the Sentient City" exhibition. It is a floating intervention that provides an interface between life above water and underwater. Two networks of floating interactive tubes, installed at sites in the East River and the Bronx River, house a range of sensors under water and an array of lights above water. The sensors monitor the water quality, the presence of fish and human interest in the river's ecosystem. The lights respond to the sensors and create feedback-loops between humans, fish and their shared environment. An SMS interface allows citizens to receive real-time information about the movement of fish via

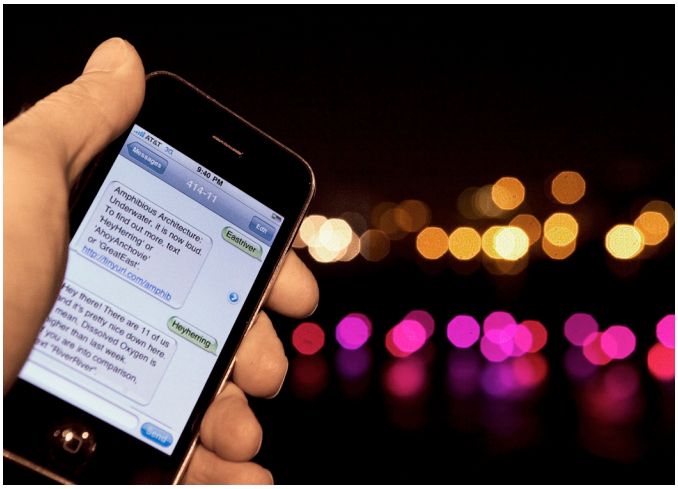


Figure 4: Amphibious Architecture by Benjamin, Yang and Jeremijenko.

text-message and to contribute in displaying a collective interest in the environment. The project attempts to generate awareness of the water ecosystem as part of the city's fabric. Mapping and tracking the invisible and turning it into visible and quantifiable data encourage engagement and participation.

Another project is the "Serendipitor," developed by Mark Shepard who uses the network to enable people to explore a city in an unpredictable way, still creating an awareness of the built environment around us. Serendipitor is an alternative navigation app for the iPhone that helps people to find something by looking for something else. When the user enters an origin and a destination, the app maps a route. As the user navigates the route, suggestions appear for possible actions to take at given locations within step-by-step directions. It is designed to introduce small slippages and minor displacements within efficient routes.

These and similar projects demonstrate the potential to re-program the city through the agency of the network, catalyzing processes for the generation of an awareness that might lead to long-term change through small-scale actions. Those projects act at the prototypical level; they suggest imaginable future scenarios for city growth at both the local and global scales. The tension generated by top-down versus bottom-up could be a constructive process of self-organization. The one does not exclude the other; on the contrary, both could work in a symbiotic and interdependent relationship.

"WikiPlaza," developed by hackitectura.net, aims to generate an open-space laboratory without hierarchical managed structure but instead managed by citizens. It attempts to embody the network as acreation of a participatory public space in order to produce "ecosophic machines," that is, new technical, social and mental ecologies offering an alternative to the dominant neo-liberalism and promoting and stimulating emancipation, autonomy and spaces of the commons. Through a series of equipment and tool-kits, WikiPlaza has been replicated in different cities, testing global replication through open source, participatory, self-organized, and self-managed processes. It embodies the materialization of the encounter with the Internet. The project manifests in its strategies a space that is in continuous transformation. Hackitectura.net states:

Figure 5: Amphibious Architecture by David Benjamin, Soo-in Yang and Natalie Jeremijenko.

"The public plaza of the future could be a WikiPlaza." Projects such as WikiPlaza are able to localize the network, operating in a specific context, responding to cultural, civic and economic needs of a specific community and promoting and organizing localism." After several decades of pushing globalization-orientated values, the public tends toward processes of localization, focusing on interactions that occur at local scale. This movement between integration, centralization, globalization and regionalism including the challenge of local cultural identity acts as a pendulum in the urban decision making process.

Many similar projects have emerged from citizen governance. The "Île Sans Fil" project in Montreal provides free wireless access throughout the city. The short period of free Wi-Fi access has catalyzed a series of artistic and community projects that emerged from the presence of the network. The "Île Sans Fil" an example out of many, implemented in an urban context, is steadily increasing the already high rate of public participation.

Very often projects initiated by networks develop an innovative hardware (spatial armature) that embodies the invisible software (programming). This family of interventions fosters participation and dynamic collaboration and sometime suggests forms of urban management. Bottom-up strategies empower citizens and are opening up the collective awareness established by shared and coordinated actions. Forms of organization take the form of the network itself.

Those types of interventions carry inherently the ability to be agents, actors and performers. The object or form is not as relevant as the potential of its impact. In this framework, architects, urban planners and designers have the potential to shift their focus. While still being concerned with geometry, materials and tectonics, they can move beyond the conception of form as object; rather they are partially the authors of form as an intense set of actions and relations deployed in space.

This shift is reframing the role and processes of spatial practitioners; it will lead to another mode of conceiving design and its methodologies. Designers will have to embody increasingly the role of facilitators of actions that they set in place and allow to unfold through multi-layered strategies. Thus, the notion of authorship changes to the coordination of networked intelligences facilitated through the project, from the "signature" that belongs to the author. It is the mutual interchange of designing spatial organizations, systems and relationships that leads to the connection between form and action.

Actions require context to be deployed, and spaces require programming to be activated. Networks are active agents as they embed actions in their protocols. The production of urban space is directed towards a territory of synthesis between object and action. Cities are assemblages of complex conditions and systems where the physical layer is continuously re-written by the constructive tension between local and global conditions. The challenge for spatial practitioners is to rethink new models of public space that act simultaneously as local - global, physical - digital, therefore hybrids. The localization of the network is the next challenge.

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