DOI: 10.23817/2023.defarch.1-11

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THE CITY OF BITS TODAY. URBAN SPACE AS A RESULT OF RULES

MIASTO BITÓW DZIŚ. PRZESTRZEŃ URBANISTYCZNA JAKO OBRAZ DZIAŁANIA REGUŁ

Abstract

The article is deliberating the formal and mathematical approach to urban issues. It contains an analysis of historical grounds that influenced the formation of modern concepts based on the use of algorithmic description and digital models. The main reference of the argument is the theory of the city presented in the works of William Mitchell. These visionary texts constitute the background for theory and practice of the present day. In research devoted to theoretical themes, a critical analysis of written sources was used. Short case studies were used to create practical references and formulate conclusions relating to the sphere of design.

Keywords: city, digital representation, medium, rule system

Streszczenie

Artykuł poświęcony jest refleksji nad formalno-matematycznym podejściem do zagadnień urbanistycznych. Zawarto w nim analizę historycznych uwarunkowań które wpłynęły na ukształtowanie się współczesnych koncepcji opartych na wykorzystaniu opisu algorytmicznego i modeli cyfrowych. Głównym odniesieniem wywodu jest teoria miasta przedstawiona w pracach Williama Mitchella. To tych wizjonerskich tekstów odniesione zostały teoria i praktyka. W badaniach poświęconych wątkom teoretycznym posługiwano się krytyczną analizą źródeł pisanych. Krótkie studium przypadków wykorzystano do stworzenia praktycznych odniesień i sformułowania wniosków odnoszących się do sfery projektowania.

Słowa kluczowe: miasto, reprezentacja cyfrowa, medium, system reguł

1. INTRODUCTION

The formalization of urban phenomena originally concerned the material components of city space. Already at the pre-medieval stage, the division of land, communication, access to infrastructure and services could be described using rules. Medieval systems of city rights consolidated this tendency, which resulted in regular parceling schemes recognizable in the landscape until modern times. Also, the building conditions were determined in accordance with the norms to ensure fire safety, drainage, and to maintain comparable conditions for plot development.

A separate, strictly algorithmic task was the design of fortifications ensuring the security of cities. Medieval walls, moats and fortifications of the city gates were designed considering the parameters of the battle movement of infantry knights and horsemen as well as the ranges and dynamics of siege machines and the processes of defenders' service. Renaissance bastion fortifications are pure geometry of the firing range of cannons often deployed in several defensive lines.

With the complication of urban infrastructure in the Age of Enlightenment and especially after the Industrial Revolution, the number of factors influencing city tissue optimization has increased dramatically. This led to the professionalization of the tasks of town planners and municipal services. However, even big, interdisciplinary teams were not able to precisely reproduce complex urban conditions in the projects. Overcoming the limitations became partly possible through the use of computer simulation methods and digital city models, however, ideological assumptions for a systemic approach to urban problems had already been developed earlier.

2. THE ORIGIN OF THE CONCEPT OF THE CITY OF BITS

From 1996 to 2005, Professor William J. Mitchell published a series of books at MIT Press that presented a coherent vision of the future of the built environment. It was a visionary but at the same time tangible vision. The architectural and urban planning experience as well as the research talent of the dean of the MIT School of Architecture and Planning made it possible to keep these works in the analytical profile, and to transfer some conceptual ideas and conclusions to the technological sphere.

The ideas contained in Mitchell's works grew out of a systemic approach to spatial issues, the source of which was Norbert Wiener's concept of cybernetics[1]. The approach to the problems of cognition in this theory was presented by the author, shaped in the spirit of combining mathematical and philosophical methodology, among others, thanks to his studies with Edmund Husserl in Göttingen. This was very helpful facilitating transmission of cybernetic ideas from the field of neuropsychology and man-machine relations into urban planning, where both technological and social phenomena occur. In the late 1960s and early 1970s, Mc Loughlin[2] and Chadwick[3] presented, for the first time, a coherent argument in this regard. Research started in British academic centers on the theory of systems led to the development of urban models based on the algorithmization of processes observed on a city scale, concerning buildings, infrastructure, as well as the movement of people, goods, and media. Michael Batty, who has been working on algorithms describing urban systems since the 1970s,[4] has become a key authority in this field. In the mid-1980s, he proposed the concept of pseudo-dynamic urban models in his doctoral thesis. In subsequent research conducted

[1] N. Wiener, *Cybernetics; Or, Control and Communication in the Animal and the Machine*, MIT Press, New York 1961.

[2] J.B. McLoughlin, *Urban and Regional Planning: A Systems Approach*, Faber and Faber, London 1969.

[3] G. Chadwick, *A System View of Planning. Towards a Theory of the Urban and Regional Planning Process*, Pergamon Press, Oxford 1971.

[4] M. Batty, *Urban Modelling: Algorithms, Calibrations, Predictions*, Cambridge University Press, Cambridge 2010.

by the CASA team at UCL, he developed a typology of digital models and a theory of growth of urban organisms[5].

3. BITS CITY LANDSCAPE

According to Mitchell, considerations about the digital future of cities are conducted in parallel to the analysis of practical problems. We will not find here the methodology of urban modeling to support decision-making processes. We will also not be enriched with simulation or optimization tools that would help predict the effects of planning activities. The argument is erudite and philosophical. It is closer to the source texts of cybernetic theory than to later works illustrating its practical implications.

Mitchell begins with a reflection on changing the living environment. In a book about the City of Bits[6], he states that "the network negates geometry". The new infrastructure of cities, carrying information over fiber optic cables, topologically corresponds to traditional networks. In usability sense – completely differ from them. It generates a user interaction environment that is intangible, spatially discontinuous, fragmented, asynchronous. Mitchell ponders how to design a city of bits and outlines the perspective of urban planning of the future, creating a parallel between the traditional building typology and new categories of network utility functions. He points out that in a networked museum, hospital or prison, the laws of the new medium apply, the same ones that Lew Manovich characterized as: modular, capable of transcoding, programmable[7]. A resident jumping through hyperlinks can experience sensations, interactions, social processes, which, although similar to traditional city life, are realized by new medium. The interface corresponds to the facade, the morphology of the terrain corresponds to the network topology and banishment corresponds to the blacklist that blocks access to services.

In addition to network reality, Mitchell's city of bits also included physical elements of the structure. In a 2010 book, a team of authors described a new concept of urban mobility[8]. The ideas presented were based on a research program launched at the MIT Media Lab in 2003, which sought to design the car of the future. MIT CityCar was created for individual transport operating in a sharing system. The electric vehicle was supposed to move in corridors much more economical than traditional streets. Power supply, maneuvering, baggage loading and evacuation were subjected to modularization and increased accessibility. The load-bearing structure of the final version of the vehicle allowed for folding, which further reduced the need for storage space.

According to the intention of the authors, the communication in future cities was to be both: individual and collective. Transport units subordinated to ergonomics could form complexes. The individual and network control system made it possible to think about the population of cars of the future as a swarm of insects communicating and choosing optimal configurations. Most importantly, the new concept of mobility changed the established ideas about urban transport routes. They could have been much safer, saturated with greenery,

[5] M. Batty, *The New Science of Cities*, MIT Press, Cambridge 2017.
[6] W.J. Mitchell, *City of Bits*, MIT Press, Cambridge 1996.
[7] L. Manovich, *Język nowych mediów*, Wydawnictwa Akademickie i Profesjonalne, Warszawa 2006.
[8] W.J. Mitchell, C. Borroni-Bird, L.D. Burns, *Reinventing the Automobile: Personal Urban Mobility for the 21st Century*, The MIT Press, Cambridge 2010.

evenly filled with optimized "parking". A shift to the use of MIT CityCar-style vehicles would mean a transformation for cities like the one that occurred in the industrial era.

4. THE COMMUNITY OF THE CITY OF BITS

Nearly a decade after the publication of City of Bits, William Mitchell goes to the psychological level. The author's original predictions about the rapid expansion of digital technology in the built environment are beginning to be confirmed. However, these are not changes affecting only matter. Under the influence of new tools, human personality changes, and thus also the image of communities living in cities. "ME++ The Cyborg Self and the Networked City"[9] book describes ourselves. Mitchell believes that the main change that the communities of the developed digital economy have undergone is the reconstruction of relationships and bonds. In a historical city, they were hierarchical and relatively easy to identify. Status depended on origin, physical and economic strength, and later also on knowledge and education. The most lasting relationships were related to families, and the higher levels of links were arranged corresponding to statuses.

The bonds of the AD 2010 community living in the city of bits have been characterized as multiple, overlapping, time-varying, fragmented and impermanent relationships. Each information channel used could generate a separate community whose reach was determined by digital accessibility. The latter, similarly to the social status, depends on the roles that the participant takes on and on the competences developed thanks to programming tools. Mitchell writes about a radical change in comfort definition and social cohesion. In the place of medieval walls and Renaissance bastions, he sees cybersecurity procedures that are the only ones able to ensure privacy, contact with loved ones, the ability to work or dispose of material resources.

Dependence on remote sources of information discourages members of the bit city community from memorizing and developing local information resources. The widespread use of devices that enhance the senses and physical capabilities of the body can lead to a weakening of attention and the ability to independently solve problems. Mitchell sees the citizen of the future as a person equipped with an extremely effective apparatus to make life easier. At the same time, he warns about the possibility of addiction to this device, or even exposure to a new category of diseases affecting not ourselves, but the digital cocoon in which we live.

In the scale of city management, these phenomena become even more important. Thanks to simulation models, we have the possibility of universal, knowledge-based participation in decision-making processes. However, these processes are vulnerable to manipulation by aggressors or organizations fighting for influence on the commercial market. In addition, the community of cities is gradually losing its attachment to locality, which means that real interests and represented positions must be interpreted as part of a global network of connections.

Ten years after the release of "City of Bits", Mitchell outlined in "ME++" the loop that the expansion of IT technology has made. It emerged from the real world and grew in an intangible network, creating a parallel structure close to the city organism. In the next step, it returns to material reality. Digitally controlled devices today called IoT (Internet of Things)[10] grow into the reality of the built environment, which makes both worlds possible to cooperate.

[9] W.J. Mitchell, *Me++: The Cyborg Self and the Networked City*, MIT Press, Cambridge 2003.
[10] A term whose first use is attributed to Kevin Ashton, co-founder of MIT's Auto ID Center.

5. VISIONS, PROTOTYPES, APPLICATIONS

William Mitchell, although he went down in history as a futurist of urban planning and architecture, grew up in the tradition of real building. This explains his desire to verify theoretical concepts with experience. He started with methodical ordering in CAD. His early work on the evolution of architects' toolbox is still an important reference in this regard. As part of his work as a professor at MIT and dean of the School of Architecture and Planning, he undertook numerous initiatives aimed at verifying scientific hypotheses through experimentation. Together with Charles M. Vest, president of the university, he created a vision of a campus absorbing the ideas of a hybrid environment of the future[11]. He created the SmartCities program, which, operating since 2003 as part of MediaLAB, allowed to implement the ideas of futuristic individual mobility, such as Greenwheel, RoboScooter and CityCar.

The MIT CityCar concept was brought in cooperation with General Motors to the prototype stage. The production successor was to be Hiriko Fold, a microcar serving the transformation of urban transport in the Basque Country. The idea had a large public response. It allowed to obtain European and local funding. Unfortunately, due to the collapse of the local company, it was not implemented.

The particularly striking accuracy of William Mitchell's predictions was revealed during a project far away from academic practice. While preparing the production of the film "Minority Report", a brainstorm of a team of scientists, architects and futurologists was organized in 1999. They were asked to create a technological vision of the year 2054. Among the invited guests was the dean of the MIT architecture department, and among the ideas given to the director you can find many elements written in Mitchell's books. The director of the film, Steven Spielberg, wanted to obtain a vision that is rooted in reality but plausible at the same time, which was consistent with the approach presented in the City of Bits. The characters of the film travel in cars that may or may not be autonomous. The transport corridors of the city are organized in three dimensions, they do not generate contamination and noise. People are equipped with augmented reality cameras: they see real objects, but they get additional, contextual information about them. Omni-directional displays allow you to operate the interface adapted to the human body. City services, smart home responses, ad content and car calibration are personalized based on information gathered online. The structures of the city of bits 2054, as Mitchell warned, tend to be hacked as soon as an aggressor appears with the appropriate knowledge and tool competence.

6. CITY OF BITS TODAY

Writing this article today, I look out the window and see electric scooters left in apparent disorder on the sidewalk. There is a bicycle rental station nearby and a shared car that illuminated the area to indicate availability. All these means of transport are offered via the Internet. The network controls placement, availability, and charges. Until recently, mobile applications searching for connections in the "public transport" category displayed buses and trams. Today, there are also options for individual shared vehicles, which often turn out to be the most efficient.

[11] W.J. Mitchell, *Imagining MIT*, MIT Press, Cambridge 2007.

Has the vision of next-generation transportation envisioned in Mitchell's books been realized? The scooters with which I started are certainly not as technically sublime and beautiful as the vehicles of the city of bits. Also, shared cars, even the smallest ones,[12] cannot fold their bodies like CityCars or climb up building walls like the bolides in the Minority Report scenes. However, modern cities have changed. Vehicles require different, much smaller traffic corridors. They do not generate exhaust fumes, are quieter and blend in much better with urban green areas. Most importantly, they contain ICT components that allow them to function in two realities: the real space and the virtual system of the city's digital infrastructure. The network functions of next-generation transport are still underdeveloped. They are limited to checking the location, searching for optimal connections and charging fees. However, it can be expected that they will be significantly expanded. The Concept -i system presented by Toyota in 2017 assumed the use of artificial intelligence to calibrate the transport network. It was to consist of electric cars (Concept -i RIDE) and three-wheeled individual vehicles (Concept -i WALK). All elements of the system were to learn from the users the preferred behaviors, which concerned not only the optimization of movement, but also the pleasure of driving, safety, impact on the surrounding buildings and people. The goals set for Concept -i solutions are inclusivity, ecology, safety, comfort of life, i.e. the priorities of sustainable urban development.

The city of bits offers the opportunity to experiment on a digital representation of real urban conditions. It is most intensively conducted in academic centers, where design and tool solutions are tested in a laboratory environment.

In 2018, a team of researchers from the Warsaw Faculty of Architecture, led by Jacek Markusiewicz, developed a concept, and built a prototype of the e- Table interactive table. It was to be used for participatory design and testing of spatial solutions. The projection on the surface of the table was coupled with the registration of the position of elements configured in real time by users. One of the experiments carried out using the table was the design of the network of Warsaw bicycle routes. The simulation model displayed communication accessibility (measured to designated network cells from any point in the city). Users could influence the simulation result by inserting additional elements on the table – sliders and markers. Adjustment of parameters (e.g. cyclist's speed, possible route time) as well as the introduction of physical structures (bicycle crossings) changed the picture of ranges and accessibility in real time.

The tools of the city of bits can also be useful for studying the past of urban organisms. Thanks to the algorithmic description of the rules, it is possible to simulate the development of the spatial structure and project its past states. The author participated in a project directed in this way, carried out by a team led by Professor Stefan Wrona at the Warsaw Faculty of Architecture. On the basis of archaeological documentation, a parametric model of the proto-town in Pułtusk was built[13]. Its structure was based on the principles discovered by archaeologists, it allowed to automatically generate hypothetical development schemes and then check their compliance with the relics. The projection of views of the proto-city was regulated by means of a chronological slider and visualized through digitally printed sections of the mock-up.

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[12] Such as the Renault Twizy available in the centers of some French cities.

[13] J. Słyk, S. Wrona, *Informacyjne środowisko rekonstrukcji. Przedlokacyjna struktura osadnicza w Pułtusku w XIII-XIV wieku*, Oficyna Wydawnicza PW, Warszawa 2015.

The city of bits grows into the physical structure of the built environment. We use its functionality while traveling, using services, communicating, working and living. It should be noted, however, that in addition to opening new opportunities, digitization of the urban environment generates threats.

William Mitchell wrote about addiction to "sensory and memory enhancers", which in turn can cause new dysfunctions or even diseases affecting people. From press releases we learn today about the frequent abuse of cars in autonomous mode. The police photograph drivers falling asleep in cars that keep their distance, lane and recognize road signs. Pedestrians, cut off from reality by the smartphone projection, get under the wheels of vehicles. We lose our way following instructions misinterpreted by GPS navigation.

The importance of the city agora is weakening. We meet more and more often in the network reality which generates specific needs and incentives. Social media are becoming a supplement to the real community, which is why the way of using the public space of cities is also being re-evaluated. Visitors to squares and parks who sit on benches and are immersed in the information space of the Internet have become a common sight. Even people who practice sports are often motivated by the instructions of the mobile app, which suggests a route, pace and activity mode.

The intensity of changes taking place in contemporary cities is fascinating. The futuristic ideas filmed in the Minority Report after only a few years partly entered the sphere of application. Inventions such as Toyota's Concept -i can accelerate the implementation of Universal Design postulates. Thanks to simulation models, we better describe the natural processes in the city, and we can offset the negative effects of development.

Considering the huge dynamics of changes, and often also our low level of preparation for them, it is necessary to strive for balance. Slowing down technological progress is difficult, as evidenced by the recent failed action of IT giants proposing to slow down the implementation of artificial intelligence. However, we can educate users. Conscious use of tools will not only be safer, but also more efficient. I believe that in certain situations it also leads to conscious self-limitation. Exploration of the city of bits can be satisfying only when it is carried out by mature members of the information society, aware of the limitations and dangers.

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