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City spatial composition representation in Digital Twin model

Abstract

The aim of this work is to improve the effectiveness of methods for record urban space. A record is understood here as a three-dimensional representation used to shape or transform urban composition¹. The effectiveness of this record, however, depends on the proper hierarchy of the elements being composed.

The essence of a city is its "appropriateness" to the needs of its inhabitants². Urban space serves as a system of transmitters³ that facilitate the functioning of its fellow citizens. The effectiveness of this system of spatial signs⁴, constantly enriched since the dawn of "urbanity,"⁵ creates the collective identity of city dwellers⁶. These signs, permanently present in the fabric of the city, constitute a language that allows for "being human among people."⁷ This somewhat forgotten language, with its proper and universally understood hierarchy of meanings, should not be supplanted by the technical structure of the city⁸, which, in its ambiguity, becomes incomprehensible and erases its

¹ Lynch K.: *Obraz Miasta*, Cracow: Archivolta, 2011

² Gehl J.: *Życie pomiędzy budynkami*, Cracow: RAM, 2009

³ Hall E.: *Ukryty wymiar*, Warsaw: Państwowy Instytut Wydawniczy, 1978. The Hidden Dimension, Warsaw: State Publishing Institute, 1978. Edward Hall is an American anthropologist considered one of the pioneers of research on interpersonal communication and spatial relations. Proxemics, a science he developed, examines the relationship between social relationships and the distance between people and the organization of space. Jan Gehl also expanded on proxemics in his research.

⁴ Pallasmaa J.: *Oczy skóry: Architektura i zmysły*, Cracow: Instytut Architektury, 2012. Juhani Pallasmaa is a Finnish architect and architectural theorist. While Hall studied space from an anthropological perspective, Pallasmaa transferred these ideas to the phenomenology of architecture—how humans experience buildings and spaces with all their senses.

⁵ Stevenson D.: *Miasto*, translated. M. Topa, Gdańsk: Części Proste 2019. Deborah Stevenson is an Australian sociologist who seeks to define "urbanity" as a set of dimensions in the fields of social science and philosophy that define the conditions of life in the city.

⁶ Jacobs J.: *Śmierć i życie wielkich miast Ameryki*, trans. Ł. Mojsak, Warsaw: Fundacja Centrum Architektury, 2014

⁷ Miłosz C.: *Abecadło Miłosza*, Cracow 1997, s. 83. The full quote is: *Wonderful. **To be human and to live among humans** is wonderful, even if we know the wickedness and crimes they are capable of.*

⁸ Łaskarzewska M.: *Miasto ukryte*, Warsaw: Warsaw University of Technology, 2023, pp. 83-84. In her dissertation, Małgorzata Łaskarzewska looks for hidden meanings in the city, defining its internal structure as technical and external.

great cultural heritage⁹. The key, therefore, is to ensure that the fundamental achievements of urban aesthetics are not displaced by a narrowly understood technology that, by stripping it of traditional meanings, displaces the concept of "urbanity." Hence, the task of this work is to bring urban composition to the forefront, attempting to define it, and then attempting to capture the proper hierarchy of meanings in the digital environment.

Contemporary digital data processing techniques offer a multitude of possibilities for record urban parameters. This multitude blurs the hierarchy of design goals. They give priority to technical-economic, quantitative parameters, which are therefore unambiguous and relatively simple to technically represent. Meanwhile, the essence of recording urban space lies in qualitative characteristics resulting from the expectations of its users. Quantitative parameters are critically important today, but they must be derived from appropriately composed qualitative characteristics. Urban composition, thus defined, should be understood as a set of features of urban space that directly impact the quality of life of city residents¹⁰, their feelings, and ultimately, their behavior. In this approach, the definition of urban composition relegates to the background the issues of city physics, technology, and economics understood at the technical and construction levels¹¹. Of course, these issues are globally crucial, especially in the era of economically and energy-efficient solutions¹², as well as from the point of view of contemporary opportunities offered by digital technology¹³.

⁹ Lorenz K.: *Regres człowieczeństwa*, Warsaw: Państwowy Instytut Wydawniczy, 1986. Konrad Lorenz (Nobel Prize winner and founder of ethology) argues that environmental signals once universally understood by humans are being blurred by the informational "noise of the big city": the human species is threatened by regressive evolution resulting from the degenerative vectors of modern civilization. "To avoid the impending apocalypse, it is necessary to reawaken among young people the sense of beauty and goodness suppressed by scientism and technomorphic thinking." Among the main involutory forces, Lorenz lists the loss of universal meanings, previously imprinted on the structures of cities created using traditional urban planning methods.

¹⁰ Wejchert K.: *Elementy Kompozycji Urbanistycznej*, Warsaw: Arkady, 1984, pp.11

¹¹ Bacon E. N.: *Design of Cities*, Nowy Jork: Penguin Books, 1974, pp. 13. Edmund Bacon is one of the most important American urban planners of the 20th century. He believed that a city is not merely a collection of buildings, but an "**act of will**," that is, a conscious, spatial structure intended to evoke specific human experiences.

¹² Meadows D. H., Meadows D. L., Randers J., Behrens W. W. (1972). *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind*. New York: Universe Books, 1972, and updates of growth limits from the years: 1992, 2004, 2012r.

¹³ Stojanovski, T: *City information modeling (CIM) and urbanism: Blocks, connections, territories, people and situations* [W:] Simulation Series, 2013, 45, pp. 86-93. Todor Stojanovski is a Macedonian architect and urban planner working at the Royal Institute of Technology in Stockholm. His research represents a modern, digital, and infrastructural continuation of the themes explored by Edward Hall, Juhani Pallasme, and Edmund Bacon. Stojanovski examines how contemporary urban design influences human behavior and mobility.