JAN SŁYK*

A THEORETICAL MODEL OF WORK IN ARCHITECTURE AND IN MUSIC

TEORETYCZNY MODEL DZIEŁA W ARCHITEKTURZE I W MUZYCE

A b s t r a c t

The creative intention is firstly realized in a model that reflects the intentional, formal and technical features of the work. In pursuit of beauty and order, the author may release emotions or, on the contrary, impose stiff order. There have been situations in history when the formal approach prevailed over the intuitive. Works based on system of rules arose not only in the sphere of the natural sciences. The sensual, contemplative message of music disciplined the creators and catalyzed the rational interpretations of the medieval motet, polyphony and twentieth-century dodecaphony. The utilitarian technical genes of architecture did not determine its rationalistic orientation. Despite physical limitations, shaping of space was often based on intuitive operation or on the formulation of principles that, like the five Le Corbusier postulates, cannot be strictly interpreted. The article analyzes the limitations and opportunities created by the formalization of creative activities. Models of architectural and musical works became the basis for determining the impact of rules on the artistic effect, among others – for the intuitive or rational mode of perception of the work.

Keywords: model, architecture, music, rules, formalization of creativity

S t r e s z c z e n i e

Zamiar twórczy realizuje się po raz pierwszy w modelu, który odzwierciedla cechy intencjonalne, formalne i techniczne dzieła. W dążeniu do piękna i porządku może autor uwalniać emocje lub przeciwnie – narzucić działaniom gorset uporządkowania. Zdarzały się w historii sytuacje, gdy podejście formalne dominowało nad intuicyjnym. Dzieła oparte na systemach reguł powstawały nie tylko w sferze zależnej od spostrzeżeń nauk przyrodniczych. Zmysłowy, kontemplacyjny przekaz muzyki dyscyplinował twórców i katalizował rozumowe interpretacje średniowiecznego motetu, polifonii i dwudziestowiecznej dodekafonii. Utylitarno-techniczne geny architektury nie przesądzały o jej racjonalistycznym ukierunkowaniu. Mimo fizycznych ograniczeń kształtowanie przestrzeni polegało często na działaniu intuicyjnym lub na formułowaniu zasad, które, jak pięć postulatów Le Corbusiera, nie dają się ściśle interpretować.

W tekście przeprowadzona została analiza dotycząca ograniczeń i szans, jakie tworzy formalizacja działań twórczych. Modele dzieł architektonicznych i muzycznych stały się podstawą określenia wpływu reguł na efekt artystyczny, między innymi na intuicyjny lub rozumowy tryb percepcji dzieła.

Słowa kluczowe: model, architektura, muzyka, zasady, formalizacja kreatywności

* Assoc. Prof. D.Sc. Ph.D. Arch. Jan Słyk, Faculty of Architecture, Warsaw University of Technology.

1. Models in science and art

The French Nobel Prize winner Allais Maurice argued that models are the main tools of scientific methodology[1]. He described their function in cognitive processes by distinguishing three stages of reasoning. The first is to put a strong hypothesis, the second – to determine all consequences of the assumption, and the third – to check whether the consequences agree with the observed facts. Modelling technique is crucial for the first two phases. The hypothesis and its logical effects do not concern physical phenomena. It operates on idealized, abstract images of reality, aiming to emphasize selected features of phenomena. In the last phase the reasoning reaches the realm of confrontation with reality. Here, it is also necessary to narrow and refine the field of observation. It can be achieved by consciously focusing on selected parameters or by using research equipment that objectifies perception (allowing to weigh, measure, analyse). The image of the world is synthesized, so that the comparison takes place at the interface between the mental model and the cognitive model.

Maurice's view, representing the discipline of the economic sciences, is rooted in empirical logic, which is mainly associated with the methods of the natural sciences. However, it remains valid, even when compared to the specificity of creative activity.

When building a model, the architect combines spatial components and obtains a configuration that becomes intelligible thanks to the relations between modules. The elements can represent distinguishable parts of the object. Nevertheless, the creation process, both in the physical and digital environment, depends strongly on applied techniques. In this case, the structure of the model dominates, because the syntax of distinctive elements can both amplify and weaken the quality of the message.

The configuration of parts depends on the intentions and functions of the model. In the basic view, the components represent building elements, used during the process of construction. The scaling process limits accuracy of reproduction of all details. The image is synthesized: blocks of stone melt into the wall, the window frames disappear, sometimes windows are omitted too and walls represented by solid surfaces become the only instrument of expression. The simplification method is not accidental and depends on the system applied to organize the architectural structure. The last one crystalizes on the basis of the theory of architecture.

The *tectonic* concept is a syntactic description that dominated in the interpretation of architecture up to the nineteenth century and significantly influenced the method of modelling. Its sources reach back to the ancient times; they were grounded in the works of Vitruvius and the theoreticians of the Renaissance. The concept enriched in the modern period, absorbing the arguments taken from the methodology of natural sciences. Today, it is received mainly through the works of Gottfried Semper and Kenneth Frampton[2]. Tectonic syntax is based on the analysis of elements that constitute the structural functions of the building and by describing relationships between them. It takes into account all the consequences resulting

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[1] M. Allais, *An Outline of My Main Contributions to Economic Science,* [in:] *Economic Sciences, Nobel Lectures*, red.: K. G. Mäler; *World Scientific Singapore*; 1992; p. 243.

[2] K. Frampton, *Studies in Tectonic Culture: The Poetics of Construction in Nineteenth and Twentieth Century Architecture*, MIT Press, 2001.

from the choice of material and the role of the environment. Frampton refers to the tradition of Viollet-le-Duc's, stating that the analysis of architectural space, which is a significant part of the contemporary theoretical discourse, is possible only after determining what exactly defines the architectural space. The tectonic idea explicitly supports the material interpretation of the building structure. It categorizes elements by specifying their physical role: binding to the ground, supporting, covering, and separating. Evaluation of solutions is carried out in terms of their technical rationality, understanding of the properties of the material and the use of physical characteristics to construct specific details and structures. In that sense, tectonic evaluation remains consistent with the concept of John Ruskin, where architectural truth manifests itself by coherence of the project and features of the material.

The digitization of the environment and the emergence of virtual reality have induced broader opportunities for representation. Among them, also those regarding the nature and relationship of spatial components. William Mitchell, in his essay from 1998[3], disagreed with the tectonic vision of the built environment. He argued that classifications based on natural-mathematical rationalism lost their validity in the moment when architecture gained the ability to record its image in a new medium. Mitchell's *antitectonic* model is characterized by: lack of physical conditions, immateriality, automatic production method; it is discontinuous due to hyperlinks and received by means of a digital interface. The Semperian foundations lost their importance in contact with the model expressed through the digital medium. Elements do not weigh anything, they do not have the features resulting from the material used, the field of work can be freely scaled, and physical nearness is not a condition for immediate contact. The new environment concerns both the process of building models and their reception via the interface. Most importantly, the antitectonic digital model can be programmed, so its syntax changes and translates into any language.

Initial stage models used by creators do not require strict limitations, because they do not serve to build the theory. Art representations follow scientific models in their intention to communicate content efficiently. A simple, unambiguous logical formula guarantees that information reaches the recipient in a form consistent with the intended purpose. Art representations differ in their considerable openness to the subjective perception of the world. A highly generalized model, which is the goal of science, does not necessarily have to be the most perfect creational depiction. On the contrary, similar observations can lead to different conclusions and feelings in art. The originality of a model synthesizing creative reflection is often a measure of the artistic quality of a work.

If a discipline requires, as architecture does, a technically complicated realization, then in addition to the above-characterized ideological model, it uses second-degree models. After establishing the direction of development, working hypotheses regarding the expected effects of the project are formulated. It is rarely possible to find a method for testing these hypotheses directly. The tests are carried out on models representing selected building features that are currently being checked. Second-degree models are much more in line with scientific criteria. They must be strict and generalized at the same time. We require that they accurately

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[3] W. Mitchell, *Antitectonics: the Poetics of Virtuality*, [in:] Beckmann J. (Ed.): *The Virtual Dimension: Architecture, Representation and Crash Culture*, New York 1998, p. 204.

describe the design situation and that they return a certain result in a wide scope of analogous situations. Creating models with such characteristics is difficult because buildings do not consist of separate structural units. They create a system in which individual components interact with each other. Therefore, the representative model has to map not only the features of individual parts, but also the relationships between them.

The passage of time changes views about the scope of science and the role of scientific models. From the concept of quadrivium and trivium, through the catalog of disciplines recognized in the Middle Ages and the Renaissance, the Cartesian breakthrough, the development of empiricism and the era of research on macro and microcosm, civilization verifies opinion on this subject. The changeability of the typology of disciplines is surprising even in contemporary classifications. The humanities, and thus also the arts, entered a group of legitimate branches of strict reasoning thanks to the work of David Hume. At least we think so, following the evolution of interpretations in the last centuries. The empirical view justified the correctness of the theory mainly through its verification based on experience. In the fields related to creativity, it meant the necessity to subject the material effects of human activity to analysis, including the conceptual and final realizations of artistic works. Empirical methods worked well in ordering the achievements and building the theory on the basis of a wide sample of research cases.

History examines the works of the fine arts; musicology typologizes styles and techniques of composition. Also, the theory of architecture, at least in part called historical theory, only draws conclusions from project precedencies and completed works. This leads to the development of a separate methodology and the emergence of a specialist community dealing not with direct creative activity but only with its interpretation. Is there another way? Can the scientific method be useful for creative activity? If so, its effectiveness in transferring empirical content would have to be significant in the application[4]. Popper advocates the widespread use of science in explaining the phenomena of the world. He believes that the improvement of the scientific method involves simultaneous generalization and clarification of theorems. Our reasoning is the more perfect the more it captures reality and at the same time – the more strictly it defines rules.

The goal, relatively easy to determine on the basis of pure sciences, in contact with humanistic disciplines, and especially with art, loses clarity. How can we gain the value of accuracy and objective truth when we rely heavily on subjective judgments associated with individual creative intuition?

To answer these questions, I will compare the theoretical view in the field of music and architecture. It will serve to illustrate the chances of applying strict reasoning in artistic activity. The selection of fields is not accidental. It allows you to observe conditions on the basis of creativity embedded in abstract realities (music) and to consider the application of methods in the physical context (architecture). The fact of establishing a strong theory of music is also significant. It was the only one of the creative fields to be considered by the ancients to be part of the exact sciences. In Pythagorean times it used the closeness of mathematics absorbing its methods and manner of interpretation. In subsequent epochs it absorbed the tradition of rational thought by building a coherent language and a consistent line of explaining structural relationships.

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[4] K. Popper, *Logika odkrycia naukowego*, Warszawa 1977, p. 101.

Architecture is literal and durable. Music is metaphorical and fleeting. Music lives in reincarnation of performances over the centuries, architecture is aging, dies, requires revitalizing treatments. The image of works separates them from each other, sets on the extreme poles of the spectrum of art. They are similar in spirit. They feed on the detail, the phrase, the texture, they grow in form and logic. They benefit from the mood created – its uniqueness and beauty.

Technological development brought music closer to architecture. The electroacoustic fixed musical moment. Computers completed the work. Today we're sampling sounds, putting on paths, and building a prefab form like a brick house. Now we can check the results – "render" the song, apply effects, colour and close in the MIDI file.

Civilization has also brought architecture closer to music. The literalness of the building structure has weakened under the pressure of the realism of the computer model. You do not have to build a house anymore to see what it looks like. You can watch it on the screen. Moreover – you can enter the artificial world and touch the shape in a virtual reality environment. We are at the root of a new trend in architecture that does not need bricks and concrete. Form materializes from pure building materials – uses geometry, light and time.

It is no coincidence that the largest names of musical and architectural avant-garde, creators operating electronic media such as Iannis Xenakis, Marcos Novak, John Cage, act on the very edge of both branches of art.

2. History of architectural and musical models

The most fascinating consequence of the achievements of Antiquity in both fields is not the physiognomic convergence. It is also not the catalogue of archetypes described in mythology. The Greek theory of art (and its practical use) have built a much more solid foundation for the music and architecture of the following centuries – the canon of proportions and sound. The consequences of the use of Greek orders[5] are found in architectural works to modern times. The appearance of dodecaphony in the early twentieth century did not deny the use of the major-minor system as an extension of the modal scale system[6].

The very fact of striving for ordering the building blocks (architectural and musical) testifies to the huge awareness and maturity of the ancient creators. Analysis of the methods and consequences of ordering gives these achievements the value of absolute genius and uniqueness. In both cases, we are dealing with the use of natural (physical) compositional considerations. Musical scales are based on harmonic connections and intervals being a consequence of the division of a vibrating string (or an air column). The mechanism of sound generation – singing, playing the instrument – remains in line with the mechanism of hearing – receiving a musical piece.

Architectural ordering reacts to natural static interactions (gravitation, work of material, transferring forces). They take into account geometrical relations and proportions resulting

[5] Doric, Ionian, Corinthian (Tuscan and Composite) orders - patterns concerning mainly the construction of columns and entablatures, used for assigning buildings based on a set of characteristic forms and proportions.

[6] Major scale – seven-tone scale with characteristic two semitones, which is a development of the Ionian scale; minor scale – a seven-tone diatonic scale with a semitone between the third and fourth degree derived from the Aeolian scale.

from mathematical laws and the principles of perspective. The composition of the architectural work is related to the way it is perceived[7].

Musical and architectural scales make classification easier. However, they are not classification instruments. They function in the area of communication as imprinted key for understanding between the recipient and creator. Order and scales, like languages, contain a set of rules. As a consequence of their use, creations with common features are created. Obtaining similarity, however, is not the main purpose of using order – just as speaking in a foreign language does not only serve to taste foreign pronunciation and characteristic consonances. Over time, through the creation of appropriate associations, it can get a more "instrumental" character (as the use of a chosen language may indicate the need to emphasize non-verbal meanings). However, this is rarely the main goal of artistic expression.

Architecture, probably from its very beginning, suffers from a lack of freedom. Recalling the Vitruvian triad: *firmitas, utilitas, venustas*[8], we see that architects were two-thirds pragmatists. First they had to take care of durability and usability. They perceived beauty through the prism of spatial logic, functionality rather than as independent aesthetic value.

The discovery of the ancient manuscript in the fifteenth-century Florence was a fact of fundamental importance for the development of architectural theory. From today's perspective, it is difficult to resist the impression that the genius contained in the cards of *De architectura libri decem* dazzled and determined theoretical considerations.

In Italian works: Palladio (1508–1580), Scamozzi (1548–1616), Guarini (1624–1683), Piranesi (1720–1780), in French: Chambray (1616–1676), Perrault (1613–1688), Blondel (1705–1774), Violet-Le Duc (1814–1879), Spanish, German and British treatises, we still find similar patterns and references. The logic of orders, the typology of columns and beams dominates as the plane of description of architecture. Even the industrial revolution did not completely unleash the theory dominated by the Ten-book tradition. Steel beams, truss poles, inherited scaled bases, heads, and decorations from their stone ancestors. Browsing the *The Seven Lamps of Architecture* by John Ruskin (London, 1849) we see a new set of forms, but still arranged according to a known scheme (typology of columns, arcades, details…) Not quite directly, the vitruvian tradition also influenced the tectonic thread of architectural theory. In the work of Kenneth Frampton we find precise explanations relating to creative techniques. They are rooted in a craft tradition of shaping space. The unchanging themes return: ground support, material and detail features resulting from the method of combining the structure.

It was only the twentieth century that brought new, "liberated" theoretical models. They were not created as a result of evolution but rather as opposition to convention established for centuries. And so the assumptions of modernist architecture were set in opposition to historical styles, modern art opposed the decorative art. In the post-war history, the status of the symbol of struggle against the established rules was moved to England where the Archigram

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[7] The vibrations of the eardrum in the ear and the characteristics of the nerve impulse correspond to the same physical mechanisms as the process of sound formation. The harmonic relations of the component tones contained in the sound wave reach the auditory organ and evoke its vibrations – subordinated to harmonic divisions

[8] Witruwiusz, *O architekturze ksiąg dziesięć*, Warszawa 2004.

group, in 1960–1974 exploded with a series of avant-garde concepts. Superstudio, Yona Friedman and the metabolists followed a similar route.

Moving further to the present day, we find the practical theories of Peter Eisenman, Greg Lynn, Patrik Schumacher, and Rem Koolhas. Writings express the personal views of these outstanding artists and as such they do not need to be proven. Interpretation of historical issues is used to fill the background on which authors clearly engrave the credo. The most unrestricted branch of the theory of architectural composition is (paradoxically) the one that concerns the largest scale of action. Renaissance urban concepts developed fresh geometrically abstract patterns. The urban garden of Ebenezer Howard was based on an idealistic, formal approach to create an urban structure. The contents of Antonio Sant'Elia, Tony Garnier and Bruno Taut concepts of new, twentieth-century towns, must be read in a similar way

Music is free in excess. According to most opinions – it is the purest art. It grows from the soul of man. It is technically unrestricted and perceived intuitively.

The development of music and its theory is not like the development of architecture. It is much more equalized. The following ages bring new components in the field of tonality, harmony, musical forms and instruments. Rarely, however, these are revolutionary changes and rarely affect all elements of musical creativity at the same time. Speaking of the theory of music, it is impossible to ignore its practical sense[9]. Practising music, especially composing, takes place over the centuries by studying earlier works, understanding and processing. In comparison with other fields of art, this is a process strongly dependent on intellectual considerations.

All musical works included in the achievements of so-called "classical music" were based on the application of theoretical rules. Importantly – these rules exceed the scope of practical activities (concerning compositional and performance techniques). An important part of them concerns the aesthetics of a musical work. Explanatory and evaluative theory allowed to distinguish between consonances and dissonances, correct and incorrect harmonic solutions, clear and blurred rhythmic patterns, etc. This is how the art of counterpoint in Baroque[10] works on the base of system described by Johann Joseph Fux. Without it, it was not possible to compose the simplest song. Interestingly, the existence of a set of rules regarding the aesthetic essence of musical creativity does not limit the diversity of the resulting works at all. On the contrary, even compositions that break the rules are much more understandable on the background of established paradigm.

Elements stabilizing the theory that would correspond to the logic of architectural orders are present here. However, they do not have such a powerful impact. In the tonality area, we can talk about a close analogy. The modal scales derived from antiquity evolve through the Middle Ages and the Renaissance so that the major-minor system could master the Baroque. It is only the twentieth century that brings changes in this area. The creation of dodecaphony and Schoenberg's serialism can be compared to the formulation of the principles of modernism.

The trend of the tonal scale overlaps with a much more diverse practice based on motivational patterns – characteristic figures and melodies, which brings individual value to the

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[9] R. W. Watson, *Musica practica; Music theory as pedagogy*, [in:] *The Cambridge History of Western Music Theory*, Cambridge 2002, p.46.

[10] I. Bent, *Step to Parnassus: contrapunctal theory in 1725*, [in:] *The Cambridge History of Western Music Theory*, p. 554.

schema imposed by tonality. Here, from the Middle Ages, the tune of Gregorian chant dominates, gradually replenished and later replaced by melodies from secular music – knightly lyrics, folk, court music, etc.

Performing techniques from one-voice, through parallelism, motet polyphony, towards homophony and serialism – music built an instrument of creating consonances[11]. The material to fill them came from a set of sounds contained in the scales. Pentatonics limited the number of possible connections, modal scales broadened the spectrum considerably, the major-minor system opened a real variety, which through the use of modulation and alteration gradually led to the construction of a palette consisting of all sounds of a certain height. The twentieth century added noises, murmurs and inarticulate sounds so that in sonorism they would gain access to all auditory as authorized components of chords.

Music gradually developed its harmony. At the moment of exhausting the potential of the means used, it was always prepared to broaden the scope. The consonances proposed by the composers became more complicated with the increase of perception possibilities among the listeners. Most importantly – changes took place in the awareness of canons and rules. Knowledge of counterpoint rules allowed creating transpositional sequences and alterations in Bach's chorals and fugues (always leading to the "correct" harmonic solution). Perfectly developed proficiency in classical harmony made it possible to create new musical ties in Romanticism (broad use of non-chord accords, Chopin chord, Tristanian accord, dissonances, alterations). The colour palette of the Impressionists was built on this foundation and opened the way to sonorism. The complication of the harmony of late Romanticism – Wagner, Faure, Franck – built the foundations of dodecaphony.

The juxtaposition of two images – the history of architecture and music, their evolution in time, and in particular – the comparison of the theoretical foundations of both fields leads to surprising conclusions. The technical, realism, constructional conditions of architecture do not give an advantage to its theoretical foundations. The translatability, uniqueness and subjectivity of music influenced the strengthening of the theoretical reasoning of the creators. Suffering lack of material substance, music had to precisely describe intangible components (patterns of consequences, order of chords, colour relationships of sounds, etc.). Thanks to this, tonality, harmony, rhythm and instrumentation obtained a powerful theoretical background enabling conscious creation.

The theory of architecture concentrates (with exceptions) on the measurable, physiognomic features of the work – deriving from its analysis the rules for the description and indications concerning creativity. In this sense – it is the equivalent of the theory of musical form.

3. Perceptual model of the work, intuitive and rational interpretations of perception

Two strands of reasoning are dominant in the philosophical interpretation of the process of perception of art. The first is based on a positivist tradition. It starts in enlightenment

[11] P. Gouk, *The role of harmonics in the scientific revolution*, *The Cambridge History of Western Music Theory*, p. 223.

materialism, due to the empirical research methodology. The focus is placed on the human being, his psyche and action. To research these factors one can mainly implement the tools of natural sciences. In the nineteenth and twentieth-centuries this trend manifests itself in existentialism and later – vitalism, intuitionism, hermeneutics and behaviourism. Christian Norberg-Schulz's writings are based on the achievements of this tendency, interpreting the meaning of the building and urban complexes: *The history of architecture describes the development and use of symbol systems (...) thus becoming the history of existential possibilities*[12]. In contemporary music, it has resulted in, among others, the aleatorism of John Cage's works, Karlheinz Stockhausen and Pierre Boulez.

The second trend can generally be called rationalism, deriving its roots from Aristotle. It assumes that even the deepest secrets of human experience are subject to intellectual exploration. If St. Thomas Aquinas argues logically for "proving" the existence of God, the more you can use the rationalist method for learning about art and beauty.

In the foreword to the book by Juliusz Żórawski, Bohdan Lisowski recalls the thought of Aristotle's: *Man can only like what is available to him, which does not exceed the possibilities of his mind, senses, memory. It must be considered by anyone who makes any objects, buildings or poetry*[13] And he goes on to say: *Zórawski's thought is actually the same as Aristotle*.

Initially, the development of natural sciences distracted philosophy from rational (theoretical) cognition. However, the twentieth-century achievements of psychology, medicine and communication theory have allowed recognizing general rules in a completely different profile, using the classic ways of reasoning. In this sense, Chomsky's linguistic studies, the interpretation of Schenker's musical meanings and the analysis of Żórawski's architectural form can be considered as new rationalism. Importantly – these are not relativistic statements, depending on individual predispositions, feelings, and intuition. With the awareness of limitations, the authors lead the thought firmly setting assumptions, implying, and checking the truth of the hypotheses with the logical apparatus.

The most extreme, concept remaining in this attitude is the proposal of Christopher Alexander. The logical proof was replaced here with strictly mathematical reasoning, which is used for the needs of creativity. The philosophical foundations of Alexander's approach can be found in Wittgenstein's mathematical idealism[14]. Seven theses that are governed by the rules of mathematical logic – contains a comprehensive knowledge of the world. The musical equivalent of *pattern language* can be found in the dodecaphony of Arnold Schoenberg, who after a period of fascination with sound, sensations, and vital force proposes a "dispassionate" schematization of music. Nowadays – the mathematization of art is gaining more and more importance. This happens thanks to the use of computers on the one hand – for analysis, and on the other – for supporting creative activities. Machines give the chance to process and automatically search for rules in huge collections of information. They support human efforts to compose on the base of shape grammar or musical generative analysis[15].

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[12] Ch. Norberg-Schulz, *Znaczenie w architekturze Zachodu*, Warszawa 1999, p. 226.
[13] J. Żórawski, *O budowie formy architektonicznej*, Warszawa 1973, p. 8.
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