

Evolution of Design Support Methods – from Formal Systems to Environment

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Abstract: *In the paper the main stages of the evolution of aided design methods (which led to the formation of new spaces of creation) will be presented. The first way in which human tried make his work easier were direct introduction of scientific researches in practice. Comprehension and studying the structure of design process creates real conditions for increase of its efficiency. Thanks to methodological researches the systematic design methods were developed. The next step was introducing the IT technologies into the design process. Firstly as a simple tool, and after as the participant of the creative process. Last years an idea of “direct designing” – the use of VR as an environment for the spatial forms creation was elaborated. The environment starts to play a role of an active mediator joining the real world, the men and the computer. In this environment the designer has access to the processes and sources of creative activity. The qualitatively new process of architectural designing arises.*

Keywords: *Methodology; creativity; design environment.*

Introduction

Methodology as a separate area of science began developing in the XX century, when the works concerning the general methodology of designing, praxeology and heuristic methods appeared. Thanks to methodological researches the general theory of systems was created and systematic design methods were developed on its basis. Development of cybernetics, electronics and computer science has enriched the arsenal of design means with the tool which does not have an analogue in all history of architectural designing development – the computer. Computer was treated as a tool in the design process. The problem of creative usage of computers was not the area of interest. Only now, computer is

considered to be a partner in the creative process. In the end of the XX century principles of virtual reality have been introduced in practice. The virtual reality is considered as space of creativity and designing becomes a place.

In the paper the main stages of the evolution of aided design methods (which led to the formation of new spaces of creation) will be presented.

Methodology as the way of supporting the design

The first stage is bound up with developing of the design methodology. Humans always tried to understand how to solve problems. All men's actions, which are not a result of an automatic reflex, demand

some thought – causing the men to immerse in the given action and create its plan. Development of designing demanded a new type of thinking and a new way of formulation of problems. The methodological thinking comprises two aspects: The first aspect is Reflection (the approach to understanding and ordering knowledge). The second aspect concerns Pragmatics (the practical decision how to solve a problem). The reflection is connected with heuristics – the process of understanding a problem essence which should be solved in an unclear situation. Pragmatics concerns the logic-procedural thinking and is connected with two formal elements: the purpose (a task, a question) and means of its comprehension (procedure of realisation). The method can have either a purely logic form, or can be expressed descriptively and explains how to reach the goal and simultaneously create the methodical and repetitive application. The methodology became a way of overcoming the complexity of design process. The first methods that supported designing were direct introduction of scientific researches in practice. Comprehension and studying the structure of design process creates real conditions for increase of its efficiency.

Systematic methods in architectural designing

The systematic approach in designing is a method of streamlining designers' actions in the process of object creation. The systematic design methods are divided into "hard" and "soft" methods. The first group of methods requires clear formulations and using complicated mathematical apparatus. Its main task was aiding the solving of functional problems. Experiments have shown small suitability of these design systems, especially if we consider expenses of preparatory design stages. As a result these methods have not been fully introduced in architectural design process. The "soft" system is based on a principle that any artefact created by men can be presented by several relevant systems. The soft system

methodology has a special status distinguishing it from traditional scientific methodology. It does not solve a problem, but deepens the understanding of the problem and stimulates the process of thinking (Alexander, 1977). "Designing the process of designing" becomes the main task. A consequence of applying the system approach in architectural designing is that the process of design becomes open. It creates a basis for inclusion of the elements of mathematics and logic, that allows the designer to leave area of own experience.

Some special attention deserves Negroponte's work "The Architecture Machine: Towards a More Human Environment" in which an absolutely new approach to modelling of design functions was shown. This approach is beyond as "soft" and "hard" system approach. It destroys hierarchical and discrete-analytical approaches to designing. This method consists of a continuity of the design activity, of functional unity of the men and the computer. The architect becomes a designer of their own activity (Negroponte, 1970). Negroponte's works became a basis for researches of "cybernetic space of designing" and for creation of the hybrid environment of architectural designing which have begun only in the late nineties of the XX-th century.

Computers in architectural design

Development of cybernetics, electronics and computer science has enriched our arsenal of design means with the tool which does not have an analogy in the entire history of development of designing. One of the basic problems was which aspects of design process could be formalized and which couldn't. It was considered that the designer carried out creative actions and makes decisions in undetermined situations, where the choice was connected with risk and the computer helped with routine works (storage and management of the information, performance of calculations, generating of standard decisions, and performance of drawings).

In the sixties of the XX-th century many

programs supporting different design stages have been developed. The completely automated complex programs covering the entire design process have started to be developed. However, due to technical possibilities such programs could not work efficiently. Researches concentrated on a problem of active human – computer interaction. The analysis of the evolution of the human - computer dialogue methods shows an interesting law. After a stage of automation of designing transition from programming to input of the text information was made. Using the keyboard, the designer applied a natural text way of dialogue with computer.

As a result graphic interface had been created. The interface became more ergonomic, and programs more user-friendly. The large quantity of CAD software has been created. The analysis of evolution of the most popular programs throughout last fifteen years (Archicad, Architecture for Microstation TriForma, Arris, Autocad, Autocad Revit, Cadvance, Datacad, Drawbase, Point Line, Versacad) showed that development of CAD programs is mostly connected to the increase of tools efficiency for drafting and the automation of the design documentation elaboration (technical drawings, finishing materials lists, photorealistic visualisation). These programs do not contribute to methodology of design.

Computer as the participant of the creative process

In consideration of creativity problems the question arises - How to apply the computer which is usually considered to be just a tool for calculations in creative actions? The simple way is its application for “computer sketching” as in traditional creative process. Therefore it is necessary that CAD systems correspond to natural forms of designers’ expression. Over past years there were many computer programs for sketching on the display.

However, treating the computer as a pencil is not prospective. We may expect more from such a perfect technology. The computer environment for

early creative design stages should not only create conditions for sketching, but also recognize elements of sketches and diagrams create models, make the critical analysis, take into account design constrains and allow using the knowledge bases. An example of such system is system RT² (Right Tool – Right Time) developed by Ellen Yi-Luen Do (1998).

The second possibility is treating the computer as the mediator - the medium between the architect and form. The analysis of creative process shows that one of the more important aspects of the creative search is men’s ability of metaphorical thinking. The computer can play a role of the intermediary in the process of creating spatial metaphors of the form (Berkel, 1999).

The analysis of computer metaphorisation methods shows that these methods can be divided into two groups. The first group’s methods are based on graphic transformations of the pictures; the second group consists of mathematics methods based on mathematical programming. Results of their work are characterised by high level of abstraction and include any associations and different means of expression (drawing, a sound, and colour).

Virtual reality – the means and the design environment

For understanding of a virtual reality the question “what can I do?” is crucial. Till now it seemed that the virtual reality bears in itself a certain psychological discrepancy. There was a question - can the forms that we created and see not exist? The philosophical basis for concept of systems of a virtual reality was created by Huserl’s phenomenology, in which he explains the situations when the subject does not exist, and yet it is perceived by the human as it occurs in the virtual reality systems. The analysis of technical characteristics of virtual spaces allows formulating the thesis that there is a qualitative revolution in the human – computer interface. It is possible to „enter” the computer world, where men find out that nothing exists except virtual forms. Designers and users

of the virtual world become a new generation of “inhabitants” of cybernetic worlds.

Last years an idea of “direct designing” – the use of VR as an environment for the spatial forms creation was elaborated. It is based on the principle of “full immersing” the architect in the environment projected by himself. The architect, being inside the projected space, defines the direction of changes and realises these changes in an interactive mode, moving the forms in virtual space.

A condition for effective functioning of a cybernetic space is the use of full semantic ways of natural communications. For direct designing using the Augmented Reality technology is especially an effective. Unlike systems of a VR where the virtual worlds replace the real world, the AR expands the real world, combining the information of both worlds.

The hybrid environment of architectural designing

At the ECAADE Conference in Lisbon W. Mitchell presented the proposition of the Design Laboratory – a Multidisciplinary Innovation Environment. He analyzed development of design activity “from studio to the design laboratory”. It has defined six stages of this evolution:

1. Designing on a site.
2. Paper designing – the design studio working in the traditional way.
3. CAD Studio – arisen in 70 and developed in the eighties of the last century. It was the first approach to creation of the hybrid design environment (the book, computer knowledge bases, drawings, breadboard models and computer drawings, visualisation).
4. Collaborative designing (90-s’ years of the XX-th century) – there was an enrichment of means of the previous stage by new technologies and methods of dialogue of members of the design collective.
5. CAD/CAM Studio - modelling and building methods are considered as a unit.

6. Design laboratory. Mitchell defines the main idea of DL as follows: “Physical design making but in digital environment”.

Necessity of creation of new designing space is determined not only by technical, but also by psychological and philosophical factors. The immemorial human aspiration to create the Theory of Everything belongs to this second group. However it is necessary to notice that now the technical aspect of creation is treated as the most important. New computer technologies change our thinking about architectural designing. It follows from distinction between the computer and human mind. The computer is discrete. The mind - analogue. As a result there is a problem with their connection.

The process of creation and perceptions of architecture changes between the Real and Virtual, Analog and Digital. It determines the necessity for elaborating the design environment in which creation will be an integrating process connecting components listed above. The environment plays a role of an active mediator joining three basic elements – the real world, the men and the computer. In this environment the designer does not adapt to the computer logic, and the computer is not simply an executor of the problems put by the designer, but both these elements become a whole – some kind of the hybrid. While traditional tools enable architects to work only on objects, in HDE the designer has access to the processes and sources of creative activity. (Asanowicz, 2002)

Major principle is the possibility of a subjective choice of methods, tools, means and media for a specific goal achievement. Effective designing in the hybrid environment demands elasticity in work with the selected means, an exit behind the possibilities given by these means and fast transition from one means to another. This principle can be realised in the cyber-real design space which main elements are the information and the interface. In a cyber-real complex there are three types of information: the information in mind of the designer, the information on the real world and the information put through

media (Stellingwerff, 2001). These information fields exist simultaneously, and they are almost inseparable. Their main connecting link is the interface. In the hybrid environment of architectural designing simultaneously there are two ways of dialogue. The first is defined by traditional methods and design tools. The second is dialogue of the designer with the computer (the traditional interface of CAD programs, full immersing in the virtual world and Augmented Reality). Complex application of different ways of communication such as natural (pencil sketches and manipulation of forms in real space), and “purely computer” makes communications process more natural.

The creative factor and the hybrid environment of architectural designing

Designing process is a display of ideas in the form of abstract images and their transformation in concrete design representations. Designing is considered as multilevel activity in which there is no one universal tool for solving all design problems. It is necessary to create an environment in which means of support of creativity do not limit possibilities of the designer to possibilities of the given means. Intuitivism of work in new space is extremely important. This space should be as naturally as ordinary space of human dwelling. It should also provide the maximum elasticity of work. It is connected to the absence of predetermined rules at the early design stages.

Glanville stresses one of the important aspects of creating of the new environment of architectural designing. Often our goal is to avoid any conflicts and to achieve the full consent. He has paid attention that the conflict is the basis for art actions and interaction. The situation when everyone is satisfied and no disagreement is present, happens very seldom. Therefore it is important to support distinctions. It is possible to agree only that “we don’t need agreement other than the agreement to disagree” (Glanville, 2001).

If we agree with it we require a mechanism

which promotes discussion. Glanville asserts that we should have the possibility to talk, but special language is for this purpose unnecessary. In case of need, such language can be created. But if there is no necessity, we can simply talk.

If we agree, that we require a new environment a question arises: whether it should be based on the predetermined technologies? There is a danger that complete formalisation will lead to restriction only to what is already known. It is impossible to stress a way of designing which reduces distinctions. Creative designing is based on completely unprecedented technique and conducts to completely unexpected results. In this connection, researches of the new design environment should not be reduced to search of the lowest general denominator, but improve and increase a designing range (Glanville, 2001).

To summarise it is possible to define requirements of a new design environment. This environment should:

- Help intuitively carry out synthesis in process creation object.
- Dynamically transform and reconstruct the methodological, tool and medial structure.
- Possess an ability of self-training, i.e. allow displaying and forming new structures that were not set earlier.
- Carry out transformations with preservation of topological variants.
- Work by a principle of multichannel communication of all aspects of the project.

One of the propositions of the new environment of architectural designing was created in the ACCOLADE research. This research was based at the A. Jakimowicz thesis that “Design – Becomes a Place”. The main goal was creation of cybernetic space of collaborative design by connection of the world of calculations and the experience world. This environment should be based on a combination of new technologies of communications, information interchange and new design media. Five main elements, having crucial importance in the new design environment were defined:

CL – Communication Language. Researches demand the consideration of all aspects of language of communications used during design actions. It also partially concerns a problem of representation (language of representation of the design decision).

CB – Communication Behaviour – concerns human behaviour in design process.

CE – Communication Environment is connected with structure of the data, access to the information, availability of communication media, information interchange, throughput, the software, procedural flexibility, the user interfaces, coordination means, and integration of means and effective methods of representation.

GR – Goals and Roles - these concepts concern

clear definition and the coordination of the purposes of designing.

E - Education – defines type of pedagogical structure of process of training, both system, and designers (Stellingwerff and Verbeke, 2001).

Conclusion

Nowadays in architectural design supported by computers we observe existing of the distinction between “working space” and “working environment”. Working space - a real place in which we work. The working environment is the expanded environment which includes the working space, the new digital media. new mutual relations. processes and social

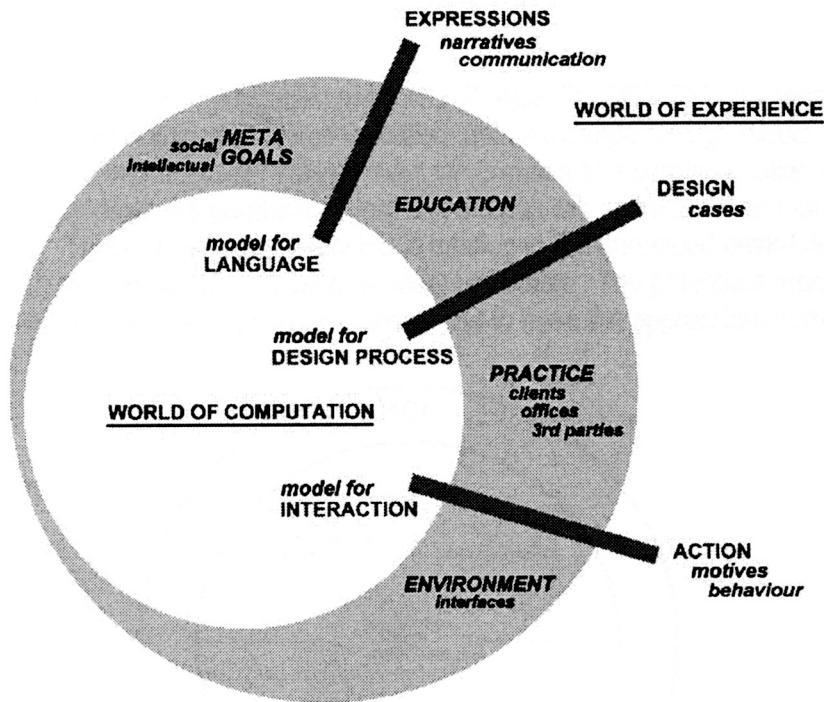
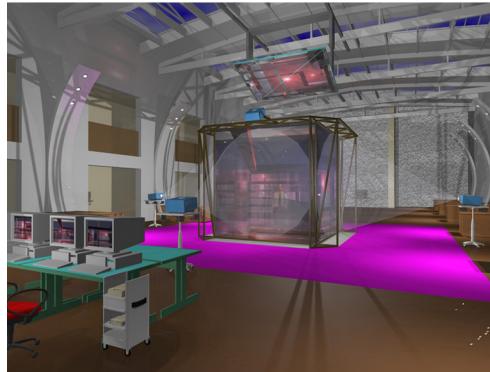
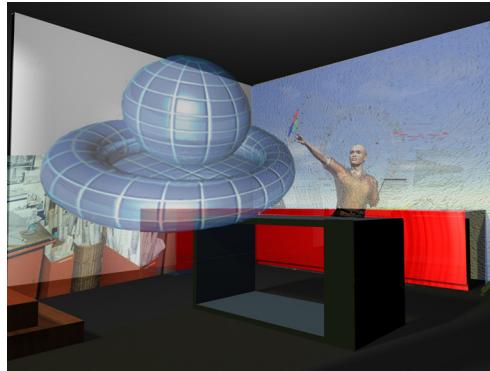


Figure 2
The main areas of focus for the ACCOLADE project

Figure 2
Vision of the new environment
of architectural design



aspects. The design environment stimulates occurrence of ideas by ways which are impossible in usual physical working space. Hybrid environment of architectural designing provides effective interaction between the digital world and the experience world. It becomes the kind of “intermediary” between these two spheres.

Hybrid environment is based on General Theory of Systems in which the system is considered together with its surroundings. If we accept that the object of designing is the system, and the surrounding is the space of designing - in HE the object becomes a designing space. If we accept that the system is the process of designing covering the object and its surrounding and the surrounding is an environment of designing - in HE the process becomes the

environment of designing. As a result there is the hybridization of object, space, process and the designing environment. Work in HE is based on both formal and informal ways and communications processes. Despite a long way of development of architectural methods of creation – “the essential kernel of creativity” is based on the use of graphic language. On the other hand, research of development of computer technologies draws our attention to a not quite realised problem of the formalized human-computer interaction. In the course of designing dialogue not only is it the dialogue at the person-computer level, but also the conversation of the designer with themselves. The role of the intermediary in these “conversations” incurs computer. As Ranulph Glanville said: “...we are limited by the paucity of our imaginations.

We can only imagine what we can imagine. To compensate, we should allow room for the computer to go beyond what we can imagine for it..." (Glanville, 2001). Effective integration of computer technology with creative architectural actions conducts to transformation of actions. The new creative possibilities, new forms of the organisations strengthened by an information technology, transform the way of designing. It is often thought that simple CAAD methods will directly lead to the increase in the designing speed and improvement in the quality of projects. This thesis is erroneous as the perfection of design process based on simple application of computer technologies only creates an alternative way of designing. Qualitatively new process of architectural designing will arise in the new environment of architectural designing.

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