Adaptability and a scenario-based design methodology for architectural education

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ABSTRACT: The city of the future will be characterised by the ability to accept and respond to new and hard-to-predict events and developments. The fast development of society and technology should be reflected in the perception of sustainability. As architects, the task is to deal with new projects and adapt existing building stock with the changes leading to a new focus for an area. In doing so, methodologies for educating architects can be examined in a sustainable way. Comparison of Vitruvian traditional hard typology, and its predicted and legible building type with the fluid and soft typology of generic indeterminacy raises new questions about design in architecture for uncertain and fast developments. In this article, the authors explore a one-semester studio work with a scenario-based design approach. This involveda new development in a dense urban area with new, and existing, buildings and areas.

INTRODUCTION

Architectural design needs to take account of the dynamics of lifestyles and the rapid development of society. Adaptability to the habitat should be an essential element of sustainability; however, that has been reduced to the formal application of technology and architectural constraints, such as sun orientation in architectural education. Buildings became machines without spirit and with limited chance for change: *…for example, zero carbon buildings with a short lifespan and no consideration of alternative uses after its original function become obsolete is arguably only a minor contribution to modern society* [1].

The impact that the building industry has on climate change is substantial; therefore, one should look at how one builds and for how long. Jane Jacobs stated that the greenest buildings are the ones already exist. Therefore, reducing energy produced during construction and prolonging the life-cycle of the building should be one of the goals of sustainability. To ensure that, adaptability in architecture should be viewed as a fundamental part of the design process, not just as additional value. Design strategies should implement the idea of time and change.

In this article, the authors introduce an educational methodology that bonds the design process to adaptability in project development delivering new and innovative solutions. The main objectives were focused on the correlation of the existing with the new proposed urban context. Figure 1 illustrates different types of design including a hard typology, soft typology and a scenario-based design. These are further discussed below.

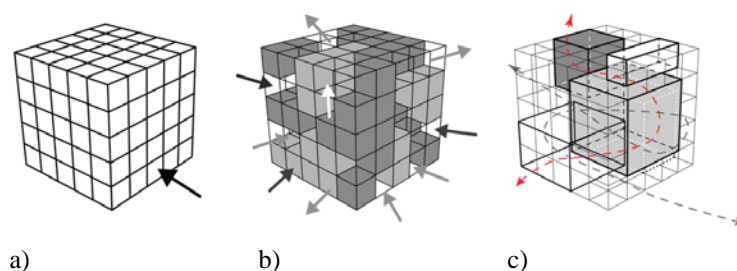a)   b)   c)

Figure 1: Different types of typology: a) hard typology with linear development and single function; b) soft typology with variable use and cyclic functional scheme; c) scenario-based design with a non-linear and fluid functional scheme.

The teaching, based on Vitruvian traditions, is bound up with hard typology. The classical Neufert typology is strict about spatial organisation inside the building and also towards the identity of the buildings type; buildings for education, healthcare or housing are supposed to be autonomous types with specifications that limit their adaptability to future change [3]. On the other hand, Schneider and Till suggest design tactics that offer indeterminacy of use and allow future change [4]. Subsequently, the freedom for users to organise their space was allowed. Adaptability, in this case, is supported by …*the idea of the* incomplete building *where a basic frame leaves space for personalised interpretation of the user* [5].

An important aspect of sustainability is the size of a building. Ongoing research at Slovak University of Technology in Bratislava concerns the importance of size, proportion and usage of the space in housing projects and could be applied to various scenarios. …*A small dwelling takes less space; uses less material and after its clearance, there will be less construction waste. Moreover, less energy will be used for heating and air-conditioning, and there will be a decrease in energy consumption in general* [6]. Adaptability in architecture is a convenient solution for such requirements. The general objective is prolonging the life cycle of the building and reduce the need for destruction or clearance.

Adaptability in architecture could be defined in various ways, depending on the perception of the scale of change in space and the environment. In general, it is defined as *...the capacity of a building to accommodate effectively the evolving demands of its users and environment, thus maximising value through its life* [7]. An adaptive architecture should have the indoor climate quality controlled by automated processes responding to the external environment. These responsive processes in architecture can adapt, for instance, exterior façade elements or use other technology that sustains the inner comfort of the building. In this type of adaptation, spatial layout and its quality does not change.

Spatial adaptability and flexibility can be employed when considering spatial changes, developing needs or programmes. However, what is the difference between them? The answer can be the perception of the time in which the change is taking place. The spatial adaptability responds to the need for change in the long-term perspective. On the other hand, flexibility takes place in response to short-term changes. The spatial change gradient captures the phenomenon of polyvalence, which is defined as a form that can be put to different uses without having to undergo changes itself; hence, minimal flexibility can still produce an optimal solution [8]. During the course, students are introduced to several concepts in architecture that support durability in time. In contradistinction to hard typology, soft typology offers various ways of dealing with adaptability.

Two leading approaches were introduced in terms of design and thinking about adaptability. First is the categorisation of adaptability types and systems by Gosling et al presented in Figure 2 [5]. There are two levels of adaptability: *design for spatial adaptability and flexibility* and *the process of spatial adaptability and flexibility*. A few more adaptability types have been added to complete the spectrum.
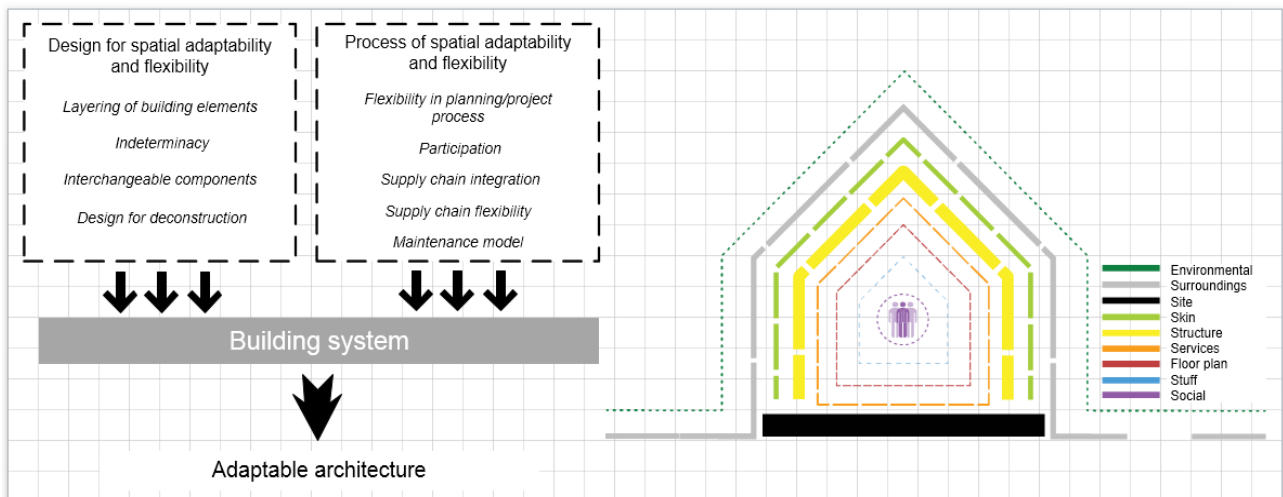
a)…..   b)

Figure 2: a) Categories of spatial adaptability and flexibility approaches; and b) layering of building elements.

The second approach involves the layering of the building components. The principle of layering is based on the division of building elements in terms of their durability. In order to achieve adaptability, these layers should be independent of each other, allowing for their adaptation or change. The division of buildings into layers has developed through different phases. The initial division of the building was into four layers, such as shell, technical equipment, disposition and interior equipment, according to Duffy and Henney [9]. This was later supplemented by Brand in 1993 to become six layers: site, construction, exterior cladding, technical equipment, disposition and interior fittings [9]. Subsequently, this division was enriched by Schmidt [7] with social aspects (users, neighbours) and the surrounding area

(public space facilities, service infrastructure, transport accessibility). Other layers since have been added that are not so much changeable but rather affect the ecological concept. These layers are the environmental layer and climatic changes.

SCENARIO-BASED DESIGN METHODOLOGY

The authors' educational and pedagogical approach involves indeterminacy and fluid perception of an architectural design concept. The variability of solutions and different perspectives encourages students in critical thinking. An interesting approach was introduced by Professor Achten that

> …*proposes* interaction narrative *as an organization of moments of interaction between the user and the system following a story that is consistent with an interaction style* (in our framework - adaptability types). *Additionally, the interactive system has an* interactive narrative *for the way that it switches between interaction styles - yet all the while following a story that remains consistent with user expectations. …Creating an interactive building should be more than the disassociated compilation of many responsive components in a single building. The notion of* interactive narrative *allows the design team of interactive systems to bring all possible moments of interaction into a coherent whole* [10].

Students are challenged to develop strong argumentation and to build their projects on a solid foundation. The scenario-based design methodology is based on understanding three types of context: current, designed and altered. These are discussed below (see Figure 3).
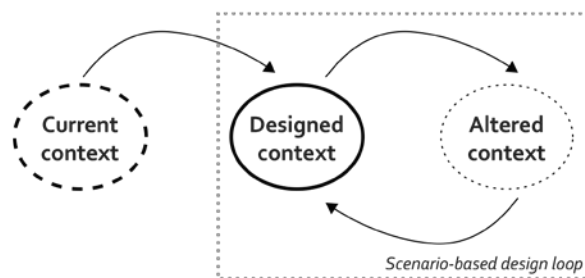

Figure 3: Scenario-based design loop based on the correlation between the designed and altered context.

Current Context

An important aspect of a new project is to understand the location. Urban settings as infrastructure, history, social relations and current amenities should lead students to develop specific understanding of the current context. In doing so, they might be able to specify the requirements of the new implementations. The academic tasks usually are without clients, therefore the inputs from the urban analyses should replace them. The importance of such a process lies in the sustainability of the economic and social models of a proposed building. The understanding of architecture should also adapt to the new perception of lifestyle and society. Architecture cannot be taken as an isolated field, but needs to be understood as fluid co-operation among different stakeholders [11][12] and other specialisations [10]. The proposed methodology provokes the students to seek such enforcement and might encourage them to use it in their future endeavours. In this phase, the students are encouraged to work in teams and gain experience of exchanging knowledge, background and interest in the field of architecture.

Designed Context

Subsequently, students create possible scenarios for further development. They are asked to reflect on the required properties of the proposal, given the results of the urban analyses. Usually, the academic tasks are without a specific client as guide during this process. Therefore, students are encouraged to design their own context based on the knowledge they have gained and deliver a proposal. In doing so, they invent the programme structure that can help them to comprehend the needs of future users. The essential part of architectural education is *…a certain degree of freedom with a defined structure, where students conduct self-study, which extend their basic knowledge* [13]. Nowadays, many incline to architectural education based on practice. However, the paradigm of architectural practice has changed. The model of the client hiring an architect to develop a project has been slowly replaced by the model of an architect proposing a project to the client. Contemporary clients reduce their interest solely to the investment; therefore, the architects are the ones who are supposed to establish a beneficial proposal for the city. This underlines the relevancy of the proposed methodology. Consequently, students should learn to embody the responsibility over architectural and urban solutions.

Altered Context and the Scenario-based Design Loop

The third phase of the methodology concerns the impact of the proposal on the neighbourhood. The intense development of the correlated concept of the proposed building with the surrounding results in inevitable change. For instance, if the proposal brings coveted amenities to the neighbourhood then the quality of life might be affected,

which might lead to other requirements. The project should take this into account. This design procedure is called the *scenario-based design loop*. The loop is a reflection of changes wrought by the proposal, but does not immediately produce an optimised solution; rather, it generates a spatial organised hierarchy. What kind of geometry is capable of absorbing all the changes? The loop can be regarded as a diagram or as an abstract dynamic machine.

The diagram as a machine points to ongoing processes of formation and extinction. *…The diagram is dynamic and therefore, from the point of view of architecture, it allows the creation of new things and ideas* [14]. Comprehending this notion of a dynamic and fluid concept is essential for architectural education. The key ability of a good architect is to reflect flexibly on ever-changing conditions.

TESTING THE METHODOLOGY

The assignment for the studio was a mix-use building in a complex urban area in Bratislava. The task was to find a balanced connection of the existing urban environment with a new proposal to create a community environment. The proposal would create a unique public space - a place to meet, to hold social and cultural events, as well as educational, sports and leisure activities - in combination with housing. The main area of the building or set of buildings was a multipurpose hall, as well as a number of public spaces, classrooms and the like. Spatial composition and operational relationships were to be adapted to modern and current requirements.

The semester task was introduced in several steps:

1. Investigation of the surrounding and context of the site from different perspectives and scales. The focus was on its historical development, the analyses of the existing urban fabric and geometry, neighbourhood relationships, infrastructure and relationship of current with expected social and economic development [15].
2. The comprehension of the current context and proposal including form composition and geometry using adaptability types and concepts introduced to the students.
3. Observation of designed context and developing the scheme for the altered context.
4. Reflection on the proposed geometry and adaptability types and the relationship to the altered context and scenario-based design loop.
5. The final project proposal for a fluid concept of the spatial organisation using restricted amount of space for adaptability.

The objectives of teaching and testing the methodology:

1. Understanding the location for the project and the complex mapping of the input data in relationship to the assignment. Students' work in different scales, from the scope of the city to the neighbourhood details.
2. Self-inventing the programme content and altering the scale of the requirements. The assignment was free in terms of the spatial volume for specific activities. The students' task was to find the balance and infill for these volumes, according to their analyses and proposals.
3. Strong argumentation of their proposals based on the concept of adaptability in architecture supported by the scenario-based design loop.
4. The overall objective was to improve students' graphic skills in presenting non-static fluid concepts and their verbal communication.

The results of the studio brought different perspectives on how to deal with specific urban and social conditions. Students introduced several interesting observations and suggestions implementing the scenario-based design loop:

1. A central position in the city usually offers sufficient amenities for the neighbourhood. Although, with the ongoing development and with the proposed project, they may not be enough. The students suggested support places for the nearby elementary school and a kindergarten for extracurricular activities, which the proposed artist and university student community could use. Hence, the design for spaces was generic and open-ended.
2. The housing part of the project was suggested as temporary accommodation for young individuals or families taking place in activities in the neighbourhood, with the possibility of merging the apartments for future permanent occupation.
3. The project would produce an attractive place for the homeless community. This is reflected in concepts of housing first or other inclusive schemes, to reflect the social situation. Services were included as inclusive activities. There was temporary to permanent occupation of the flats.
4. The concept of office spaces as project-based employment was considered in the project. The gradient from co-working spaces to permanent offices was offered.
5. Including the original neighbours in activities, car-parking opportunities, community gardens and use of proposed public space was part of the sustainable concept of new development, where original context and design places exist in harmony.

Figure 4 shows a student project for a multipurpose centre; different types of housing connected with greenhouses supporting the concept of fluid typology. Figure 5 shows a student project for a multipurpose centre with different types

of housing for young individuals connected to the educational centre and sports activities. The project consists of different types of apartment, from studios to penthouses, to reflect the heterogeneous composition of the population.
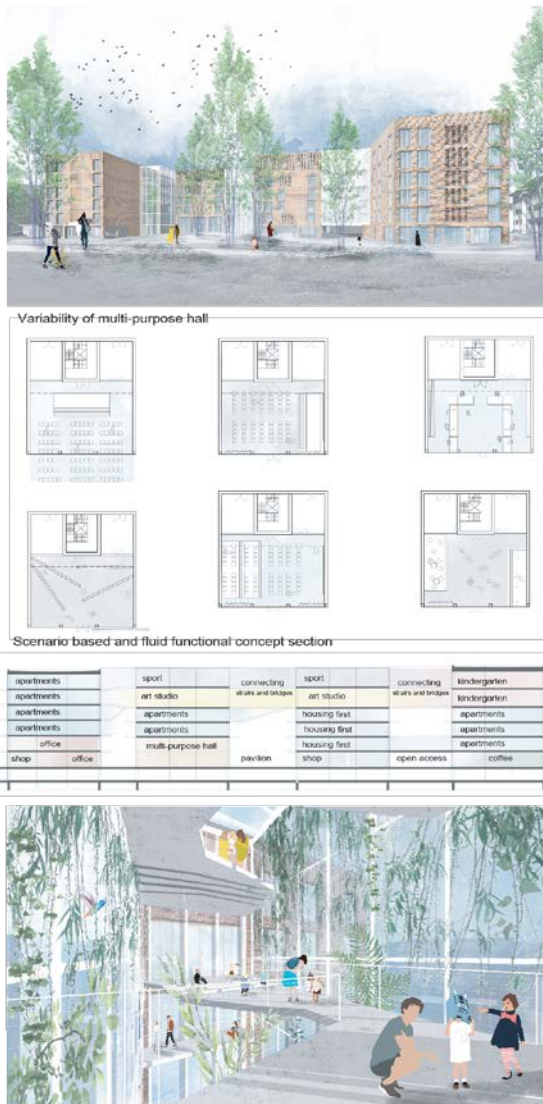

Figure 4: Student project supporting the concept of fluid typology. Author: Marianna Jarina, Faculty of Architecture, Slovak University of Technology in Bratislava, Bratislava, Slovakia, 2017.
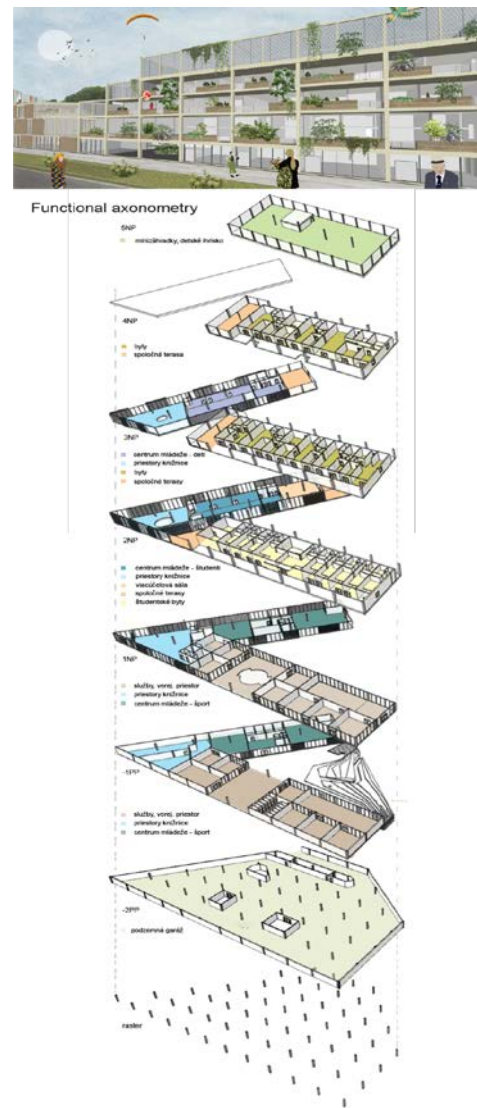
Figure 5: Student project for a multipurpose centre with housing for young individuals. Author: Alexandra Knezovičova, Faculty of Architecture, Slovak University of Technology in Bratislava, Bratislava, Slovakia 2017.

CONCLUSIONS

Adaptability in architecture as the educational methodology offers not only working with formal adaptable tools, it also raises questions about the overall development of architectural projects. With different scenarios to test and reflect on different ideas, students are helped to establish critical thinking and encouraged to find a variety of solutions. The results showed interesting observations of cultural, social, urban and architectural contexts. On the other hand, the final proposals lacked geometrical and technological innovations. The contemporary understanding of adaptability in architecture suggests its resilience. Authors go further; the authors advocate anti-fragility in terms of Nassim Nicholas Taleb: *...Anti-fragility is beyond resilience or robustness. The resilient resists shocks and stays the same; the anti-fragile gets better* [16].

The authors observed the need to implement computational design tools to help process the large amount of information and parameters of complex systems. For further developments, the authors suggest engaging automation, virtual or augmented reality or genetic-/nature-inspired processes to develop the methodology [17-19].

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BIOGRAPHIES

Marek Lüley graduated from the Academy of Fine Arts and Design in Bratislava in 2011, gaining his Bachelor's degree in architecture. During his study, he undertook a study visit to the University of Applied Science in Tier, Germany (2010). He finished his Master's in architecture degree at the Academy of Fine Arts, Institute of Architecture in Vienna, in 2013. After his studies, he ran his own practice dealing with refurbishment and reconstruction of residential projects. Since 2017, he has been a postgraduate student in the Institute of Ecological and Experimental Architecture at the Faculty of Architecture of Slovak University of Technology in Bratislava, Slovakia, where he primarily focuses on his research thesis, *Adaptable Architecture*, dealing with time and change in architecture and its ephemeral functionality.

Henrich Pifko is an architect and associate professor in the Institute for Ecological and Experimental Architecture in the Faculty of Architecture at Slovak University of Technology in Bratislava (STU), Slovakia. He graduated from the Faculty of Architecture, STU (1983) and started his professional career at the Institute of Civil Engineering and Architecture of the Slovak Academy of Sciences. Since 1993, he has been teaching at the Faculty of Architecture, STU. His field in research, in education and in design practice is energy-efficient and sustainable architecture. He has been the lead-author and/or editor of books entitled *Efficient Housing* and *Manual of Sustainable Architecture*. He is the Chairman of the Passive House Institute in Slovakia, a founding member of ArTUR (Architecture for Sustainability) NGO and the leader of the *Architecture 2020* Centre at the Faculty.

Robert Špaček finished his study of architecture in Slovak University of Technology in Bratislava (STU), Slovakia, in 1976. In 1981-1982, he was a postgraduate student at the University of Hannover. He is a member of the Institute of Ecological and Experimental Architecture of the Faculty of Architecture at the STU, which he founded in 1990 with Professor Julián Keppl. In his research, teaching and publication work, he focuses on sustainability, urban democracy and ethics, as well as architectural theory and review work. He is an author,co-author or editor of dozens of scientific and popularisation texts, including the books, *Efficient Housing*, *Manual of Sustainable Architecture* and *Solar Cities*. He is a member of scientific and publication boards, as well as other associations. Between 2010 and 2018, he was the Vice-Dean of the Faculty of Architecture at the STU for Research, PhD Study and PR.