

Meta-Design and the Triple Learning Organization in Architectural Design Process

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Abstract. The paper delves into the improvement of Meta-Design methodology being the result of implementation of triple learning organization. Grown from the concept of reflective practice, it offers an opportunity to segregate and hierarchize both criteria and knowledge management and at least twofold application. It induces constant feedback loops recharging the basic level of “design” with second level of “learning from design” and third level of “learning from learning”. While learning from design reflects the absorption of knowledge, structuralization of skills, management of information, learning from learning gives deeper understanding and provides axiological perspective which is necessary when combining cultural, social, and abstract conceptual problems. The second level involves multidisciplinary applications imported from many engineering disciplines, technical sciences, but also psychological background, or social environment. The third level confronts these applications with their respective sciences (wide extra-architectural knowledge) and axiological issues. This distinction may be represented in difference between e.g. purposeful, systemic use of participatory design which again generates experience-by-doing versus use of disciplinary knowledge starting from its theoretical framework, then narrowed down to be relevant to particular design task. The paper discusses the application in two cases: awarded competition proposal of Digital Arts Museum in Madrid and BAIRI university building. Both cases summarize the effects of implementation and expose the impact of triple-loop knowledge circles onto design, teaching the architect or helping them to learn how to manage information flows and how to accommodate paradigm shifts in the architectural design process.

1. Introduction

Architects optimize their design effort primarily through improvements within the design process. Therefore, this is or should be one of the most significant subjects of research - to understand mechanisms of architectural design, its specific characteristics, its implementation and feedback, the importance of constraints and creativity combined with limits, cultural and social sensibility. There is implied and hard-to-be manageable plenitude of issues and relationships between them, affecting the ability to acquire satisfying, acceptable architectural result, and of course, fluctuating hierarchy of criteria, usually non-replicable beyond single case application. As a result, an appropriate approach to any architectural task requires construction of every particular procedure in a seemingly unique way, but at the same time some clear milestones of the process are similar, if not the same. This paper aims to analyse and attempt to determine the flow of information or knowledge within architectural design process using triple-loop organization in order to understand how triple-loop model reflects the nature of the discipline, and how it affects professional work.



The overwhelming amount of data to be collected, particularly in case of more complicated architectural tasks, points towards information processing and calls for efficient management of information flow combined with multiple supportive actions undertaken by designers. However, the discipline of architecture is unlike the majority of engineering disciplines, and it focuses very strongly on topics which are not susceptible to typical research, to usual narrowing of optimization procedures. This specificity is defined by already mentioned uniqueness, open structure requiring inclusion or exclusion of various contextual components regarding the problems at hand, and unpredictability of results. In this paper selected aspects of design methodology are analyzed in an attempt to disclose the connection between design process structure and the imbued learning organization.

The concept of architect learning from their own experience, although gradually exposed in the history of 20th century architectural theory, has achieved its proper expression in the works of Donald Schön [1] and also his collaboration with Chris Argyris [2]. The idea of reflective practice, learning from the observation of one's own progress and drawbacks in design process in an ordered manner was truly a systemic introduction of second level learning organization into common architectural practice [3]. This additional, reflective layer of cognition and rationale was a proof that in architecture and other design-related disciplines one cannot avoid being contaminated with personal attitudes, individually adjusted tools, methods, routines, last but not least set of preferences and worldview. At the same time this apparent difficulty, being the reason of significant criticism towards design as weak in its ability to be described by scientific means, may be overcome by recursive analyses of architectural workshop and the implementation of learning procedures using several diverse modes of learning – one for particular application, and particular task at hand, and another for the entire practice, as resonating experience, which may be used not only in identical works, but works similar, entirely or partially.

Simultaneously the last turn of the centuries witnesses the shift of architectural paradigm, broadening or blurring of disciplinary boundaries. Architecture, being the science of acting – making, gaining knowledge by making, and as a result of the feedback returning the knowledge to the process of making the task and re-making the disciplinary stance – more and more calls for the open, inclusive character and proficiency going beyond traditional field of disciplinary problem definition. On the one hand, Halina Dunin-Woyseth and Fredrick Nilsson claim, there is new consciousness of learning (education) being the source of architect's knowledge through research-like design process [4], and on the other hand there is a holistic approach to architecture acquiring maturity, which is a reflection of non-reductionist understanding of the role of this discipline, as seen by Christopher Alexander [5]. It is quite apparent that phenomena described by these researchers are discovered rather than invented, disclosing the true nature of designing and architectural design process, immersed so deep in reality that both above-mentioned trends must be also traced back to elaborations on systems theory, as seen in the oeuvre of Gregory Bateson [6] so prolific in the field of architecture and urban design, and complexity theory [7], so aptly summarized by Alexander. Both these areas bridge various disciplines in a contextual, but very strong way.

Learning circles emerge in the field of architecture and they display the multidirectional flow of information, depict the system and the methodology of the use of knowledge and, reversely, the process of knowledge generation. Architect learns from their theme, from its context, from people connected or related to the task, enriching their professional skills, applicable beyond the task. The process encourages architect to research the subject, to apply various methodologies and systematize acquired data. At the same time architect applies his proficiency reinforced with the knowledge, manages – selects, hierarchizes. The specificity of architectural task differs from usual engineering type of the process. It forces designer to constantly identify, challenge, and redefine the very foundation of architectural problem. Rarely the solution to the disciplinary problem encourages a practitioner to tackle the abstract values behind the final product, and to confront the initial formulation of the problem with interpreted reality and socio-cultural environment. This area is a good example of how architectural

design process goes beyond Argyris and Schön's deutero-learning, engaging higher level of learning organization enabling designer to alter the entire system of seeking for a solution [8]. I will argue that triple-loop learning, although used in seldom occasions, is inherent concept of architectural profession, and architectural research. The paper also intends to indicate traces of immediate implementation of this mode of organization of design process in various tasks, particularly those with stipulated social importance, assumed strong cultural impact requiring active semantics and identity.

2. Meta-Design and the implementation of the triple-loop learning

The evolution of thinking on design process exposes requirement to encompass previously mentioned aspects of architecture, its characteristics, and multiple connections to related problems. Architecture calls for the integration of three domains – intradisciplinary, interdisciplinary, and transdisciplinary. These domains correspond to various perspectives or insights, the first exploring the architecture and other space-related disciplines, the second bridging the first one with disciplines non-related to space directly to establish connection, knowledge exchange mechanism. The third invites architect to combine his already established proficiency with another, inspiring and feeding design process directly or indirectly. Meta-Design methodology, introduced in 2007, proposed the concept of parallel design sub-processes [9]. The first sub-process is simply called design process, and the second – meta-design process. The principal idea behind the methodology is to provide and integrative platform for design. The integration relates to various disciplinary domains, to balance between the visual and the verbal, to the real and the virtual – or the abstract and the physical. While the design process refers to action learning (learning by doing), Meta-Design reflects cognitive aspect of the process and offers mechanisms to build referential framework for the design. The third sub-process relies on validation and results of critical, usually multicriteria evaluation, but affects and challenges the design paradigm from which it was derived.

Putting aside the details of Meta-Design which are herein of secondary importance, the triple learning organization of design process is to be seen as one of the major components of this approach to architectural design. Both Bateson's as well as Argyris and Schön's concepts refer to the inherent process of learning from various sources while making the design. However it is important to depict the structure of multithreaded learning process which determines and feeds back the design effort. Regardless of the reference, implementation of levels of learning in the field of architecture requires to adapt the framework – with replacement of the basic term depicting the core activity "learning" with term specific for the discipline "design" (or to be more precise "architectural design"). Thus, three levels will be defined. The first will be "designing" seen also as exploratory experience and the source of understanding of the problem, intuitively or rationally. The second level is "learning from designing" perceived as observation of architectural workshop in search of causal sequences, process managing and decision support components. To describe the interpretation of this level one may determine elements which correspond to references, to the ability to distill design goals criteria, to establish critical apparatus with procedures of evaluation or validation of particular solution contributions. The third level is called "learning from learning from designing". It may be described as the process of learning how basic principles of the system determine the course of design, which decision-support elements from the second level are selected and how they respond to the aims established on this third level, how closely the most abstract ideas behind the architectural task are represented – ideas that determine the paradigm of the system. Designing is about appropriation and efficiency, it focuses on achieving predetermined goals, learning from designing about relevance, verification whether goals really have been met, learning from learning (from designing) about profound understanding of the problem and grasping the importance of the task, the values that have to be carried by the project upon its realization [10].

Triple-loop learning may be also understood as triple-loop knowledge flow. It presents design process as decision-making process in which self-consciousness of the framework of the project exposes fundamental questions of how to design on level 1, what to design on level 2 – a level, which is usually,

in ordinary, common practice, often implicit, and why to design on level 3, a question usually allegedly not within the scope of an architect [C.f. 11]. The issue of purposefulness reflected in triple level organization, however, defines the ultimate role of an architect who goes beyond providing the design to their client, it goes to responsibilities of an architect as one whose focus should combine clients requirements and expectations with public service related to establishing quality of built environment and added cultural values. This perspective allows an architect to understand the position of the project, its significance both inside and outside of scope of client's interest. Going beyond the scope is necessary if an architect is to understand widely the consequences and role of particular components of knowledge. As Hummelbrunner and Reynolds write, levels respectfully may be associated with concepts of appropriation and efficiency, relevance, and understanding and importance [C.f. 12]. If it goes on the field of architecture it may be interpreted that appropriation and efficiency are attributes sought after and design deals with spatial properties, specifies concrete elements like function or form. Managing the aspects of design asks for gaining the relevance through the adjustment of information or data acquired from community or administration or other interested/involved parties to assure the relevance of the design course. However, dealing with the abstract notions or values and decoding the nature of the project, refers to the fundamental questions of architecture and those may be asked as a justification to seek for understanding, but at the same time they allow to attempt to respond in order to establish the importance of the architectural work and its influence on the environment, whether social or related to nature.

Knowledge elements cannot be seen as equal one to another. They obviously serve different purpose, and the efficiency, relevance, and importance may be established depending on what these pieces of information are related to, and how they are located in multidisciplinary structure of the project. While both intradisciplinary and interdisciplinary approaches are suspected when architect gets involved into design, axiologic perspective is often defined by transdisciplinary (or "undisciplinary" to allow for more neutral interpretation) approach requesting, by a minimal extent, to enter the field of ethics to determine the role of the architecture. This ethical predicate, once established, sets the perspective of connecting architecture to society – as a response to social and cultural issues. Therefore the integration of multiple disciplines, or juxtaposition of relevant positions architect exemplifies in their search for appropriate response to the task at hand may be determined as shown in the table below (table 1.).

Table 1. Knowledge production in design process and multidisciplinary approach.

Loops of knowledge processing	Knowledge processing type	Disciplinary approach
Level 1 Designing	Knowledge generation	Intradisciplinary approach to design
Level 2 Learning from designing	Knowledge synthesis	Interdisciplinary approach to design
Level 3 Learning from learning	Knowledge synergy	Transdisciplinary approach to design

The aim of design, although it may be formulated on one level only, will affect built environment in multiple ways. If it is not programed or its upper levels are processed unconsciously by designer it still has its impact, but then the result is much harder to be controlled. While the concept of the design usually focuses on providing high quality of architectural solution it seems reasonable to extract framework which allows an architect to trace the trajectory of the project – establish values, determine methods, and process design itself. Assuring the flow of knowledge produces various results on various levels or loops, as presented in table 2.

Table 2. Results of knowledge flows (learning loops) in design process

Loops of knowledge processing	Affecting the design (mode)	Role
Level 1 Designing	Reshaping the design (the object of design)	Informing on techniques and tools Research in-action
Level 2 Learning from designing	Reshaping the methodology (the method of design)	Informing on methods Programming flexibility
Level 3 Learning from learning	Reshaping the paradigm of design (the purpose of design)	Informing on values Informing on paradigm Ultimate reference

As a result of structuring of the design process typical design efforts of experimenting and investigating supported by the rationale is supplemented with methodology and axiology apparatus, respectfully. This connection, as conscious connection, is of primary importance for the design in order to relate concept design, namely the process of conceptualization, to the concept itself, namely the idea of the project – with the assumption that the idea is constructed or at least filtered with objectivized approach.

3. Triple-loop knowledge flow organization in application

The two applications provided opportunities to implement methodological, systemic improvements, and in this particular case it was done within Meta-Design. Putting aside the issue of intuitive design which most often is inherent to effort throughout the entire course of design, one has to consider the important difference between the quality of design in which the intuition forms the basic power and potential of architectural team versus the concept in which intuitive (or other type of) approach is preceded by intensive intellectual effort related to structure the design process itself, understand the task, collect related data, build individually tailored framework and apply it, allowing then to initiate the intuition to navigate through areas in which detection of wrong design is quickly detected and therefore efficiently eliminated.

The first case is BAIRI which stands for Bydgoszcz Accelerator for Interdisciplinary Engineering Solutions, which is part of University of Technology and Applied Sciences in Bydgoszcz (UTP) – Fordon campus. This particular building is focused on supplementing the campus with the building that instead of typical faculty seat it will accommodate new and flexible laboratories for multiple engineering branches, including architecture, civil engineering, environmental engineering, industrial design, and visual arts. Currently some labs are available for UTP, but they are insufficient and at best slightly outdated when confronted with contemporary requirements of various curricula.

What constitutes contemporary laboratory, which attributes should be implemented into design, and to what kind of general principles laboratory for various engineers should refer? On the one hand, to put things briefly and in a simplified manner, within level 1 an architect faces the reality of explicit requirements combined with the transposition of programmatic contents into physical space divided into sections and rooms. However even in basic contents of pre-prepared program (usually by a client, in this case, by university in cooperation with interested faculties) a necessity to understand internal technologies of particular sections must be investigated with further deepening of knowledge of how every single faculty intends to operate dedicated areas. Laboratories as main elements of the program affect the way students and academic staff circulates within the building, so common spaces may be seen as resultant, yet still they require understanding of specificities (e.g. between environmental lab and interior design lab). Herein the decision on methods to gather knowledge appears, and at the same time this knowledge must be appropriately converted in order to be rationally used in spatial

representation of the architecture. In BAIRI case it was the method of direct observation, inquiries, and interviews. The process of integration of various sources led to the synthesis of knowledge, allowing successively to adopt view on how to aggregate laboratories due to requirements related to special installations, requested in some labs, and completely obsolete in others. Simultaneously selected method of site analysis included not only daylight operation analyses (shadow casting). These fragmentary concepts and partial solutions were confronted with the ultimate goals – to have flexible laboratories, to allow for experimentation, and to acknowledge the ever-changing technologies being the subject of research. After all, building should allow for e.g. testing façade systems in real conditions, and obviously façade systems evolve in time, resulting in necessity to replace areas in facades and at the same time to have the ability and the access to measurement and research systems close to examined façade. Similarly, testing of façade materials like cladding, solid surfaces, morphing surfaces, call for specially designed solutions. But these solutions reflect the most fundamental values inherent in the building due to the establishing of certain set of criteria for the evaluation of the project and to abstract values the building is supposed to represent. On level 3 all these elements are considered as contributions, and confronted with the idea – either provided by the university or, as it was in this case, co-created by architects, dean of the most interested faculty, and related staff.



Figure 1. BAIRI project

The manifestation of the integrative process in the course of this design provides seemingly similar spaces, divided and organized into three stripes – internal communication (circulation of users), the main research area, and the experimentation area – an external part of the building fitted with measuring equipment. The project, although interpreted the spatial disposition in a unifying manner, fulfils the requirement of flexibility and exchangeability allowing for temporal exclusion of external part, and furthermore for replacement e.g. the old façade with the new one independently in every lab. The crane located on top of the building provides semi-automated service to perform this exchange [C.f. 13]. The formal solution instead of being the response to required technologies, is rather the response to assumed values which induce relevant technical solutions and force both architectural and engineering elements to be included in the design – currently having building permit and scheduled for budgeting with support of external grants.

Digital Arts Museum in Madrid (DAMM) was another project in which Meta-Design equipped with the framework of triple-loop knowledge flow organization was implemented – this time international ideas competition. The location for DAMM has been selected in the dense urban environment of Centro

and Embajadores. Unoccupied landplot at Calle de Valencia is rather small, and significantly limits multiple potential developments, whether by its size (less, than 700m²), its relation to nearby buildings due to obscuring the daylight, or simply because of typical museum technology, requiring to facilitate interactions between the institution seated in the building and the external world. There is only one active, external façade to be designed, and the program assumes simple internal division into main exhibition areas, storage and service areas, and supplementary areas like small shop, cafeteria and multimedia hall.

In this case the usual approach to design had to be re-organized profoundly. The main theme of the competition – digital arts presented in public – encouraged the exploration of basic notions of what contemporary digital art is, how it's message is and will be conveyed in the future with respect to the fact that the virtual is probably one of the most dynamically changing environments. Madrid project turned the order of activation of particular levels of knowledge acquisition. The basic questions had to come first – how the notion of digital arts museum can be defined, what it shall become in spatial terms, and finally (going down to level 1) how this institution should manifest its presence in public space. Digital technology grows from connection and information oriented proliferation of the work. A museum requires the interaction between those visiting and the objects stored or exhibited, open architecture, which by the way is more and more extensively used term outside of the discipline of architecture, results in open structure and modular physical substance.



Figure 2. DAM Madrid project with additional images showing the transformative nature of the façade

Again, the three levels of knowledge processing were necessary to be able to define the reality of the to-be-conceived museum. Contemporary museum calls for, as said above, connectivity, openness, and interactivity – while DAMM can only activate one façade, only small portion of the façade was

dedicated as a connection to storage and service area, and basements were intentionally extended and underground levels multiplied to grant necessary space, which cannot be easily accessible by the public. The vast majority of the façade has been designed as independently opened screens, with the ability to switch on multimedia outside or inside, and with the provision of interactive panels and keyboards, extending the presence of the museum and its operational hours beyond the open hours of DAMM. The collection of knowledge on IT technology, on its progress, directions and recent scientific achievements could then be converted into architectural interpretation, and the internal structure was also filled with modular screens – future improvements will allow to change those screens easily giving ground to new technologies and enabling the communication of various new data, works of art or descriptions in new ways (e.g. holography) to future visitors. Museum in a traditional sense is an institution that collects, examines, describes, and popularizes certain aspects of related to theme or topics. But herein digital world posed additional challenge and the nature of the museum had – according to architects' assumptions – to include characteristic traits of internet and computer applications used as tools or media to work on and exhibit the art. Having established the ideological framework and using the third tier of knowledge methods for the project could be established – what can be done to assure the proper transformation of ideals formulated as expected outcome. Meta-Design core concept was very helpful, granting criteria driven and technology limitations driven design. The method of atomized design, which relies on simultaneous designing of small, unchanging components of the entity (those that should not be changed, even if their importance for the main theme of the project is of lesser importance), was supplemented with associative design method, connecting solutions to particular spatial-temporal cycles presumably generated by DAMM. These methods were selected due to their compatibility with specified conceptual stipulations, fulfilling the knowledge cycle on level 2. Thanks to applied methodology step-by-step fixing of challenging, complex program of the museum and thus gradually eliminating design problems became possible. The level 1 knowledge processing was focused on making the external skin of the building truly interactive and rational – detailed design assumed that every vertical door was in fact composed of four independent panels, positioned separately depending on requirements of the exhibition concept or users' preferences. Ultimately design was praised receiving one of prizes in the competition.

4. Concluding remarks

The main idea of triple-loop learning circles which in Meta-Design are called Theory-Practice Meta-Circle(s) is to support the organization of design process and to allow for greater degree of self-awareness and control of the flow of knowledge, and other pieces of information. The rate of blind seeking for appropriate configuration of architectural design may be significantly lowered, and the research related to levels 2 and 3 provides fruitful, if not fundamental reference, at least revitalizing the process. It seems that it does even more, contributing to the ability of efficient improvement of core design efforts. The wicked nature of design problems as described by Horst Rittel and Melvyn Webber [14] on the one hand, and the uniqueness of particular project configuration resulting in inability to generate direct outputs to theory of architecture and therefore on the other hand, requires, as James Powell writes, holistic understanding of consequences of the entire object and its constituents. But this postulate may be extended to include several layers of relationship – a building (or an object) with an interior, surroundings with a building, and an archetype (for that particular building or object) and its physical manifestation and by the inclusion of values, and implementing axiologic perspective necessary to respond to ethical duties embodied in architecture, to force the mind of the designer to include in their arsenal, in their workshop the mechanism enabling the switching of the paradigm, which Powell addresses by calling for a strategy to enable shift in priorities. The inclusion of this knowledge, self-awareness of Meta-Circle, e.g. triple-loop knowledge flow within design process, directly corresponds to the quality and is helpful in focusing on and ultimately achieving design going beyond mere response to spatial problems. After all space is just the container used in order to accommodate social and cultural processes, and providing shell for these processes is not sufficient to assure qualitatively satisfactory

built environment. Triple-loop knowledge organization improves ability to split the task into parallel courses and fosters skills and ability to focus on the most strategically important design challenges.

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