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New strategies for learning architectural design: a videogame simulating the design process in urban environment

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As demonstrated by significant sociological studies, gaming activities allow behavioral experiments that otherwise would not occur. Today some International Universities use gaming activities, in particular video games, for educational purposes. In the architectural field, characterized by increasing complexities in design process, the video game could be the device to learn the practical aspects connecting architectural and urban design strategies. In this paper we would illustrate the research project "ArchiLOGIC", aimed to synthesize the design process by producing a virtual application that is able to assess the architectural and urban results in a qualitative way. Thanks to the new dynamic forms of tale, screening and communication of the urban design, it is possible to figure out a virtual device with the ability to reproduce the dynamics connected to the design process in the real world.

Keywords: architectural video game, learning, virtual school

1. Introduction

As demonstrated by significant sociological studies, gaming activities allow behavioral experiments that otherwise would not occur. Today some international universities use gaming activities, in particular video games, for educational purposes.

In the architectural field, characterized by increasing complexities in design process, the video game could be the device to learn the practical aspects connecting architectural and urban design strategies.
In this paper we illustrate the research project "ArchiLOGIC", aimed to synthesize the design process by producing a virtual application that is able to assess the architectural and urban results in a qualitative way.
Thanks to the new dynamic forms of tale, screening and communication of the urban design, it is possible to figure out a virtual device with the ability to reproduce the dynamics connected to the design process in the real world.
In ArchiLOGIC players face urban and architectural design at different levels. The goal is to provide a design, building it with a firm and seeing it experienced by citizens. It is necessary to complete the mission according with physics, economy and society rules. Players have an initial budget that they will use to meet the game requirements. In ArchiLOGIC game action takes place in a heavily anthropized context, on the western city model. Here the historical matrix determines conformation and character. Settling the gameplay in a populated space, actually existing, players know the project influencing elements by practice, they understand the close relationship between the design parties.
By simplifying and reducing the complexity of the design process, the urban space thus becomes fertile ground for architects and architecture students experimentation. Within ArchiLOGIC teachers can load one or more projects in a simple and intuitive way. The preparation of the environment 3D model, which will be defined during the demo development, would use external platforms, using the latest systems of procedural modeling and working through the GIS data acquisition.
Game score will be visible through four sustainability indicators: ecological, spatial, economic, social.
For all design elements the contribution provided for each sustainability type will be shown, so that players can always be aware of their decision effects in the design context. Players will interact with game elements and characters through their avatar. By fulfilling all the brief requirements, game ends and final score is showed.

2. Why videogames for learning Architectural design?

"Of course, working hard on the project, two lines intersect: one is programmatic, drawn by memory, reason and will; the other is definitely empirical, it is headed by attempt, chance and deepening" (Gabetti and Isola, in Ciucci, 1989). By giving students programmatic tools, in ArchiLOGIC they learn through practical experience.
The draft of an architectural and urban design videogame comes from significant sociological studies on the game action. Game allows behavioral maturation of the individual through practical experimentation. Game action doesn't lead to consequences that would result in society, thus allowing you to make choices, mistakes, to experiment with new solutions (Bateson, 1996). The German psychologist Buhler in 1949 (*Ibidem*) defines game: "functional pleasure", a pleasure that comes from exercising functions that are going to be fully developed. The ArchiLOGIC game takes his approach drawing on those design methodologies that feed on conflict between different components involved in transforming environment, overcoming the shape control "obsession".
Therefore, videogame design extends the scope of its action on tools that allow and organize the interaction between spaces, streams, environments and users more than on the configuration of physical, three-dimensional structures. A dynamic and diagrammatic attitude where the prevalence of processes on objects and of methods on results, turns the project into the result of a complex intent ecology.
Videogames are characterized by interactivity and multimedia besides advantages of message simultaneity. Interactivity implies the presence of predefined paths, players can go wrong many times, but through the mistake they can reach the result. The perceptual experience is comparable to that of the real world as actual, substantial, real (Fusco, 2006), thanks to the empirical knowledge process.

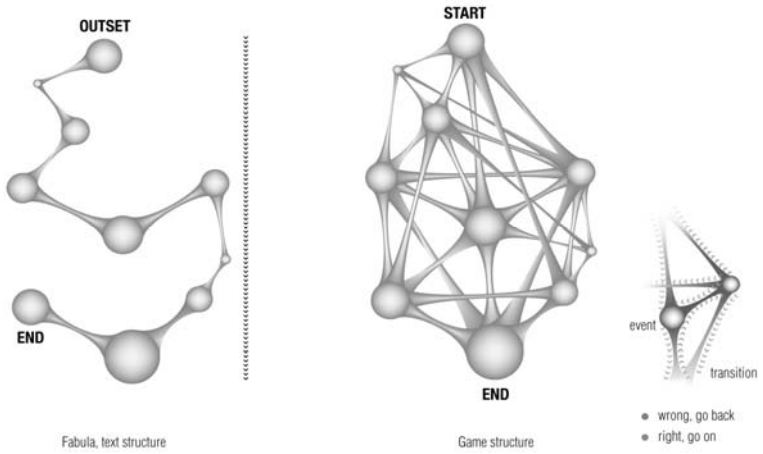


Figure 1. *Conceptual frameworks of comparison between the structures of text and game*

An example of educational videogame for universities is Ice Cream Empire (see: www.icecreamempire.it, last view on 02.05.2013). It was created in 2010 by the Bocconi University in Milan. It is a simulation game to 'train' economics schools students to management business management. The device used to play the game is the mobile phone and it had already grown to more than 18,000 members two years after its creation.

The aim of ArchiLOGIC is thus to formulate bases for the realization of a video game that allows users to deal with all stages, from preliminary design up to the (virtual) building of the architectural object, by making the real creation process of the architectural work accessible through the digital instrument.

Videogames are closely related with architecture and more recent approaches to the project are deeply connected with videogames and their structure.

When it comes to design teaching approach at Architectural Association of London, Innocenti says that abandoning the cause and effect linearity for a complex and nonlinear approach has been in place as an option since the fifties (www.architettura.it/files/2004021002, last view on 02.05.2013).

The new perspective on the systems organization stems from a shift in the point of view, from the classical determinism top-down logic to that bottom-up of the emergence theory.

Top-down and bottom-up models are strategies of information processing and knowledge management, dealing mainly with software and, by extension, other humanistic theories and systems theories. In general, these methods are employed for analyzing problem situations and find appropriate hypotheses to their solution: for example the development of a specific software, the mathematical or geometrical problems solving, the processing of a text, the resolution of a practical/operational problem.

In ArchiLOGIC, the selected approach is 'bottom-up': we aim at refocusing attention on the design logic, shifting the emphasis from purely formal aspects. In general we can say that the videogame structure is based on countless geometric and logic relationships that influence gameplay. Every action performed by each user activates a simultaneous exchange of multiple data and information.

Therefore, by taking advantage of viedogames inherent structure, players can handle large amounts of data at the same time (even if unconsciously) allowing the interiorization of relationships that always exist between the design elements. In the bottom-up information flow the cognitive process is characterized by knowledge of all variables that can affect system elements. It is the holistic approach.

That setting can leave the highest level of freedom to players, who can choose the design process.

During their undergraduate degree course, students experiment design methods depending on the specific objectives of the class. Thanks to the cotinuous comparison with teaching staff, the design process can be understood and criticized, internalized and critically revised by students. The interactive tool is different, the same design experience can be repeated many times, though never repetitive with the holistic

approach. Players can, in this way, experience the design acting intuitively to achieve with practice full consciousness.

3. Methods and tools of representation for ArchiLOGIC

Videogames are different from any other kinds of media, although they resume their various languages (Gee, 2003). They have several features that make them unique and operate differently from others, such as the language of the game play is unique among traditional narrative media. Some studies stated that interactivity is what distinguishes video games from other forms of mass entertainment media. This feature allows the game to exercise potentialities of attraction and immersivity that other media do not have. To play a game is to learn a new language, one native to the medium of videogames, rich in the culture of gaming and spoken fluently by its players.

Dynamic visual communication is the core of this new media that needs also the presence of texts and sounds, shaping itself like a multimedia. Observed by Engeli, multimediality is an effective communications medium. It is fascinating because it involves more senses at the same time. More are the senses involved in receiving information; better is our concentration (Engeli, 1999).

When we look at the idea of using videogames in an academic field, as a part of programs to teach students new knowledge, skills and abilities, we assume that games could teach to think and solve problems and change users' behavior.

Videogames could help and improve didactic experiences by means of new techniques for reaching a digitally savvy audience (Thomas, 2008). Used for this purpose, videogame can be related to "serious game". Serious games enable new types of educational experience that can be rigorously, effectively, and consistently deployed, increasing the power of any teaching group that well uses them.

When McLuhan clarified that "any technology gradually creates a totally new human environment" (McLuhan, 1964), he pressed for a deep reading of new media. The emergence of a new medium does more than require mastery of a new vocabulary.

An educational videogame like ArchiLOGIC reduces the complexity of the real designing process to a limited number of variables; it is possible to distinguish the game from reality.

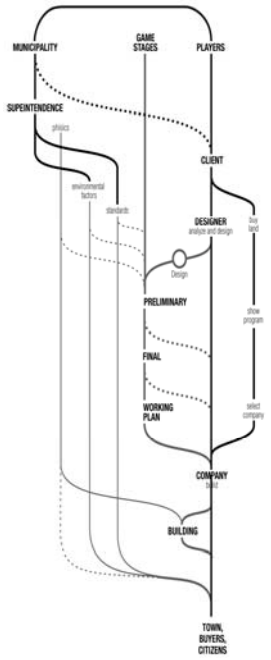
The choice of the visual language must necessarily consider that the video game has educational purpose conveyed to students of Architecture, which, from the beginning of their university studies, learn to read architectural and urban drawings and to communicate their design ideas through the projection methods and the graphical representation techniques. The figurative choices of Archilogic are not therefore comparable to those of videogames with recreational functions, generally characterized by a detached realism or even hyperrealism, neither to those of educational videogames created for students not expert in the conventional representations.

Different kinds of graphical communication will characterize the phase of output of data and restrictions, set up from the game, integrated to the map for orientation, and the phase of input of the projectual solutions elaborated by players.

If many videogames, also those of entertainment, make wide use of maps, that are often visualized by mixed projective methods, elements not to scale and unconventional symbols, in ArchiLOGIC the tools for the orientation may be more rigorous, facilitating, at the same time, the understanding of the space. Meaningful territorial sections may be accompanied to plan views, while colors and symbols will allow thematic readings, organized by layer. Additional information for players will come from three-dimensional models of the city context in axonometric view, which will concur to deepen the knowledge both of the conformations of city tissue and of the spatial relations between the buildings. The various representation and visualization types above mentioned will be integrated from the diagrammatic representation, which introduces interesting potentialities for the analysis and the following management of the project.

In architecture, diagrams have in the last few years been introduced as part of a technique that promotes a proliferating, generating and instrumentalising approach to design. As van Berkel and Bos affirm: "the essence of the diagrammatic technique is that it introduces into a work qualities that are unspoken,

disconnected from an ideal or an ideology, random, intuitive, subjective, not bound to a linear logic - qualities that can be physical, structural, spatial or technical. [...] The diagram is not a metaphor or paradigm, but an 'abstract machine' that is both content and expression" (van Berkel B., Bos C., 1999).
In the projectual phase it will not resort to a 3D modelling work, that it would involve an expansion of game times, but to the composition of juxtaposing and overlaying volumes.
The passage from the orthographic and axonometric visualizations to those perspective ones "in subjective", with possible and expectable animations by walk and fly-through, will concur to estimate the perceptive effects generates from the different compositive solutions.



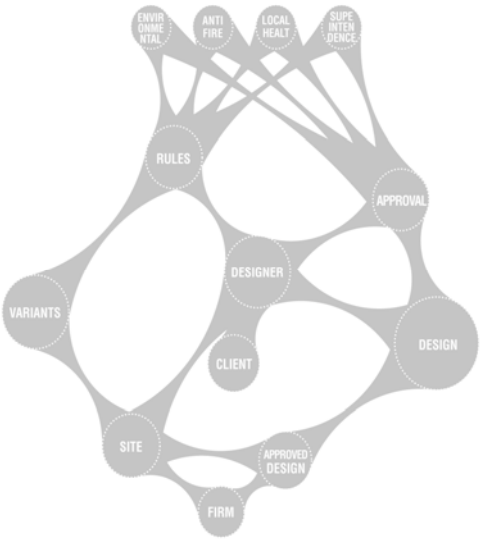


Figure 2. *Diagram of ArchiLOGIC design process*

Figure 3. *Conceptual framework of relationships between stakeholders*

The metaproject of ArchiLOGIC

ArchiLOGIC is therefore an architectural design serious game. It focuses on teaching a sensitive approach to the project rather than on the design specific standards.
To do this, the game must respond to players' actions in a critical way, bringing attention to qualitative rather than quantitative aspects of the project.
Therefore it is necessary to clarify how to make the interactive application able to judge the design quality.
We define the game rules, according to which the score rises or falls during the action, formalizing a spatial and morphological urban environment analysis method.
According to a series of international studies, gathered in the late '90s by the governmental guide 'By Design', which presents the conventional approach to urban design quality, the 'urban design is defined as the art of creating places for people, which concerns the connections between people and places, movement and urban form, nature and buildings.
Inspired by these studies, the score is defined through four sustainability levels: spatial, ecological, social, economic. The optimal feature of urban design are listed and described below. They then are translated into a mathematical algorithm by ArchiLOGIC and become the main evaluation tools of the project.

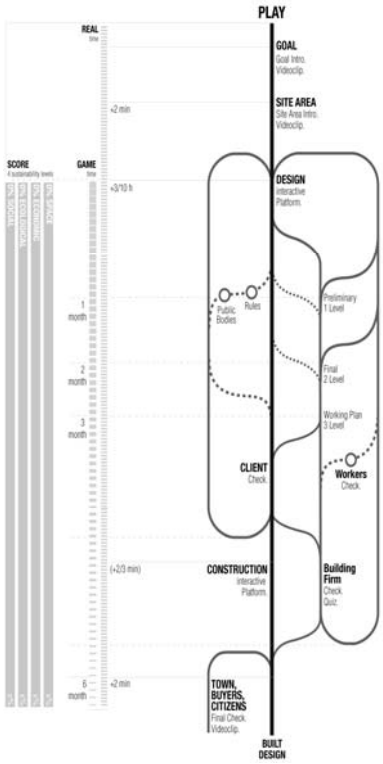


Figure 4. *Diagram of ArchiLOGIC proof of concept*

Character and identity: promotion of the character in the urban space and landscape in response to the distinctive local patterns of development and culture, by strengthening them.
Continuity and closure: promotion of the street frontage continuity, and public and private spaces clear definition.
Public spaces quality: promotion of pleasant, safe and uncongested public spaces and routes; efficient for the entire population, including disabled and elderly.
Easy movement: promotion of accessibility and local permeability, with the creation of places connected together and easily accessible, placing traffic needs in the background from the people ones.
Readability: promotion of the territory readability, with recognizable routes, intersections and landmarks.
Adaptability: promotion of environment adaptability through the development, in order to respond to social, economical and technological changes.
Diversity: promotion of diversity, allowing the choice between different kinds of developments and uses which are interconnected in creating viable places that respond to local needs.
Urban Sustainability: to enforce resources and energy utilization patterns in relation to the urban environment pollution, increasing the global and local environmental conditions perception.
Maintenance of public spaces; to avoid permeability decrease when private spaces overwhelm public ones.
Finding solutions to the urban edges emergence: avoiding the dispersion of industrial, institutional and commercial functions in suburbs. Loss of character. In suburbs it predominates a lifestyle based on car use.
Finding solutions to the urban centers threat and the "urban renaissance": urban centres adaptation to a role focused on leisure and finance activities, "creative industries", production of high-value services, the renewed metropolitan life popularity. Avoiding the growing territory corruption: resulting from the prosperous growth and increased demand for higher quality life, aging of the population in many rich countries and increase of a single component households. Need to urban regeneration resulting from the structural economic change: industrial decline in many cities and impossibility for new industries and

services to face the global economy and the need to invest in slums and retrieve large ports and territories of obsolete railways.
Affordable housing: affordable housing shortage, together with the continuously rising prices, leaves aside a significant part of the world's population.

Starting from these assumptions, we proceed by defining the parameters that will influence the score four levels of sustainability, social, ecological, economic and spatial.
The idea for this schematization came from The Function Mixer (see: MVRDV, 2003), a software designed by MVRDV, which triggered the implementation of multidimensional processes leading to the creation of sustainable, complex, different and functional environments.
This software gives back physical and spatial data translated into three-dimensional model by qualitative parameters, through the mathematical algorithm.
The optimization of this process has been defined through the Multi-Criteria Evaluation (MCE), interweaving the various urban design needs.
It is necessary to introduce a cost-benefit analysis to develop ArchiLOGIC. It will include the analysis of parameters generated by the designed space. However, the process that we intend to use here is opposite to the one proposed by the Function Mixer.
The method allows the computer to operate a qualitative assessment of the player design, by developing quantitative data entered by the same during the game action.
A similar process called "Space Syntax" (www.spacesyntax.net/software, last view on 02.05.2013) was developed in the early '80s by Professor Hillier with his group at the University College of London.

The "Space Syntax" assumption is indivisibility and interaction between morphological space and society. Through the Multi-Criteria Evaluation it allows identification of a rules set that, if followed, will ensure architectural achievement through the Analytical Network Process.
The urban form is evaluated through public space morphology and structure. The three key factors are: vitality, security, development. The study of morphology and society is based on the position of people in space and their movements. The foundation of it all is people natural movement. In ArchiLOGIC the computational method is used to recreate the natural human flows in space, and then analyze and evaluate it. It is therefore necessary to define the virtual limits that will convey these flows.

Referred to the 4 sustainability levels, it is possible to identify 12 parameters that influence them:
Space sustainability directly affected by: natural lighting, efficiency, diversity.
Economic sustainability directly affected by: flexibility, cost of construction, value.
Social sustainability directly affected by accessibility, relationships, prevention of crime.
Ecological sustainability directly i affected by: energy, modal split, green.
The 12 parameters do not include all the elements that influence in general the architectural design, but can cover a wide range of relations between the parties and are hence valid at the game educational purpose.
In ArchiLOGIC the design evaluation, and therefore the definition of players' score, will be through the screening of the identified parameters. The game should be able, through the mathematical algorithm, to decide whether to increase or decrease score.
Each parameter, in fact, indirectly influence all, or almost all, the sustainability levels which is not directly connected to. In this way it is possible to figure out the complexity of design elements relationships. Players will be able to realize the influence of their choices, with ever new and unexpected scenarios. So the achievement of the game goals is free from default locations.
Players could implement the design according to their priorities and at the same time they can understand the effects of actions taken in an intuitive way.
Once the design is finished, players can see the total score. There is a maximum level of attainable score. The higher the level of sustainability achieved, the higher the quality of the project.
So configuration scenarios of the score are endless as the compositional possibilities of the player.

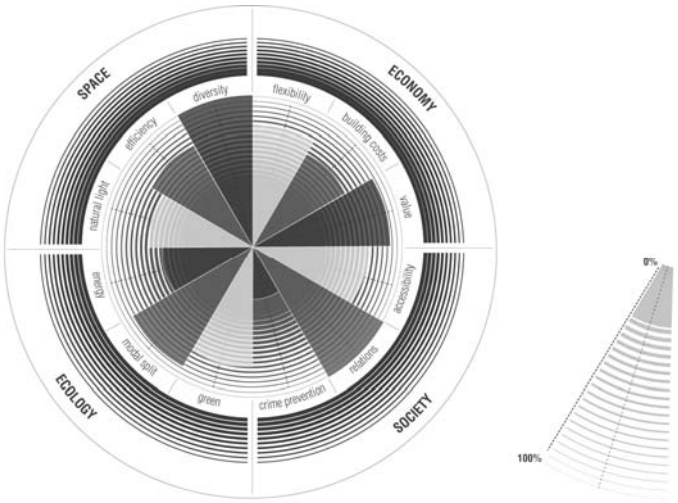


Figure 5. *ArchiLOGIC score defined through four sustainability levels*

4. Conclusions

ArchiLOGIC metaproject development is currently accomplished. Later stages of the work include the development of a prototype, a demo developed by a team of engineers, computer scientists and scholars of representation and multimedia communication, and its test on a significant sample of teachers and students, until its launch on the web.

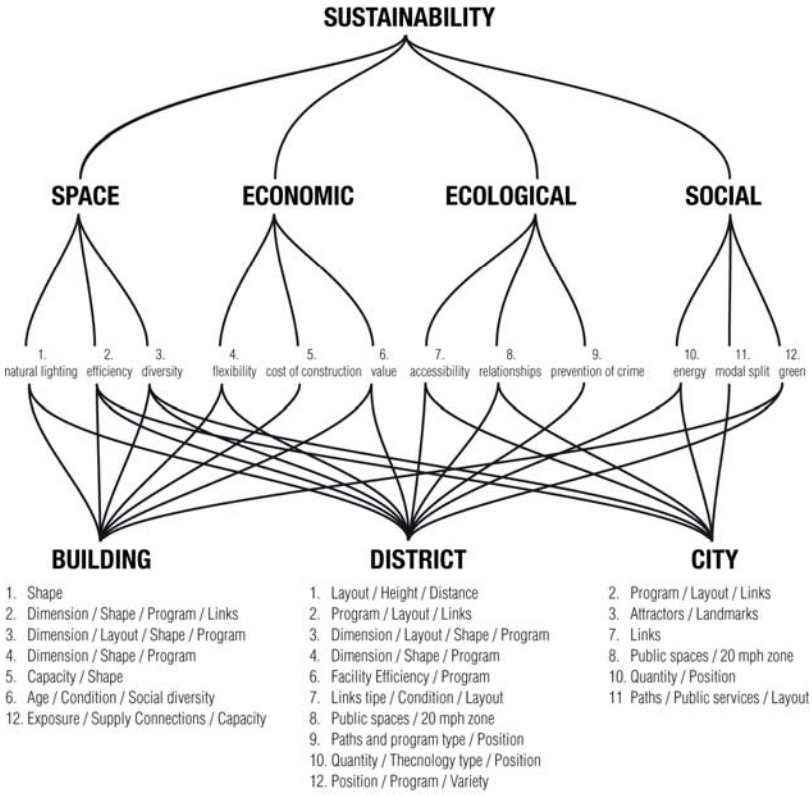


Figure 6. *Diagram of ArchiLOGIC sustainability levels and sublevels with their impacts on buildings, quarters and city*

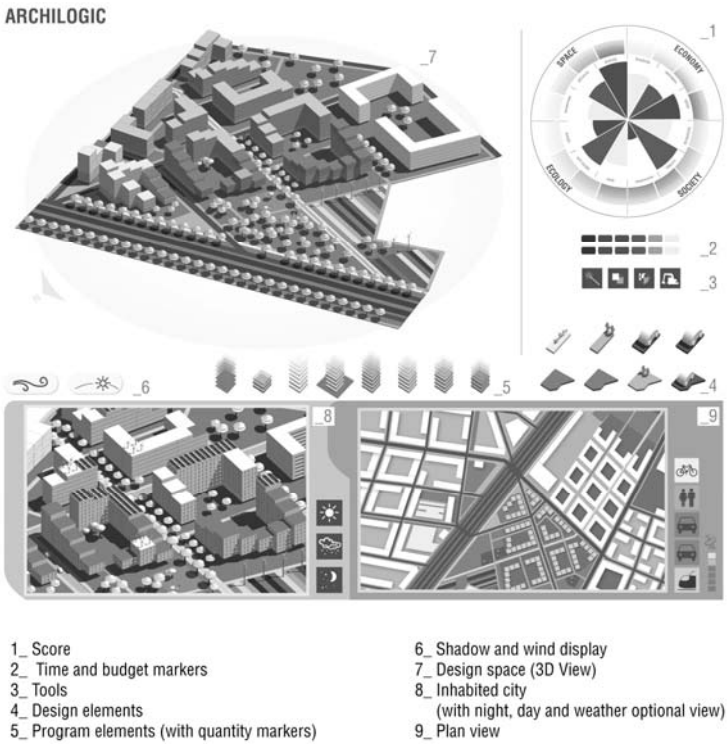


Figure 7. *Graphic interface of ArchiLOGIC: site plan and axonometric view of masterplan*

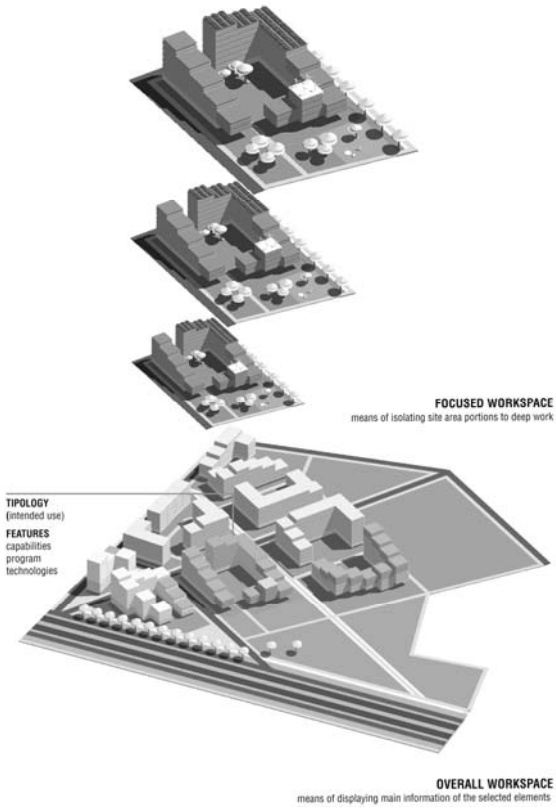


Figure 8. *3D digital models with alternative design interventions*

References

Ciucci G. (1989), *L'architettura italiana oggi, racconto di una generazione*, Laterza, Roma - Bari.
Bateson G. (1996), *Questo è un gioco*, Cortina Edizioni, Milano.
Fusco, I. (2006), *Virtual Geographic*, Costa & Nolan, Milano.
Gee J.P. (2003), *What Video Games Have to Teach Us About Learning and Literacy*, MacMillan, New York.
Engeli M. (1999), *Storie digitali. Poetiche della comunicazione*, Testo&Immagine, Torino.
Thomas D. (2008), "Messages and Mediums: Learning to Teach With Videogames", in Davidson D., *Beyond Fun. Serious Games and Media*, ETC Press, Pittsburgh.
McLuhan M. (1964), *Understanding media*, Mentor, New York.
van Berkel B., Bos C. (1999), *Move*, UN Studio & Goose Press, Amsterdam.
MVRDV (2003), "MVRD1991-2002 Studio Projects", *El Croquis*, no. 86, Madrid, December 2003.