Chapter 1
Introducing a Research Perspective in Urban Design and Representation

Barbara E.A. Piga, Eugenio Morello and Rossella Salerno

Abstract The chapter aims at providing a framework to the content collected in the book and, in particular, it investigates the mutual and influential relationship between representation and urban design. This topic represents the core activity and is at the very basis of the main approach developed by the research structure Laboratorio di Simulazione Urbana 'Fausto Curti' at the Department of Architecture and Urban Studies of the Polytechnic of Milan, where physical and digital simulation is interpreted as the anticipation of future urban environments from a perceptual and experiential point of view. In fact, the entire book deeply explores the topic of urban simulation from different perspectives and in an interdisciplinary way. This chapter presents the structure of the entire volume, a synthesis of the content for each contribution, and the relationship between the parts that are organized in thematic categories, namely: conceptual and experiential approaches, digital modelling and visibility studies, physical modelling in the professional practice, mapping and simulation, and frontier tools. The contributions by professionals and researchers address the topics of simulation and design from both theoretical and practical perspectives with sound references to case-study applications. By presenting the current state of the art and the possible future directions of research in urban simulation, the book aims to become a reference for researchers and professionals, but also for higher education in urban design.

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The main aim of the book is to address how Environmental Urban Design can benefit from traditional and emerging representation and simulation techniques, with particular reference to human-centered approaches in a multi-sensory perspective. This specific point of view on design was developed by the research structure *Laboratorio of Simulazione Urbana 'Fausto Curti'* at the *Polytechnic of Milan—Department of Architecture and Urban Studies*, where from the concept of this book originates. In fact, the authors of this chapter are all members of the laboratory, and contribute to its research work from different perspectives.

The urban simulation laboratory investigates the topic of human experience in the urban environment, following a phenomenological and environmental design approach. Hence, experiential simulation is an imperative to our research, and the anticipation of ungiven environments (i.e. future or lost spaces) is the core of our exploration. The link between design, evaluation, and forms of representation is the dimension where we mostly focus our attention and efforts in research; for instance, we look for innovative methodologies and reliable design tools for supporting design thinking, or for enabling a trustful and comprehensive understanding of places that are not reality yet, in order to ease their quality assessment in advance.

The first statement for our research is that the restitution of simulations should guarantee reliable and accurate outcomes, i.e. as close as possible to reality; this can be best accomplished if these simulations are the result of cumulated investigations that refer to the object of analysis. In other words, bringing together multi-sensory perspectives and environmental considerations of places can enrich the overall interpretation of space and enables to get closer to a complex reading of environments. We strongly believe, that this can be better achieved through an interdisciplinary perspective. The book addresses this matter proposing contributions by authors belonging to different disciplines that deals with the environment, namely: architecture, urban planning, ICT, and environmental psychology.

The second statement regards our approach to experiential simulation: we aim at shortening the gap between the representation of reality and reality and, hence, fostering its application in the design process, from conception to evaluation. Obviously, photo-realistic (or better "sensory-realistic") simulation requires a lot of time and energy to be produced, but the recent and rapid advancement of ICT opens up new opportunities towards our scope. Hence, innovation in our work lies in exploring the potential uses of novel tools for design. Of course, ethical questions related to the validity of models and simulations, issues related to the proper framing and assessment of visual and multi-sensory perception, are embedded in our daily work. We believe that transferring operational tools to design has still a long way to go, and novel approaches in teaching and thinking the design of spaces will emerge in the future. Of course, the process of constructing not existing realities and adding multi-sensory and environmental features to simulation represent big challenges, because today the process of accurately modeling virtual environments is still demanding, and most of the attention and time goes directly into it. Anyway, it is reasonable to expect that this problem will be gradually overcome thanks to a more collaborative and sharing approach, to accurate data provided by public administrations, and thanks to further software development that

will increasingly ease the modeling phase. Having the models at hand, the relevant concern is then how to properly use them in order to improve design outcomes. The chapters present different approaches and methodologies that provide possible answers to this issue from different perspectives. In fact, the definitions of simulations presented in this book are not unique, and not all the authors share our definition of simulation; rather, the richness of the book relies in the purpose of giving back different perspectives that can be interrelated or that can be taken separately.

The strict interrelations among the different contributions and parts of the book is guaranteed by a simple but crucial question: how representational solutions can enhance an urban design approach where achieving people wellbeing is the core mission? How to grab, represent and design the atmosphere of places? Which kind of technologies and tools are available today for supporting multi-sensory urban design? How to represent and simulate current and future environments taking into account the way we experience places? In order to answer these questions in a structured way, the book is organized according to the following main thematic categories, namely: *conceptual and experiential approaches*, *digital modelling and visibility studies*, *physical modelling in the professional practice*, *mapping and simulation*, and *frontier tools*. Each part collects contributions by professionals and researchers that address the topics from the theoretical and practical perspective with references to case-study applications.

More in detail, the contributions related to *conceptual and experiential approaches* show how a mixed methodology, based on different modalities of representation and assessment, can better contribute to inform design in terms of physical structure or subjective experience. In fact, even if it is possible and useful to represent the urban environment in a geometrical form, i.e. portraying the objective metrical dimensions of the city elements, this modality is far from being lifelike, and it is hence beneficial to pair it with experiential simulation, that aims at realistically depicting future scenarios to be virtually experienced by people. Both approaches are relevant for urban design, but while the first one has a long tradition, the second one became a recognized tool only at the end of the Sixties. This modality enables to partially anticipate citizens' reactions to urban transformations, thus enabling to take better informed decisions.

Rossella Salerno traces the main characteristics of both approaches with a specific focus on the development of experiential simulation. The different ways in which the environment is represented enables to focus on different specific urban elements, and this has of course an influence on the design process and its final outcome. Geometrical representation generally emphasizes urban form aspects, while perceptual tools move the attention to people experience.

Barbara Piga further investigates the usefulness of the multi-sensory environmental approach for urban design. She highlights the possibilities of dynamic and interactive tools for renovating the design approaches and for fostering a stronger and more efficient human-centered perspective. Accordingly, she proposes a theoretical framework for structuring the environmental design practice from design-thinking to evaluation and communication.

Marco Boffi and **Nicola Rainisio** delineate a holistic environmental psychological perspective for studying people's reactions to experiential simulation. They suggest guidelines for developing a mixed method for assessing inhabitants' feedbacks to future urban scenarios; this is based on a mixed approach derived from different traditional fields in the psychology domain.

The three chapters together give back an historical overview of geometrical and experiential simulation for design, while suggesting novel approaches and methods for reinforcing a human-centered multi-sensory perspective in today's urban design.

The second part explores the topics of *digital modelling and visibility studies*. Digital model of real contexts or design projects, is the prerequisite for developing different kinds of analyses and simulations. In fact, even if a 3-D model is basically a mock-up representing the geometrical characteristics of an environment, through simulation it is possible to derive experiential data out of it. The intrinsic correlation between the shape and layout of urban elements and the corresponding people's perception can in fact be unveiled in a quantitative way.

Eugenio Morello addresses the issue of human comfort and environmental quality of places starting from the visual perspective. In particular, he introduces the visibility analysis as a technique for anticipating clues about the psycho-physiological experience of places. The quantification of geometry-based visual aspects of urban spaces can have a direct applicability to design and environmental assessment of places.

Thomas Leduc, Francis Miguet and **Vincent Tourre** propose a novel technical method, based on the "open space convex partition solution", in order to study the visibility (isovist) of a person moving through a specific environment. The analytical possibilities of tools influence the possible applications, but even design results. Knowing how a tool calculates the simulation outcomes is crucial in order to correctly interpret results.

Åsmund Izaki and **Christian Derix** present part of the work developed by the design research group Superspace at Woods Bagot for analytical purposes, design and review of architectural projects. In particular, they present a human-centric approach based on a generative computing methodology that integrates visual and spatial analysis. A selection of case studies related to experience, wayfinding, collaboration and impact explain the usefulness of the method for the design process in the professional practice.

In the next section, three contributions address the potentiality of the *physical models in the professional practice*, with different perspectives. In particular, the contributions cover three crucial aspects: the relationship to the materiality of scale models as a design-thinking support, the influence of digital fabrication in the design process, and the role that mock-ups can have for envisioning immaterial design outcomes. The first two are related to model making, while the last one refers to the usage of models for simulation purposes.

Andrea Rossetto explores the potentialities of physical modeling as a knowledge-medium tool focusing on the link between the model and the reality that it represents. The author interprets the model as an instrument through which the forms belonging to the place can be expressed. He argues that the model making

process is a method that supports site analysis and design conception: through the experience of modeling the architectural form arises.

Alessandro Capati shows how it is easy and effective to produce an architectural model thanks to a sharing approach based on manufacturing technologies. Architectural physical models can, in fact, become a direct output of digital 3-D model. This relationship between virtual and physical objects can amplify the possibilities of construction as well. Indeed, nowadays this modality of modeling is influencing the way architects design, but it is also innovating construction procedures and technologies. At the same time, this process is contributing to rediscover the crucial role of physical models in the design process.

Giulio Podestà presents the use of physical models in the simulation process for design, with a specific reference to daylighting simulation. The evaluation of the natural lighting environment can support the design process; in fact, the designer can compare the performances of alternative solutions and validate their efficacy in terms of building orientation, masses, type of envelope, and so on. In daylighting simulation, physical models are ideal tools because they are highly reliable, due to the fact that they do not need the intermediation of numeric simulation.

The following section presents the investigations on three different analytical possibilities of digital *mapping and simulation*. Topographic and cartographic representations have been long used to map objects and areas by quantities, using metric and geometric parameters, so responding to a need of describing buildings, cities, landscapes in an objective way. Nowadays it is possible to reconsider this traditional use and so finding new outputs, i.e. using cartographic bases to go beyond and try to widen the approach in analyzing reality including information coming from the senses.

Andrea Giordano argues how different kinds of information can be fruitfully linked to 3-D models in order to support the understanding of cultural sites. The author presents a case-study application of a multimedia platform that represents shapes, conditions and appearances of historic monuments in Venice, Padua and Carpi (Italy). The research presented explores a novel way for the fruition of cartographic and cultural information that take advantage of recent ICT developments. 3-D models become a tool of analysis for cultural heritage.

Valerio Signorelli argues that ICT improvements have led to new forms of representation able to extent the description of qualitative, temporal and emotional peculiarities of the urban environment, often neglected and difficult to treat with the traditional media. In his chapter, the author analyzes limits and potentialities of the sound-maps, conceived as solutions developed for representing the qualitative aspects of the sonic environment within the urban planning discipline.

Anetta Kepczynska-Walczak and **Bartosz Walczak** focus on digital technologies that allow to dynamically simulate different scenarios of urban and architectural designs and to test them in a virtual environment. This can support consensus building and, finally, can drive to choose the optimal solution. The authors highlight that computer techniques have become a very powerful tool for designers, not only for modelling 3-D forms but, furthermore, as an analytical tool: the environment, which requires intervention, does not even exist, or is at the early

stage of planning, could be modelled, simulated and presented to enable public discussion and support decision-making.

The last section of the book focuses on *frontier tools*. In recent years, solutions for envisioning design projects in an experiential way through Virtual or Augmented Reality increased significantly. Nevertheless, so far these solutions are mainly devoted to describe indoor spaces, and are generally adopted at the end of the design process as communication media. Of course, the possibilities brought by these types of simulation could be fully exploited if used from the very beginning of the design process. Moreover, today the user interaction with the virtual environment is mainly related to navigation and a small range of some basic actions, but this is probably a temporary condition that will be overcame by the technological development, hopefully in a multi-sensory way. The last chapters present three applications of Augmented Reality for design: the first one is mainly related to its usage for the visualization of the final design project onsite, the second one is primarily connected to the sharing of ideas and solutions among the different actors, while the last one principally addresses the use of AR for the conceptual design phase.

Chiara Calabrese and **Luciano Baresi** present a tablet-based solution for outdoor Augmented Reality that enables to visualize urban design projects on-site. The accurate and stable localization of the virtual model in place is a crucial element of reliability, but it is quite difficult to achieve it in open spaces, since these generally present a high rate of visual complexity. To overcome this problem, the authors propose an integrated solution based on GPS and beacons. The application can be used to visualize design projects, or its alternatives, on the site of construction for an experiential appraisal.

Laura Cibien argues how interactive and collaborative interactive planning tables, i.e. augmented physical models, can inform and improve the dialogue and the sharing of ideas during the different phases of the design process, while supporting the envisioning and deep comprehension of project outcomes. A theoretical framework is presented together with a chronological overview of interactive tables. This outline enables to grasp the trend and to envision the possibilities that future ICT developments will bring into the professional and educational practice.

Myriam Servières, **Gwendoline L'Her** and **Daniel Siret** investigate how mobile devices are changing the modality in which architects interpret, analyses and design the urban space. In fact, these tools are not only modifying the way inhabitants interact with the environment, but are innovating methods and procedures of the professional design approach as well. In fact, mobile tools are leading to an augmented urban experience, and following this trend it is possible to imagine possible future scenarios of people and environment interaction. The authors present the results of research works and workshops on this topic.

The book contributes to portray the state of the art and the possible perspectives of research and professional practice based on the relationship between tools and urban design processes and outcomes. In particular, the advancements in the ICT domain are widening the designer toolkit and consequently the design possibilities, while enabling a more conscious experiential approach to the envisioning of places.

At the same time, it is clear that it is essential to take in serious consideration some crucial issues that this renovated panorama is generating, such as the urgent need to upgrade and reinforce an ethical, critical and deontological approach to simulation within the design process, from conception to decision-making and public participation, and from education to professional practice.