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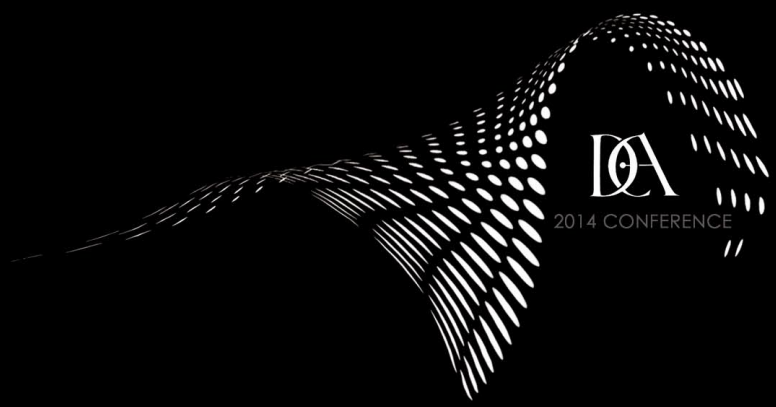

DESIGN & GRAPHIC PALIMPSET [*DIALOGUE-DISCOURSE-DISCUSSION*]

EDITORS: M. SALEH UDDIN, Ph.D., and CHRISTOPHER WELTY, AIA.

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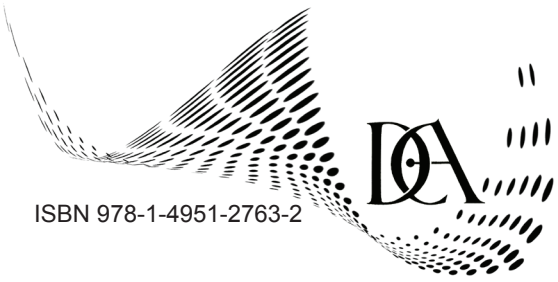
Design & Graphic Palimpsest [Dialogue-Discourse-Discussion]



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The Combined Use of Urban Models to Support a Collaborative Approach to Design Towards the Sustainable University Campus: Participation, Design, Transformation

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Abstract
The mission toward urban sustainability requires tools for developing a vision and for monitoring change through time. For instance, representation of past, current and future places is the first medium we can work with in order to map the path toward sustainability. The launch of the university project 'Città Studi Campus Sostenibile' for the renewal of the campus according to sustainability principles was the occasion to use modeling as a powerful "hub" for converging and disseminating relevant information, thus supporting and fostering urban change. In this study we explore the role of urban modeling and simulation within a highly collaborative design process and introduce several applications for the sustainable campus project.

In particular, we are interested in exploring the integrated use of these different techniques of modeling and simulation. For instance, urban modeling refers not only to the reconstruction of digital and physical environments, but also to the simulation of future scenarios that will impact on the campus layout. In fact, the proposed models are currently used in different ways and with different aims, like communication, participation, design (including evaluation), decision-making, education, monitoring (including archival of memories). Firstly, the model used for communication and design purposes supports sustainable practices and works as the connector between the involved stakeholders (public, institutional and private ones): for instance, in public meetings, the urban model was the basis for the debate and in some cases the accelerator of processes thanks to the power of communication and the proof of evidence given by representation. Secondly, the digital model is a collector of memories and actions and helps in monitoring and reporting changes. In this sense, the model reinforces the task of mapping the change and contributes to the measurements of traditional sustainability indicators.

Visualizing urban sustainability through models
The Politecnico di Milano together with the Università degli Studi di Milano launched in 2011 the project 'Città Studi Campus Sostenibile'[1], an initiative aiming at renewing the district in a sustainable way, by applying innovation from our university research, supporting more sustainable lifestyles on campus and promoting a shared and collaborative co-design open to all the actors of the local community of the university district Città Studi. In particular, our laboratory[2] was asked to lead and support the process by structuring the project and reporting its evolution. Our approach to design relies on the use of urban modeling and simulation as a way to achieve urban transformation. The task in this project was to use urban modeling and simulation to visualize sustainability, i.e. representing and defining visions for a sustainable future and actions taken during the process (Videira Lopes & Lindström, 2012). In doing this job we have to face three main challenges: firstly, how to make use of digital models and simulations in order to reinforce and stimulate a collaborative approach to urbanism and collective co-creation of the urban transformation among different actors (citizens, municipality, universities); secondly, to find modalities to report on the model mainly minute and diffused actions; thirdly, to find the proper form for the design and the representation of an evolving masterplan that relies on an inclusive approach, and is not based on the unique action and decision making by the designer, but rather on the definition of rules and guidelines to conduct the process (Piga & Morello, 2013). We argue that the use of modelling and simulation can give a relevant impulse to the process, because it allows guiding and speeding up the process by creating alignments among the actors.

Figure 1. The construction of the 3-D urban model of the campus, illustrating different levels of detail for the same area.

Combined use of different model types

The reconstruction of the campus model includes a variety of representation devices, ranging from physical to digital items. As part of digital models we include, among others, 2-D cartography, urban photography in various forms (single pictures, sequences, panoramas), video recording and the 3-D model (Fig.1). Moreover, the attempt to augment the model with additional layers of information, like for example the inclusion of sensory cues and dynamic features (people, means of transport), or user-generated narrative contents, highlights the potentialities of the model for recreating the *ambiance* (or atmosphere) of places (both real and envisioned ones). Finally, the model can be immersive and the use of game engine technologies is showing great potentialities in this sense.

	PHYSICAL URBAN MODELS	**DIGITAL URBAN MODELS**	**PHYGITAL URBAN MODELS**
Application	The urban maquette	Renderings, immersive models	Augmented Reality, (AR), Augmented physical models (ApM)
			
Design phase and usability of the models	Communication Participation processes Design Decision-making Education		
Human Interaction to the models	Physical and direct interaction to the model (no interfaces). Comprehensive view from the top. General understanding of the physicality and layout of intervention and possibility of multiple views by the observer.	Human interaction to digital models is mediated; hence, it requires the use of technical devices. Digital models are usually separated from a direct human experience by computer screens, or printouts of renderings. Innovative immersion techniques enable an interactive fruition of the models.	The connection between physical items (models or reality) with digital models allows exploiting and combining the different potentialities of the media. With AR onsite an immersive experience is enabled.
Visual interaction to the models	The immersive and subjective view is missing (if not integrated with a micro-camera recording moving through the model and projected on screen).	Digital models provide fixed points of view (renderings) or permit a dynamic visual fruition (navigable, interactive and immersive models as the ones realized with game engines). With some devices, such as the Head Mounted Display (HDM) it is possible to generate an immersive (generally visual and kinesthetic) experience.	AR on site allows to simulate an immersive interaction with the simulated project in the real context. ApM allows recreating an immersive and subjective view at the ground level if integrated with a micro-camera recording moving through the model and projected on screen).
Dynamic fruition of the models	Assured with a micro-camera recording moving through the model and projected on screen.	Animated videos, immersive and interactive models permit a dynamic fruition of the model.	AR on site allows a 1:1 interaction with the augmented real environment. ApM allows similar interaction as physical models but augmented with interactive elements (eg moving cars and people)
Dynamic elements embedded in the models *(traffic and pedestrian flows, light to simulate the solar path and the shadow casting, etc)*	It is possible to use dynamic elements in the maquette (depending on the scale), but it is more common to use just static elements.	It is possible to use dynamic elements in the digital model. These can have fixed paths or react to the physical environment.	AR on site can be augmented with dynamic elements ApM or projections on the physical model can enhance the dynamic perception of the model.

Table. 1: Synthetic comparison between physical, digital and phygital models and their interactive capabilities

The combined use of physical and digital urban models allows reaching a more comprehensive understanding of future transformations and thus a richer and argued approach to design and decision making (Appleyard, 1977; Bosselmann 2008; Batty, 2007). Moreover, the concept of "phygital" refers to the action of bridging the digital with the physical world, providing unique interactive experiences for the user. A number of technologies (QR Codes, Augmented Reality, 3-D models) enable interactivity and engagement between digital devices, physical materials and human beings. For instance, one technique is complementary to the other, as reported in table 1.

Integrating the temporal dimension into digital models
The representation of places through digital models has to be dynamic and report the changes happening over time if we want to get an understanding about the functioning and the 'ambiance' in time and space. In fact, renderings often represent snapshots taken at special moments which are not representative of the atmosphere of the place, but tend to celebrate dramatic events like a sunset, a foggy evening or a spring day. This is true especially for commercial renderings, used in the real estate industry for marketing. On the contrary, our aim is to give back the average conditions that best anticipate how people will experience the place.
Time in digital images can be declined according to different elements as follows:

- the environmental conditions of the place, originated from the time cycles due to Earth's daily and yearly rotations, which define day and night (hence shadowing conditions), the seasons and the climate conditions;

- the variation of dynamic features during time: in the short term we can include people flows, nature (animal and plant life), objects (cars, artificial lighting, the sound components ; in the long term, we can list urban transformation, like the layout of building facades, the growth of vegetation.

Different techniques can give back time through digital models:

- a sequence of renderings depicting the same environment at different times (from simple snapshots and time-lapses to video-sequences), as represented in figure 2;

- immersive models that allow users to navigate and experience motion and time together (real-time);

In any case, time can be manipulated and accelerated, and this permits the user of simulation to get a faster understanding of changes. We also proposed to build an archive to monitor urban spaces over time (Piga et al, 2013). The archive should mainly collect pictures of places taken at different times and possibly from the same point of view, but also simulations of future design schemes to represent places in future conditions. Several actions happening on public space are diffused and little ones. Hence, urban transformation might be invisible to people, which do not really notice change. The ultimate goal is to visualize these diffused and small changes and give back a sense of the place over time.

Simulation supports inclusion – towards a collaborative inclusive approach to urbanism
Before starting any kind of work on simulation and modeling, it is crucial to establish the role of simulation within the process, especially within a collaborative design approach like the sustainable campus initiative. Visualizations and simulations help in the process of understanding things by anticipating transformation scenarios both for professionals and laymen. Moreover, simulations support the process of people engagement, if visualizations are used to create awareness and build consensus among the community within an inclusive and highly collaborative process. Of course, we have to face the fact that simulations are never neutral: for instance, simulations are not unbiased *per se*, because, even if photo-realistic and possibly representing typical conditions of the ambiance of the place, they differ anyway from reality and introduce a gap in the human perception of simulation as opposed to the immersive experience of reality (Bosselmann, 1998). Nevertheless, our research on urban simulation works on reducing distortion of digital images (both renderings and photographs) aiming at providing an experience which is close as much as possible to human perception of reality.

Moreover – and this is our main concern in this work – we tackle the question "how and when to use simulations within the process", knowing that these choices will affect the course of events. In other words, we are guiding the process and defining the rules of the game and by doing this, we are potentially driving the path. This opens up fundamental questions about participatory design (Selle, 2011) and how processes of co-creation should make use of technical expertise for providing physical actions and solutions (Sheppard, 2001). We argue that inclusive approaches to urbanism need technical expertise in design for two main reasons: in order to accelerate decision making and for envisioning future scenarios that laymen eventually do not take into account because these are not part of their technical background.

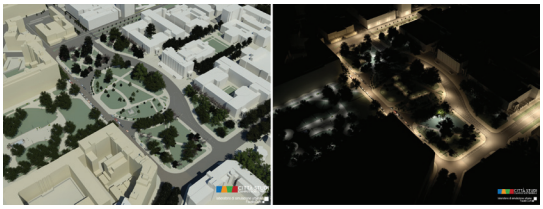

Figure 2. Renderings of Piazza Leonardo da Vinci (Milan) represented during day and night.

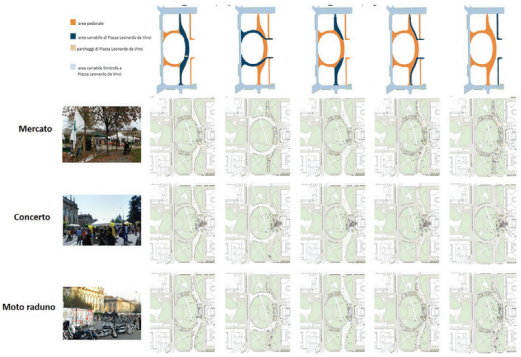

Figure 4. 'Città Studi Campus Sostenible': alternative solutions for the transformation of Piazza Leonardo da Vinci discussed with the local community and public authorities

Applications of modeling and simulation for the sustainable campus initiative

In particular, in our work for the sustainable campus initiative, we used simulations with multiple aims, mainly communication, design, evaluation and monitoring. All these applications constitute our approach to design and are diversely used at different stages during the process. Below, we report the main steps when the models were used during the process.

Firstly, a launch video for the campus vision was proposed in order to engage the local community (both university and citizens) and share the initiative and the broader commitment to sustainability for the renewal of the entire district (Fig. 3). This specific use of visuals was supposed to accelerate participation even if it was initiated from the top. In other words, the whole sustainable campus project which was at first launched with a top-down approach aimed actually to boost a bottom-up reaction and activate a self-sustained process.

Figure 5. The online digital interface for comparing simulation and reality. The application on Piazza Leonardo da Vinci with alternative design schemes tested on the spherical image (www.labsimurb.polimi.it/tour/sim/pLeo. html)

In a second stage, we started envisioning future transformation of places using simulations based on the digital urban model of the district. The laboratory was not in charge of providing design schemes, but to collect and support incoming suggestions from the participation tables and the projects. Hence, what we proposed was to work on comparative studies and not providing one solution only, but to make evidence of the different characteristics of alternative design schemes. In particular, we propose simple drawings showing alternative design solutions supported by quantifications (Fig. 4) and we built up an interface where current conditions of places could be simultaneously compared to alternative design solutions from a subjective (visual) point of view (Fig. 5). In particular, the online interface allows navigating at the same time the spherical picture of the present condition and the digital image from the same point of view. Hence, this technique enables to facilitate the understanding of the impact of design..

We had the chance to test these tools with the community through two different modalities, namely public meetings and online discussion through social networks. Displaying alternative solutions supported by quantifications or enriched through dynamic features enhanced the discussion and enabled the convergence among the different stakeholders during meetings with the public authorities. Hence, we argue that the use of alternative design schemes enables to leverage the relationship among the actors at the table, because no one is meant to be the proponent or supporter of a unique solution. Moreover, since all the actors are at the same page, displaying multiple solutions allows introducing and making visible to everyone all the ingredients for setting up a concrete discussion on the physical elements of design whereby the participants have a certain degree of freedom given by the arguments emerging from the visualizations. Hence, even if not professionals, all the actors can make use of the model and react to their stimuli, thus effectively contributing to design. In short, we argue that simulation facilitates decision making if used in a proper way.

The risk is that a steered use of visualizations could drive the process towards the solution preferred by the proponent of the simulation. Hence, the proponent has to be neutral at this stage of the process, and does not have to convince people on one solution, but only deliver a series of elements to orient decision making. Only at a later stage of the process, once the convergence on one scenario has been reached, simulations can go deeper into the detail of design and provide more refined information. In short, a sort of trial-and-error and responsive process is emerging, whereby the mutual contribution of professionals and the community are co-creating the design solution within a collaborative process.

Figure 3. 'Città Studi Campus Sostenible': frames from the launch video for the strategic vision (superimposition of transformation scenarios on the photos representing the actual condition)

Moreover, in order to reinforce collaboration, we started to explore the use of social networks as integral part of the process. The increased reachability of people and sharing of ideas enabled by the World Wide Web opens up new possibilities for diffusing design and the use of simulation. In particular, we are testing the use of social networks as a novel and powerful opportunity for simulations to be shared and discussed through a e-collaborative process that will speed up public discussion at the organized tables with the community. In fact, online participation does not require people to sit down at the same time at the table and can thus happen in an asynchronous way, without losing relevance.

We are testing the use of Facebook® for promoting the renewal of via Celoria, a relevant street that crosses the university district and has the potential of becoming a terrific university walk between the two universities of Città Studi. The online page[3] (Fig. 6) was opened in March 2014 and effectively promoted in the late spring of 2014. We can count more than 100 followers as of June 2014. Facebook® represents an easy way to reach people and catch their attention, especially students. Anyway, Facebook® was not designed for the purpose we intend to use it, hence we had to adapt our work program according to the features offered by the social network, which enables different possibilities to sustain collaborative design.

On this page we uploaded three general scenarios represented by simple schemes showing three different car-accessibility scenarios, from a simple reduction of parking lots on the street, to the creation of a traffic calming area, to the creation of a car-free pedestrian area. The design alternatives are represented through plan views accompanied by the quantification of parking spaces and pedestrian spaces and simplified 3-D views of the street. Additionally, an online survey among the three scenarios was launched and the collection of comments on the schemes was encouraged. Anyway, we noticed that the use of

Figure 6. The use of social networks to promote the renewal of via Celoria in the university district

Figure 7. The attendance to public events to promote the renewal of via Celoria in the university district, where we make use of the physical model of the street, the use of posters with digital representations of places and the links to promote the online e-collaboration through social networks.

internet alone was not enough to support the initiative of the street renewal and the attendance at public events with a physical model, posters and postcards integrates the process (Fig. 7). Moreover, the physical model displayed at public events is actually the main attractor for engaging people and reconnecting to the digital world (the phygital bridge).

Considerations and future work

The use of the urban model reveals to be not just a tool for communication , evaluation and design, but it enables to structure a complex process towards a co-shared design approach: for instance, it can be used to engage people and create a critical mass to support (or contrast) urban transformation, to discuss projects, to evaluate alternative design schemes, to design and co-design places. In short, within an inclusive process, working on models and simulations can accelerate the decision making process in a very effective way.

The model is a hub in a double sense: firstly, it represents the anchor point where all the stakeholders can easily refer to for providing observations, changes, evaluations etc.; secondly, the urban model is the basis for enabling further simulations and studies (e.g. environmental and urban studies).

Of course, modeling and simulating future environments requires technical skills and resources (mainly human resources and data). Thanks to the advancement of ICT and the delivery of more user-friendly software, techniques are becoming cheaper and less time consuming. Future work will aim at collecting the outcomes of the numerous ongoing research projects on sustainability through the campus model and map the memories and the evolution of the process.

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Footnotes

www.campus-sostenibile.polimi.it (Politecnico di Milano and Università degli Studi di Milano)

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