

Envisioning the sustainable campus: the urban model as the hub that supports the transformation

Eugenio Morello ¹, Barbara E.A. Piga ¹, Valerio Signorelli ¹, Laura Cibien ¹

Envisioning architecture refers to our daily experience in the design practice. Almost all our work has to do with the task of giving back a form of representation of non-existing environments for ourselves and for our interlocutors in order to share and better understand the physical outcomes of the exemplified environments. With this contribution we want to share the current experience of our research group, the Laboratorio di Simulazione Urbana ‘Fausto Curti’ within the sustainable campus project, because the recent work on the topic of envisioning architecture raised key questions about the sense and the importance of providing models and simulations within a complex and long-term process of urban transformation.

In 2011 the Politecnico di Milano (POLIMI) together with the Università degli Studi di Milano (UNIMI) launched a new project called ‘Città Studi Campus Sostenibile’ in order to promote a new vision towards a sustainable campus². The project aims at transforming the whole campus neighborhood into an urban area being exemplar in Milan with respect to life quality and environmental sustainability. The initiative is open to the participation and support of researchers, students and all campus citizens. Goals of the project are the following: to experiment innovation developed by scientific research; to promote life style transformation and more livable spaces; to become a good example for the whole city; to cope with the international network of sustainable campuses³.

The laboratory was involved from the very beginning of the initiative as the support structure with the mission of building up the vision for the campus, providing the modeling and simulation part for the project and collaborating to the set-up of the process to develop the initiative. It was a unique occasion for our research group to experiment recent research works and techniques on a real project (Piga et al, 2011a, 2011b; Signorelli, 2011, 2013). The sustainable campus initiative itself started as a highly participative and inclusive process, whereby the entire decision making about actions and transformations on campus should happen on the basis of a “living lab” concept. Hence, this way of proceeding required a novel approach to modeling and master-planning because the designer was not asked to design the physical transformation (top-down approach), but rather to accompany the changes emerging from the collaborative works as a result of the involvement of the campus community (bottom-up approach). This approach to design was possible because we are talking about a renovation project whereby the life on campus is already ongoing and only small incremental changes can be implemented. In fact, if the project was about designing a totally new campus from scratch, than a highly participative process would be difficult. On the contrary, starting from a consolidated and well known situation by the community members, it was easy to get their suggestions or ideas about future transformations, or even to apply on site the results of the scientific research. For instance, knowing the weaknesses and opportunities of the present situation derived from daily experience on campus makes it easier for lay people to envision change.

¹ Laboratorio di Simulazione Urbana ‘Fausto Curti’, Dipartimento di Architettura e Studi Urbani, Politecnico di Milano, Milan, Italy.

² The project started in early 2011 by Professor Giovanni Azzzone just after his election as the Rector of the Politecnico di Milano, and was one of the main initiatives of his electoral program. The project is coordinated by Professor Alessandro Baldacci and Professor Manuela Grecchi. More information can be found at the project website www.campus-sostenibile.polimi.it.

³ Please, refer to the International Sustainable Campus Network (ISCN) reports delivered by POLIMI in 2011 and 2012 (Morello et al, 2012; Morello & Perotto, 2013).

What kind of modelling for the campus

The model is much more than a mere visualization and communication tool: from the very beginning we considered it as an effective design tool that enables to better understand the physical space (analysis) and drive the process (design). The first task for the laboratory was to build up the baseline for the construction of a smart model with multiple aims: firstly, a model that can anticipate the outcomes of future change (envisioning); secondly, a model that can integrate the contributions by multiple actors (sharing); thirdly, a device for reporting the activities and changes in time (communicating); fourthly, a model that enables to archive and trace the transformation (monitoring). Moreover, a truly interoperable model should serve in the future as a platform for the management of the campus operations of buildings and open spaces. Such a use of the model goes beyond the sustainable campus purposes and would require additional funding, but it could be a tremendous occasion for improving the efficiency of the facilities management on campus and bring all the different maps and cartographies used today by the institution on a unique basis (think about maps for orientation and virtual tours, maps for the energy management, maps for the technical facilities; all this information is actually separated, simply two-dimensional and static).

The digital urban model of the campus originated on the basis of the digital elevation model of the city of Milan⁴. Starting from this draft model, the volumes in and around the campus were refined by improving their geometry, adding the textures of materials and the superimposition of the rectified pictures of the building facades; moreover, a relevant part of the work was the construction of most of the outdoor spaces, both in terms of geometry, assignment of materials and inclusion of vegetation⁵ that changes according to seasons (see Fig. 1).

Moreover, the model was intended to be an “augmentable” one. In fact, beside information related to buildings and open spaces that could help in the management of the campus, we put a lot of attention to the sensory and immersive enhancement and usability of the model; the first attempt was the pilot project conducted by Valerio Signorelli (2013) that introduced the auditory dimension into the model. The recording of real sounds in the urban space can be reproduced inside the model, taking into account the distance and directionality between the source and the observer, i.e. the user of the model. Another fundamental feature that gives back the sense of immersion in a virtual environment is dynamism: without it no immersive model would be perceivable as likely to the user. We argue that navigating inside a model without movement of any kind already creates a sense of estrangement and detachment. A number of dynamic features such as pedestrian people, cars and means of transport in general were embedded in the model implemented using a popular game engine (Fig. 1). In fact, immersive and navigable simulations of an urban environment carried out from the human point of view would not be plausible without the tentative representation of the dynamic experience in a place.

All what we described above is possible by putting different tools and types of digital models together. The interoperability of the model still represents one of the biggest challenges of this work, also because these operations are very much subjected to the rapid evolution of technologies. In fact, the increasing availability of interactive tools makes the whole work easier but it risks getting old very soon and makes investments on one technology alone very risky. Of course, this complex and long work is justified by the temporal extension of the project, which does not have time constraints, and is a process supposed to continue in the future indeed.

The construction of the model is still an ongoing work and will probably be a continuous work of maintenance in the future. By working on such a complex model the issue of maintenance becomes a major concern, and this will require the definition of standardized

⁴ The construction of the model was carried on under the supervision of Valerio Signorelli and with the help of numerous students, in particular Rosa Magri.

⁵ The inclusion of textures and vegetation into the model would require a detailed description of the choices made by our team but this goes beyond the aim of this contribution.

procedures for implementing the model itself in case of multiple contributors and future resources for its enduring development. Currently, the model comprises most of the central spaces of the POLIMI areas with particular attention to Piazza Leonardo, i.e. the main public square, which can be considered as the main gate to the university district.

Two years after the launch of the project we better understood the fundamental role of modeling and simulation within the overall collaborative process. The digital model of the campus represents the hub indeed, where all the changes can be first verified, envisioned, shared and, once in place, reported and monitored through time. The envisioning of the transformation indirectly – and maybe unconsciously – influenced the process of concept design and represents a sort of accompanying of the ongoing transformation. Below, we report an insight on sample applications of modeling and simulation for the sustainable campus project.



Fig. 1 A snapshot of the digital campus model in a view from the top. In this picture, Piazza Leonardo including means of transport, urban furniture and vegetation



Fig. 2 The use of dynamic features inside the model: people and means of transport were added to enhance the experience of the place

Envisioning the change

The simulations carried out starting from the model aim at envisioning both future transformations affecting the physical space of the campus and the more ephemeral activities and events undertaken during the initiative. For instance, envisioning does not only mean to represent the visible and tangible actions, but temporary activities as well.

The very first task we were asked to accomplish was the delivery of a video to launch the project and communicate the spirit of the initiative⁶. As described above, the project was conceived as a collaborative platform whereby the decision making and the changes on campus should be the result of a participative process. Hence, circulating a video at the very beginning of the project could bring opportunities and risks at the same time: on one hand, the opportunity was to diffuse the initiative and reach out the campus community, giving suggestions of possible changes in order to launch a positive message about the sense of promoting sustainability; on the other hand, the risk was to show possible physical interventions or solutions in a traditional sense, i.e. by imposing the hand of the designer.

Therefore, our strategy was to avoid to define a unique physical design, but only launch suggestions of possible actions. Along a path through the campus based on the use of street-photography (a sequence of pictures taken at regular intervals) and the digital model for top and bird's eye views we highlighted a series of themes that we grouped according to four topics related to sustainability, namely: environment, energy, accessibility and people. Those topics were characterized by an icon and a color to catch attention and constituted an easy message to memorize. In fact, after the launch of the video the four topics were confirmed and helped in the construction of the whole project and constituted the origin of the thematic tables that still drive the collaborative process. In short, the path through the campus was the excuse to attach suggestions (slogans and thematic icons) and visions (photomontages and renders) while we encountered hot places and topics (samples of the screenshots in Fig. 3). For instance, a number of stops along the path represented relevant places where we superimposed possible transformations. This way of proceeding through a comparison of today's and tomorrow's conditions was an effective way to reach lay people. In so doing, no hierarchy or priority was attributed to the envisioned solutions, since the appearance of topics depended on the physical path itself. Envisioned solutions were always presented in a gentle way, without stressing the detail of the physical intervention but rather communicate the strategy. The sedimentation of suggestions given by the video comes back in the process many times: for instance, the creation of a pedestrian space on Piazza Leonardo da Vinci thanks to the removal of the car parking lots was anticipated by the video and became reality about two years after (see for instance Fig. 4).

The digital model of the campus itself was used to test alternative design solutions within the decision making process. The renewal of Piazza Leonardo da Vinci was supported by a series of immersive virtual environments and panoramic photography showing different design schemes for the renovation of the pavement in front of the main building of POLIMI. The simulations themselves were mounted on a web-based application that allows comparing the actual situation (360-degree panoramic photography) and the alternative schemes (on the digital model) on the same screen and navigating both environments at the same time (Fig. 5).

We could observe that using simulation served as an effective way of putting a real information on the table and accelerate decision making, because the type of material we proposed was easy to understand by all the involved actors⁷ in the process, and did not raise levels of uncertainty and ambiguity as opposed to words, thus serving as an effective basis for discussion. For instance, in that case, by making the simulations available we accelerated the

⁶ The video can be downloaded from the sustainable campus website at the following address: <http://www.campus-sostenibile.polimi.it/en/web/guest/altri-download>

⁷ The main actors involved are the technical offices and the representatives of the City of Milan, the representatives of the local district, POLIMI and UNIMI.

alignment of the involved actors that quickly agreed on a shared solution after evaluating the alternative design schemes.



Fig. 3 Screenshots taken from the video of the launch of the sustainable campus project. A 360-degree panorama on Piazza Leonardo da Vinci. Below, the picture; above the suggestions given by the vision



Fig. 4 Screenshots from the video of the launch of the sustainable campus project showing the suggestion of creating a pedestrian space instead of the car parking space in Piazza Leonardo da Vinci. Below, the square with cars at it appeared in 2011; above the suggestion with no cars



Fig. 5 The digital platform with the alternative immersive design solutions for the renewal of Piazza Leonardo da Vinci. Left, the 360-degree panorama (courtesy of Marco Stucchi); right, the renewal of the asphalt with paintings simulated on the digital model

Sharing ideas of the change

Beside the professional use by our laboratory, the model of the campus was conceived as an open model to be shared among the community and used as a platform to test design solutions. The model is available on the website and everyone can download it for free. Until now, a number of students and design studios within the School of Architecture and Society applied the model to embed and test their design proposals.

In particular, we launched a design competition open to students in the fall of 2012 aiming at rethinking an open space on campus that is currently used as a parking lot in poor condition. The competition was a first attempt to open the decision making to students: for instance, students could design their own spaces and give ideas for driving the work of the technical office. For our research group, writing the brief of the competition was the occasion to test the use of simulation as a tool for evaluating design proposals, thus stressing the dimension of the perceptual experience of the proposed design schemes. In fact, we set up a number of relevant points of view to be verified through the design. We also delivered a number of immersive 360-degree photos containing guidelines directly on the pictures (a series of written instructions highlighting the hot topics in the environment). Participants could use the digital model and were asked to verify their design according to the given relevant points of view (samples are given in Fig. 6)⁸. This requirement should enable a comparative study among the design solutions and help the jury in the evaluation process. In short, we argue that if properly used, the simulation can become a relevant feature to assess the quality of architecture and serve as a useful device for evaluation.



Fig. 6 A sample of a render from the design competition for students where the campus model was given as the basis to verify the design schemes (courtesy of Andrea Migazzi, Emiliano Passoni, Fabio Monaci)

Reporting on-going activities and transformations: mapping diffused actions on campus

Ephemeral temporary activities and diffused small actions on campus are very difficult to grab and often do not leave physical traces after they are carried out and completed. This issue was a major concern for the governance of the project, because a lot of efforts were spent in diffused or almost invisible actions at the small scale such as social events and installations aiming at engaging with the community on sustainability. Hence, we were asked to take note of the numerous events and small-scale transformations happening under the umbrella of the

⁸ A virtual gallery of the delivered projects was published on the sustainable campus website: www.campus-sostenibile.polimi.it/en/web/guest/mostra

initiative and find a way to report and implement the model with this information. The aim of this work is purely about communicating and documenting the facts and achieved results of the initiative. Of course, informing the community is a way of legitimizing the project and engaging more people.

The work is still under construction, and relies on the use of a web-based platform including the map, the model of the campus and the reference to the different events and activities taking place on campus. The challenge is to move from a static map of the activities to an interactive and dynamic map that serves as a real database or repository, where activities can be tagged and organized.

Monitoring the transformation: the construction of the archive

Finally, the construction of a geo-referred archive with a comprehensive layering of information, from visual features to other sensory elements, facts and textual information, remains the final goal of the work and will constitute the repository of the process. Such an archive will serve not only to testify the actions undertaken by the project according to a quantitative approach (collection of information), but also as a basis for monitoring the change and drive future transformations. Future research based on the comparative study of past, present and future situations will be possible and methods of evaluation of interventions on campus can be set up on the solid basis of the archive. For instance, by recording a series of temporal conditions of places (for example by taking a number of pictures from the same position and with the same technique at different times, according to a scientific methodology), we can get a very rich database to conduct further studies on the impact of urban transformations in time.

References

Morello, E., Perotto, E., Piga, B.E.A. (2012, April). *ISCN POLIMI report 2011*. Retrieved August 26, 2013, from International Sustainable Campus Network website: <http://www.international-sustainable-campus-network.org/reports/view-category.html>

Morello, E., Perotto, E. (2013, April). *ISCN POLIMI report 2011*. Retrieved August 26, 2013, from International Sustainable Campus Network website: <http://www.international-sustainable-campus-network.org/reports/view-category.html>

Piga, B.E.A., Signorelli, V., Morello, E. (2011a). *The experience of an academic simulation laboratory: The use of visual simulations for education and research*. Respecting Fragile Places: Proceedings of the 29th Conference on Education in Computer Aided Architectural Design in Europe . Ljubljana, 21/9/2011 - 24/9/2011, Ljubljana: ecaade and UNI Ljubljana, 734-741.

Piga, B.E.A., Tangredi, C., Signorelli, V. (2011b). *Investigating the traveler experience: the use of eye-tracking for urban design purposes*. Envisioning Architecture - Proceedings of the 10th Conference of the European Architectural Envisioning Association. Delft, 14/09/2011 - 17/09/2011, Delft: Delft Digital Press, 161-168.

Signorelli, V. (2013). *Sensescape in urban open spaces, tools for an interactive multi-layers representation of the urban ambiances*. Unpublished doctoral dissertation, Politecnico di Milano, Milan, Italy.

Signorelli, V. (2011). *Game engines in urban planning. Visual and sound representations in public space*. Proceedings of the 7th International Conference on Virtual Cities and Territories. Lisbon, 11/10/2011 - 13/10/2011, University of Coimbra, Nova University of Lisbon, 533-536.