# Learning from Lost Architecture: Immersive Experience and Cultural Experience as a New Historiography

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***Abstract***

*In 1986, a group of Spanish architects decided to physically recreate an icon of modernist architecture. Mies van der Rohe's German pavilion for the Barcelona World Expo of 1929 was at the cutting edge of spatial and structural innovation but its influence was limited to what we understand through drawings, photographs, limited film footage and historical interpretations. We can now physically visit the pavilion and experience it but what of all the other pavilions by famous (and less famous) architects that are no more? It would be costly and time consuming to physically rebuild all of them, however virtual reality (VR) technologies and human computer interaction (HCI) methods can bring them back to life. International expo pavilions are temporary structures designed to be at the cutting edge of structural and material technology but what makes them unique and inspirational is seldom preserved directly, their architectural insights, experiential richness and cultural significance are easily lost. This paper asks: How might immersive digital experiences of space help us to recapture 'authentic' experiences of history and place? What implications does this have for architectural history, heritage and conservation?*

*The authors offer some answers to these questions by presenting preliminary results from a larger project entitled 'Learning from Lost Architecture': a virtual reconstruction of the Italian Pavilion at the Paris Expo of 1937. Firstly, we will contextualise the practice of digital cultural heritage and present its potential for immersive, investigatory architectural experiences. Secondly, we will critique our own practice to*

*better evaluate the potential of virtual reconstructions to affect architectural learning, discovery and historiography.*

**Barcelona, 1986**

When Ludwig Mies van der Rohe designed the German Pavilion for the 1929 Barcelona International Exposition he would have imagined, like all the other architects designing their nation's pavilions, that soon after the Expo's close his structure would be gone and largely forgotten. History has shown us otherwise. Thanks to the space for innovation afforded by its status as a temporary structure, the Barcelona Pavilion entered the canon of modern architecture along with Mies' 'canonisation' as one of the four great modernist 'masters'. Had Mies lived to 100 he would have seen his pavilion brought back into being. When Oriol Bohigas wrote to him in 1959, Mies agreed to lead the reconstruction but the project did not go ahead until well after his death ten years later.[1] The work of the Fundació Mies van der Rohe in Barcelona exemplifies how physical and virtual reconstructions of temporary architecture can work together, creating a 'complete' experience of architectural space and place. But what of the sense of history? In neither case can we completely travel back in time to experience the newness of the exhibition architecture for the first time, instead revisiting a particular time, with specific cultures, via the concept of "cultural presence"[2], or the feeling of being in a place constructed, inhabited and modified by a different culture.[3]

**Recapturing Pivotal Movements in Architectural Innovation**

Modern Architectural history was dramatically shaped by revolutionary innovation experienced firsthand at exhibitions and World Fairs. The pavilions were unique sites of spatial, structural and material innovation—highly resourced, competitively sourced and tasked with displaying a nation's cutting edge.[4] Yet architectural historians are seldom resourced to leverage sophisticated Virtual Reality equipment, heritage organisations are only recently recognising modern architecture (especially temporary exposition buildings), and technology's ability to create richer, immersive experiences of built environments is only now becoming feasible as an educational resource and scholarly tool.

A strong practice exists of recording information about historical buildings using Building Information Modelling (BIM), Geographic Information Systems (GIS) and other 3D modelling primarily for research, documentation, conservation, and recreation of buildings.[5] However, the architectural accuracy of BIM and GIS projects fails to create a sense of embodied presence or provide experiential learning.[6]

Embodied Learning links the development of creativity and critical thinking, bridging interdisciplinary connections between science and art.[7] However, researchers have insufficiently studied embodied learning applied to architectural history, and the consequent effect on the practice of historiography. Interaction designers have evaluated embodied learning methods in virtual reality with users, demonstrating successful support of spatial visualisation in anatomy learning in an active, experiential way.[8] How, then, can this impact learning about lost architecture? Design, analysis, and evaluation of interactions with and around technology increasingly use the concept of embodied interaction.[9] This paper presents preliminary investigations into how these methods can effectively and affectively transfer to virtual experiences of architectural space. According to Waters, Hughes and Hughes,

> Virtual Reality transports the mind beyond the two-dimensional bounds of text and photographs; it engages the imagination and forms visual and cognitive links. VR can free participants from stereotyped bounds projected by society … the stories of these technological wonders and numerous related artefacts … can be fully explored and used to motivate the inquiry process.[10]

In addition to extensive research within the gaming domain, several applications of Virtual Reality (VR) extend people's current knowledge and capabilities. Research in Human Computer Interaction (HCI) currently focusses on supporting human interactions in virtual environments, including interactions with objects to explore cultural heritage,[11] enriching feedback through multi-sensory engagement;[12] and enhancing understanding of large datasets through embodied navigation.[13] Our research builds on previous investigations in embodied interaction and virtual environments, leveraging digital technology with multi-sensory feedback and embodied navigation, to create a phenomenological experience of past innovative architecture, providing new opportunities for scholarly discoveries.

**Current VR practice in architecture and expositions**

A preliminary review of current 3D visualisations of International Expositions revealed no complete reconstruction, virtual or otherwise of the Paris Expo of 1937 despite its relative fame amongst 20th Century Expositions. Existing Expo visualisations are mostly fly-overs or walkthroughs of deserted sites. Examples include: a 3D reconstruction of the 1913 Ghent World Fair;[14] the World Expo Museum's virtual reality fly-over of Shanghai, the former site of Expo 2010;[15] a virtual tour of Monaco pavilion at the 2015 Milan Expo;[16] and UCLA's recreation of Chicago's World's Columbian Exhibition of 1893, experienced in a

CAVE (an immersive virtual reality environment where are projected on three to six of the walls of a room-sized cube).[17]

Virtual reality is increasingly accessible for architectural practices, home users, and cultural and educational institutions as a new delivery mode for content. Due to digital games and visual effects in films the public has high expectations of immersive, engaging experiences. However, architectural history repositories of 3D content are scattered; inaccessible; lacking in features or narrative; or only available on specialised technology. Online collections generally don't exploit the scale, sensory richness and potential of VR, biofeedback and sensory technology now available. Meanwhile, logistical difficulties exist for Australians and New Zealanders attempting to visit the sites, recreations and VR labs of Europe or the USA. In terms of tools and repositories, UCLA is developing VSim, highly detailed models with associated historian narratives and resources; the Smithsonian has a 3D online viewer of some of its artefacts; Europeana has a 3D model collection; 3D-ICONS aims to produce architectural masterpieces for Europeana; and Cyark is a project to digitally preserve heritage at risk and has online 3D models but it is still unclear how the public can access the models.[18]

**Challenges of virtual reality and exposition pavilions**

Embodied learning requires the viewer to believe they are 'really there' in the virtual environment. However, is this enough to create what we call 'embodied discovery' of innovative practices, where architectural scholars can construct their own understandings of lost spaces? Virtual reality relies on sight and sound to block stimuli from the 'real world' and replace it with the virtual environment. What of the other senses people use for navigating the world—smell, taste and touch? These senses are more primitive, creating strong emotional responses, triggering memories, and providing background information to human interactions with the world. Without emulated smells of 1937 Paris air, the feel of the marble floor, and the touch of a breeze, how realistic can any emulation of the Paris World Exposition be? Researchers have explored multi-sensory virtual reality with touch, smell and taste, but corresponding device development is in its infancy.[19] Sensory devices and related interface methods can augment the ocular-centric tendencies of Virtual Reality environments.[20] However, deciding on shared and contested levels and elements of authenticity[21] has proven more difficult, some have even argued that photorealism creates its own problems for both critical understanding[22] and for historically and culturally appropriate interaction.[23] One solution may be to convey attenuating, location-specific, graduated sensory input, modulate sound, view or shaders in relation to the level of agreed upon knowledge, modulate viewpoint by avatar chosen, or depict the stability or opacity of

built objects according to the level of trust in the authenticity of the records.[24] User experience research will determine which sensory stimuli will augment embodied learning and discovery in the virtual reality pavilions.

The nature of World Expositions calls into question whether this project may unintentionally detract from the original pavilions' aura. Ephemerality is part of their value. A World Expo is fleeting, elevating the memory of the visit because the buildings will soon be lost forever. Constructing magnificent buildings, only to tear them down a year later reinforces the costly investment, enhancing the pavilions' financial and cultural status. Would the audience value exposition visits as much if they could conveniently revisit the site anytime later in virtual reality? Is archiving a 3D pavilion replica for posterity a fitting tribute to what the buildings represent? Or would a temporary virtual exhibition, to be deleted afterwards, better exemplify the ethos of the expositions?

The virtual reality experience itself may oppose embodied learning and discovery. Although presence can transport the audience emotionally to another place and time, the person remains aware of their physical location. The mediating technology, whether a head-mounted virtual reality display or an immersive installation, never completely disappears. The novelty of virtual reality creates an experience focused on the technology, distracting from the experience of the virtual reality content. This tension between the technology and the content informs the virtual experience, challenging designers to shape this new space into an embodied environment to provide an immersive, meaningful experience of a 1937 pavilion in 21st Century technology.

**Paris 1937 and the larger project**

Of the 20th Century Expositions, Paris 1937 stands out as the last Universal Exposition, dedicated to Peace in a political climate on the brink of global war. Each country recruited its most famous architects to design a pavilion responding to the expo theme: 'Arts and Techniques in Modern Life' while presenting the best of its nation to an international audience.[25] The *Learning from Lost Architecture* project will create embodied experiences of the interior and immediate exterior context of five pavilions chosen for their architecture, innovations, design or integration with modern art (Australia, Finland, Italy, Japan and Spain). The chosen pavilions represent different political, cultural and geographical contexts, including a mix of well-known and lesser-known structures. We will also create the walk under the Eiffel Tower along the expo's main avenue to experience the famous 'stand-off' between the German and USSR pavilions by Albert Speer and Boris Jofan.

The Italian Pavilion, our initial prototype, was designed by the country's most famous architect, Marcello Piacentini. The equally influential Giuseppe Pagano designed the interiors and was director of the exhibition designs. The Italian Pavilion's reinforced concrete structure was a modernist interpretation of the Classical tradition, housing innovative exhibition design of the 1930s developed at the Milan Triennale. We chose the Court of Honour for our initial prototype as it acted as the ceremonial entrance to the building from the neighbouring street, bringing visitors face-to-face with a large bronze statue of *Italy who Flies Across (Italia Trasvolatrice)* set against a shimmering wall of blue-grey mosaic tiles, soaring up the pavilion's six-storey tower. One side of the colonnade was a solid wall decorated with frescoes and in front of them was an exhibit of four venerable objects showcasing Italy's technological advances: from Galileo's telescope to the latest propeller (Figures 1 & 2).[26]

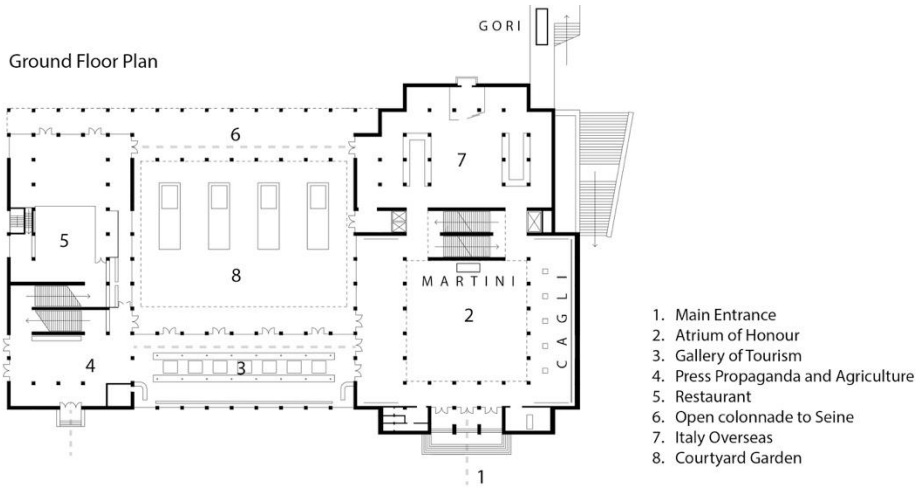


**Figure 1.** Marcello Piacentini & Giuseppe Pagano, Italian Pavilion, 1937 Paris Exposition. Plan showing court of honour and other spaces seen in the virtual model. Source: authors.


**Figure 2.** Marcello Piacentini & Giuseppe Pagano, Italian Pavilion, 1937 Paris Exposition. Colour render of pavilion entry. Authors & Photographs of court of honour from *Casabella.*

## Creating cultural presence for discovery in history

To create and test the phenomenological experience the broader project *Learning from Lost Architecture* will employ a user-centred, iterative development approach to explore new forms of interaction, embodiment and collaboration linked specifically to the methods and findings of architectural history (Figure 3). The project will investigate which aspects of the virtual reality experience promote the strongest sense of 'being there' while providing an environment conducive to interpretation of the designer's intentions for lived experience of the built environment. The innovations inherent in temporary expo pavilion architecture have strongly influenced subsequent designers, but think how much more far-reaching the impact would be if designers and historians could cross over from visual and intellectual stimuli into the realm of embodied experience to make their own discoveries. Books, fly-throughs and current virtual reconstructions of canonical architecture impose a specific view dictated by the architectural historian or the virtual reality artist. Virtual reality with a user-driven interface can extend our imaginative space through embodied movement, design and interaction, empowering the audience to become the agents of their own understanding of space.[27]

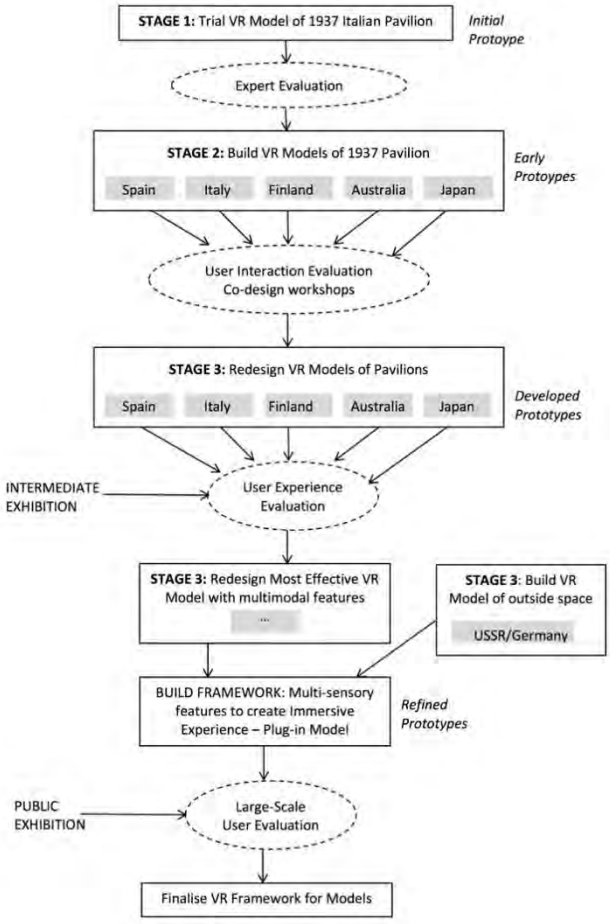


**Figure 3**. Iterative development model. Source: authors.

Creating an immersive experience of lost architecture is a complex process beginning with the traditional methods of architectural history: collection, collation and interpretation of primary source data for the pavilions, including plans, sections, photographs, film footage and contemporary descriptions. These were used by architectural modellers, VR specialists and VR developers to construct our initial Italian Pavilion prototype. This input material and the initial prototype will feed into a virtual place-making approach through a series of user evaluations and co-design workshops with architecture students, architectural historians, architectural designers and urban planners, exploring their needs and design ideas. These activities will interrogate what different user groups seek in an immersive experience by defining what can be understood from current information sources, and what is lacking. The workshops will comprise small group discussions, forum reporting and critiquing of envisioning tasks to sketch their ideal experience and imagine possibilities of emerging digital interactive technologies. The researchers will introduce existing 3D models of buildings, including the Italian Pavilion VR prototype, to participants during the workshops for inspiration (Figure 4). Workshop outputs then contribute to developing the interactive experience and the four remaining pavilion VR models. The research will evaluate with users the experience in an immersive CAVE environment (EON Icube Mobile) to the use of mobile phones in wearable headsets (Samsung Gear VR), and head-mounted displays (HTC Vive) gauging the role played by shared experience through person-to-person interaction, facial expressions, body language and dialogue with other end-users in the same space of the cube.

**Figure 4**. Screenshots of virtual model of Italian pavilion showing the different views available. Source: authors.

A limitation to using iterative development with user experience testing to create cultural presence is that we can only include the receiving culture in the design process—modern day architectural historians, students and designers. Personal input from the transmitting culture, the original architects and population in 1937 is limited to personal descriptions

through diary entries, descriptive articles and architects' statements which lacks the richness of direct human participation.

**Initial prototype: *the Virtual Italian Pavilion***

The VR development team created a first stage prototype to act as a discussion prompt in the user experience research to find out what additional elements would be needed for an embodied architectural experience. Applications were exported for EON Icube Mobile, Google Cardboard, HTC Vive and Samsung Gear VR so that multiple platforms could be tested. Google Cardboard's low resolution and limited field of view resulted in a poor sense of immersion so this platform was deemed unsuitable for the project. Further, the SketchUp model initially supplied could not be accurately imported into Autodesk Maya, so the models had to be constructed over again.

Developing for the EON Icube Mobile created a challenge for the development team. The Icube could only display static objects, so advanced capabilities of VR such as objects moving in the breeze, real-time lighting and shadows, and moving water were impossible to display on this platform. To facilitate this limitation the development team followed an architectural visualisation pipeline which fixed, or 'baked', lighting and shadows onto the models' texture maps. The process for developing the preliminary prototype can be seen in figure 5.

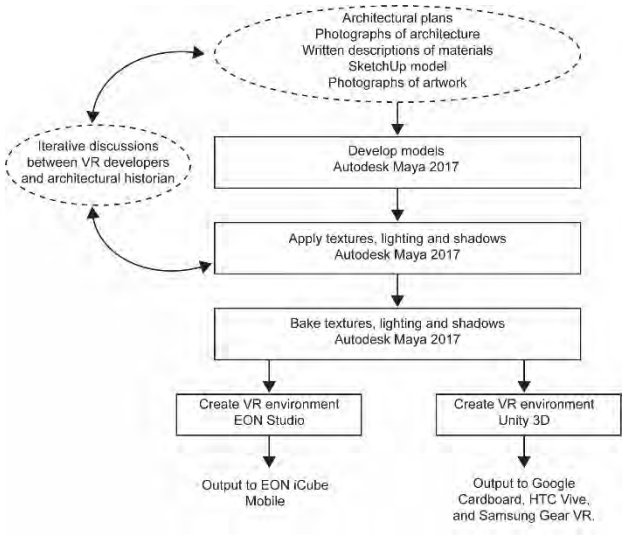


**Figure 5.** Development pipeline of initial prototype. Source: authors.

This process meant that the headset VR apps also had static objects with baked lighting and shadows, reducing the realism even though these headsets are capable of greater fidelity than the EON Icube Mobile. In future iterations of the prototype, an adapted pipeline

will diverge earlier to keep fidelity as high as possible (figure 6). The development team will use Unreal Engine instead of Unity 3D for Samsung Gear VR and HTC Vive because of its greater rendering quality and speed on those platforms.

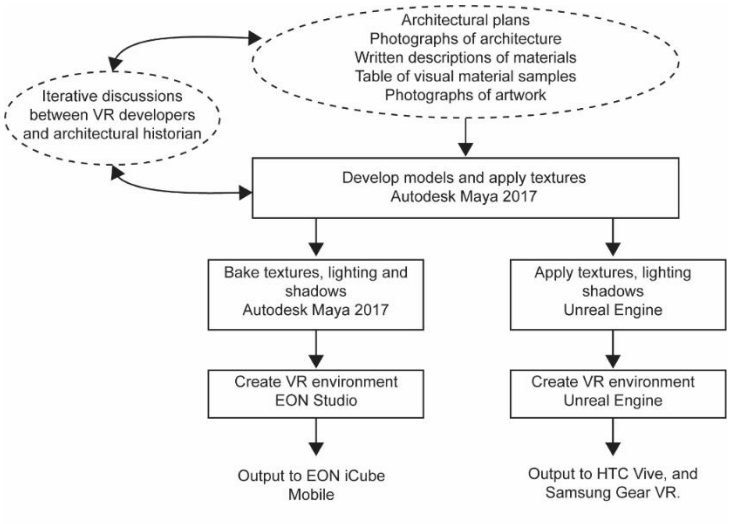


**Figure 6.** Revised development pipeline. Source: authors.

Through an expert evaluation, the prototype revealed three main insights: the value of non-architectural information, the importance of movement and the value of detail. Non-architectural information such as lighting and weather conditions are intrinsic to spatial experience. In the preliminary model the image of the sun and clouds were fixed in the texture of the sky to simulate a generic, fine-weather day (Figure 6). The use of precise location of the sun based on the time and date, longitude and latitude would create shadows similar to those present during the exposition to encompass various weather types throughout the Exposition's duration (25 May 1937 to 25 November 1937). Even better would be a system that allows people to experience different lighting and weather conditions to see the architecture in different environmental contexts.

Movement and intuitive self-navigation to explore the space are also key to immersive experience. This became apparent when comparing the experience inside the EON cube with the Samsung Gear VR and HTC Vive. The higher resolution of the head-mounted displays can make the environment seem more 'real', however the EON Icube Mobile affords the ability to walk around inside the cube as one does inside physical space (albeit within a 3m x 3m limit). It also possible to relate to others, seeing facial expressions and body language, comparable to the experience of physical architecture. Navigation devices used across the various platforms can detract from immersion. The EON Icube Mobile and HTC Vive require use of a hand-held controller

and Samsung Gear VR has a button on the headset. Concentrating on the navigation device causes participants to feel like they have one foot in the 'real' world, preventing them from experiencing total immersion.

Our third insight echoes Mies himself—'God is in the details'. The prototype model omitted the background sights and sounds of the site. Views of a generic streetscape from the virtual windows diminished the atmosphere of the fair which, in 1937, would have included paving surfaces, visitors walking past in 1930s clothes, voices, the river lapping around the shores and glimpses of the other pavilions. We contend that these and other sensory stimuli will help match the viewer's mental schema, building credibility in the experience and the sense of 'being there'. This allows for more effective immersion in an embodied discovery experience.

The other important detail is the integration between the experience of art and space. Pagano felt strongly about the unity between art and architecture, making it the main design driver behind his work at the Triennale. The location of the statue, frescoes and views out to the large courtyard and the Gallery of Tourism were an integral part of the spatial experience. Standing close to the bronze statue and looking up to her towering presence is part of the thrill of being in the courtyard. The artwork provided focal points to the VR experience, giving the viewer meaningful objects to explore.

**Conclusion**

The initial prototype of the Virtual Italian Pavilion has made the first step to move beyond virtual reconstructions for the purpose of architectural documentation or information delivery into embodied experience for holistic understanding of a building's experience and embodied discovery. In the next stage, *Learning from Lost Architecture*, user experience research and human-computer interaction will provide opportunities to enhance learning, discovery and meaning for an audience and matching mental schemas with virtual stimuli and interaction to create a more immersive experience. Further research will also include ways to preserve and distribute these virtual heritage 3D models to make them accessible to other researchers including issues of accuracy documentation, metadata, interoperability, searching and long-term preservation.[28]

World Exposition pavilions represent an important topic to explore in virtual reality: temporary constructions that hold a permanent and significant place in architectural history, with a unique culture providing insight into the world history and the legacy

of innovation. The prototype of the Italian Pavilion, demonstrated benefits to using this visualisation approach and feedback on the usefulness of different VR technologies. Our contribution is to provide an immersive VR experience of lost architecture that goes beyond delivery of information toward scholarly discovery of new insights and re-interpretations of past innovation in design.

**Acknowledgements**

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**Endnotes**

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