5. *Interactive Phygital Displays*. Physical resounds and digital explorations to empower a historical archive of design culture

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5.1 Information technology and the accessibility to the Cultural Heritage

Cultural Heritage increasingly benefits from the spread and development of *Information and Communication Technology* (ICT) to convey structured information characterized by various dynamic digital formats that are increasingly open and implementable. This process has been further strengthened due to the pandemic mobility restrictions, fostering the access of a broader audience to information previously reserved for selected users and better reaching younger generations, who are more inclined to interface with this technology (Lampis, 2017).

Digital technology allows for the preservation and ordering of heterogeneous types of information, including entire collections and documentary archives. It enables access to the Cultural Heritage tangible assets (e.g., works of art or paper documents) and to an increasing quantity of intangible assets, such as digital data archives, electronic journals, multimedia products, AR or VR processing, etc. These latter kinds of knowledge products are part of what has been named *Digital*

Cultural Heritage, for which the urgency of preservation is gradually emerging (Stone, 1999; Cameron & Kenderdine, 2007).

Accessing the content made available by *Digital Technology* through a *Physical Interface* generates a *Phygital Experience* (Nofal *et al*., 2017). The concept of *Phygital* comes from the retail and marketing design sector, combining physical and e-commerce elements, and has gradually been applied to other areas, including *Cultural Heritage*. It fosters greater user engagement and enables more effective access to information through the physical and digital convergence of the content in the same space-time (Belghiti *et al*., 2017). Indeed, the *Physical Display* that participates in this *Phygital Experience* has its formal nature and location in space, contributing to a broader significance since it can communicate and anticipate both modes of interaction and content (Bollini, 2023).

Starting from these considerations, the paper reports the outcomes of the research activity aimed at defining a system of exhibition *Phygital Displays* to convey the historical and cultural identity of an academic structure – the Department of Design of the Politecnico di Milano – implemented through a Digital Archive Platform for the celebrations of the 30th anniversary of its foundation. To be placed in the campus indoor or outdoor spaces, these displays were conceived through a catalog of generative metaphors in the convergence between content and behaviors derived from the project context.

The exploratory research was carried out through an articulated process that ran at the same time as the construction of the Digital Archive itself. The process initially involved two intertwined aspects of the design intervention: the study of the *Interactive Phygital Display* (IPD) – the physical medium supporting the interaction between user and digital information – and the study of the target audience, its behavior, and its proper type of information to access. Therefore, focusing on the IPD location and its operation span, the research activity analyzed how it could promote the digital archive platform during the celebrations within the engaged area, eventually envisaging a traveling device that could be disassembled and reassembled for a traveling exhibition. On the other hand, the study also considered a permanent device to be placed and multiplied in indoor or outdoor spaces as a school identity element situated within the Campus of Department

and School of Design headquarters and possibly on the Main Campus in the city center. As with the nature of the device, reflections were made regarding the target audience. It shifted from the study of the external visitors expected at the main events of the anniversary celebrations to the proper young inhabitants of the Campus, aiming to share the story of the structure's genesis even with those who did not witness nor participate in the process, identifying as the goal of this knowledge sharing (Lupo, 2021) the increase of sense of belonging of the community.

The abovementioned remarks have been developed along with the ripening of the Digital Archive narrative back to the beginning of the process through a circular path, fostering selective fruition of the contents, proposing defined itineraries and multimedia documents (e.g., video and interviews) with different levels of in-depth cultural experiences. It excluded consultation of the archive for research purposes, reserving it for another level of use to be provided in other more dedicated and private settings.

5.2 Interaction between users and display within the physical and digital dimension

The objective of the research outlined above is to identify the characteristics of an Interactive Phygital Display that could promote the Digital Platform dedicated to the history and identity of an Academic Department and School to its Campus residents and visitors. Moving among elements that compose the Phygital Experience, such as space, narrative, and technology (Borsotti, 2023), the research methodology was aimed at exploring two additional aspects, highlighting the interaction between the user and the physical and digital aspects of the display. The first part was geared toward analyzing the qualities of the physically situated element, considering its material feature, signifying aspect, location in public space, and its relationship with users, leaving the interaction with the digital medium in the background. Instead, the second part of the analysis is more focused on the user's access to the digital archive through the Phygital Device.

5.2.1 Signification and situated physicality of the *Phygital* Experience in the context of proximity

The first part of the study is addressed to identify an Interactive Phygital Display that can send signals or messages to intercept the attention of the user who attends the environment being narrated, which is, in this case, the university campus. These are mainly outdoor devices, with sometimes low transmission of digital content and a limited, indirect, or unintentional degree of interaction, privileging sound or visual signals. In addition, the physical appearance of the medium, its shape, and its location can emphasize cultural meanings and content related to a context of proximity, often reinforcing a sense of community. The *Interactive Landscapes* by Daan Roosegaarde projects about immersive environments and relational architectures effectively represent this type of situated experience; in particular, the famous *Dune* with its artificial sand reeds and their small LED light lighting up and weaving when solicited by human interaction along a footpath on top of the quay of river Maas.

Figure 1.
Daan Roosegaarde, *Interactive Landscapes*, 2007-23.

The potential of the IPD based on its physical significance and its relationship with the local context brings with it the following criteria of Case Studies selection that have been adopted in the first part of the research process:

- consistency between thematic context and physical feature of the medium;
- proximity factor to the local context;
- immersive experience and engagement of the local user;
- user role (passive or active) and degree of responsivity of the medium.

The two projects reported below help analyse the category of immersive phygital installations in public spaces where the physical dominant has a semantic value, in these cases directly recalling the

environmental sustainability theme. Both the projects were produced in two recent editions of Design Week in Milan. The first, titled *Mine City: Design, Dismantle, Disseminate* (Milano Design Week, 2024)[1] is a phygital project representing an urban environment talking through digital video interfaces. It is made of wooden fruit crates that will be dismantled to return to their original function after the event. The installation is aimed at displaying the culture of conscious design, recycling, and sustainability consistently with the theme *Materia Natura/Material Nature* launched by the Fuorisalone. it, that is the digital platform of the Milan Design Week 2024. The second case study is *Sit on the wor(l)d*[2], a rest area set up in the courtyard of the University of Milan, during the Milan Design Week 2022, where a limited series of seats, hosts visitors of the event enjoying the Tree Talker technology implemented by the scientist and Nobel Prize winner Prof. Riccardo Valentini, which provides a diffusion of the sounds of the earth, where the phygital sound and video-projection installation detect and reveal the state of health of the trees with a system of non-invasive sensors composing a hybrid scientific-artistic-musical installation on the theme of eco-systemic sustainability.

Note 1.
Organized by the newspaper *Corriere della Sera*, designed by the MCA studio – Mario Cucinella Architects.
Link→

Note 2.
Born from recycled trunks painted by Gabriele Borgia and interpreted by the artist Marco Nereo Rotelli, the *Tree Talker* technology implemented by the scientist and Nobel Prize winner Prof. Riccardo Valentini provides a diffusion of the sounds of the earth.
Thanks to the contribution of the geologist Paolo Dell'Aversana, applied to the Courty trees.
Link→

In a possible Design Oriented Scenarios (DOS) type representation, these case studies (Khan & Wiener, 1967) would be placed in a quadrant that provides for a low degree of complexity in the transmission of content by emphasizing instead their physical and formal role of signification concerning the thematic context and their consistency with the place of action, spatially situated. Such Phygital Experiences predict a specific relationship with physical reality and a good level of Physical affordance (Nofal, 2017). In more circumscribed and protected environments, it would be possible to evaluate case studies more focused on digital interaction integrated with habitable furniture, the manipulation of historical design products, or even the experimentation with modalities borrowed from typical behaviors and gestures of campus users such as querying texts in the context of a library, or desk working. This would especially allow for conveying more nuanced content, such as that offered by the School and the Department of Design's digital archive discussed below.

5.2.2 Digital archive and *Phygital* experience

This research explored the potential of both actual and digital paths, intertwining two main experiences: the phygital dimension and the narratives of a digital archive.

In this context, one of the roles of design is to trace out innovative content-based and aesthetical lines capable of creating new forms of knowledge experience.

In some cases, one can speak of an *expanded environment*:

> **digital or real places, technologically and narratively expanded, where consuming the story is equal to constructing it differently or to deciphering it thanks to the use of dynamic devices [...], stories with a high technological quotient [...] where space is always an active part of the story, the plot and storylines vary depending on the relation and reactions of the public with the environment, [...] the reformulation of typical spatial copies: open/closed, real/virtual, natural/fictional is continuously altered.**
> **(Giovagnoli, 2013, p. 90)**

Figure 2.
Mario Cucinella Architetti MCA, *Mine City* per *Corriere della Sera*, Milan Design Week, Milan, 2024.

Figure 3.
Marco Nereo Rotelli, *Sit on the wor(l)d*, Milan Design Week, Milan, 2022.

The project allows the visitor to proceed in a *vertical* modality through casual links (which, therefore, respond to strong intentions and determination in searching for specific information) or in a *horizontal* through causal links, providing an overall view, achieved through thematic or formal associations and correlations in a type of *cultural flâneurie*.

The theme of digital space experience – in particular where a strongly identified environment, such as this archive, is evoked – opens up the complex yet interesting question, which one can define as the proxemics of digital cultural spaces in reference to those specific places where experience occurs and where the relation-

ship (with other people, with the cultural heritage, with the space) becomes a central factor, enriching the visitor experience.

An additional topic explored through this research activity was the *Phygital Archive*, a physical installation with embedded digital devices that collect and systematize data to enable people to discover contents and explore cultural paths.

Following, we will mention three significative cases, each of which represents a different model of collecting, systematizing, and showing cultural data.

The first case is an installation part of *ArtLens* in the Cleveland Museum of Art (designed and developed by CMA and Local Projects). The *ArtLens* project is a series of interactive devices (such as large touch screens, motion capture systems, tablets, smartphone applications etc.) that take advantage of the digitized collection and AR program that can display information about artworks. We would like to dwell on a phygital installation that represents a dynamic iconographic archive: a 40-feet touch screen displays many pictures of artworks. Visitors – through seven tablet-designated positions – can quickly browse the exhibits and collections they expect to watch by touching the screen, and the smart program will create several *re-configurations* and plan the best tour route. It is not only a collector of art pieces displayed in the museum but also a *bridge* with further works of art out of the museum to foster a connection between the permanent collection and external ones. In this way, we can go in-depth (vertical knowledge-microscope metaphor) into each piece and – at the same time – explore a broad landscape of pieces worldwide (horizontal knowledge-telescope metaphor). When the visitor points to the artwork on the wall with the application, the description and interpretation of the artwork will be displayed on the screen through real-time interaction. Through this system, they can participate more in the space and have a deeper dialogue with artworks. This experience is not entirely digital but is enhanced based on real spaces and artworks. The experience can be customized with a high degree of freedom, allowing visitors to explore the museum according to their interests or preferences (Shilong, 2021).

The second phygital case embraces a poetic and artistic approach: *Les Archives du Coeur* in Teshima Island (Japan) by Christian Boltanski, who works on one of his main topics: the power of the memory.

This archive collects thousands of recordings of people's heartbeats worldwide. The cultural experience happens in four different stages, each of which is an individual ritual that acquires meaning only through collective contextualization. The first stage is *welcome* by the archive keepers, who receive the *donors* who wear aseptic white uniforms and stethoscopes. The second stage is focused on the *delivery and digital recording of heartbeats* in a space where people enter individually. Here, each person has a computer that can write a thought and – simultaneously – read thoughts by other people. Later, visitors can *immerse themselves in the dark heartbeats room where an installation based on sounds and speed lights* reproduces obsessively the last heartbeat recorded mixed with other ones already present in the archive in a completely phygital way. Finally, the *memory* of this experience was sealed by a CD with the recording of your heartbeat, complete with enumerated and signed certification of the visit. Herein, the artistic phygital installation becomes a sort of sensorial *museum* where the heart rhythm is the representation (recorded trace) of the human being's essence. Even if the core of the project is this permanent *museum*, several temporary exhibitions worldwide have been managed in order to make this archive *nomadic*.

Figure 4.
CMA & Local Projects, *ArtLens*, Cleveland Museum of Art, 2018.

The third case is the permanent installation *Un museo al minuto* (by NEO – Narrative Environment Operas) for Museimpresa in ADI Design Museum in Milan. The metaphor of this phygital artifact – located close to the entrance of the museum – is a big digital watch that beats time, unveiling more than 110 company museums and archives that collect and tell the Italian culture of innovation and design. The *phygitality* is recognisable thanks to three elements: the installation has a totem identity like a geometric and essential round red watch (physical), offers a dynamic video-narrative (digital), and is present on social

network (digital). This work valorises visually company museums and archives; each subject is represented by an identifying picture which is substituted – every minute – with one of other museums/archives on the quadrant of a big watch, the metaphor for the stratification of the corporate culture over time. The second hand movement composes every time a different quadrant. With its rhythmic section, the pendulum is the symbolic representation of the past, present, and future. It tells the ability of companies to look at their own history and – at the same time – to look to the future.

Figure 5.
ONE MUSEUM A MINUT, 2022, site specific installation. Design by NEO [Narrative Environments Operas]. Photo Museimpresa.

In these cases, the relationship with the physical dimension of space influences the way with which the installation and the cultural experience are conceived. Even if all three projects are placed in museums, each creates different proxemics. The first one (*ArtLens*) is almost an *architectural* part of a room and is an augmented surface through which visitors can go beyond the museum and interact with it. The second one (*Archive du Coeur*) is a *secret* world to discover intimate human elements where visitors become protagonists and contributors. The last one (*Un museo al minuto*) is a symbolic and self-narrative *monument* around which visitors meet each other.

5.3 Meta-design results

5.3.1 Generative metaphors as tools of communication

In this research, we embraced the metaphor as a tool to envision and communicate ideas and meanings about new concepts of the inhabitable phygital device.

It represents a mental model that can be expressed by words, drawings, or pictures. It is a movement of affine meanings, an abbre-

viated and contextual knowledge (Weinrich 1976; De Angelis 2000). Therefore, with the expression *metaphorical space* we mean those installations that express some values related to a specific kind of space, using something figurative and symbolic in the place of another thing.

Actually, the metaphor is a tool applicable to all the stages of the design experience.

It is recognisable in narratives about field analysis and brainstorming (spatial metaphors); in narratives about problem definition and creation of new hypotheses (experiential metaphors); in narratives that argue design choices (popular metaphors able to easily explain the project); in narratives on staging artifacts (persuasive metaphors that build stories around the project); and finally in narratives developed through the interaction with the final users (inter-linguistic metaphors which characterise user interfaces) (Caratti, 2013).

From this follows the idea of *translation by design*: translating encompasses the action of interpretation and expressing new metaphorical spaces. Also, metaphor is a valuable key to expressing interior spaces and architectural models because it focuses on one specific image that summarises the idea's core. In this case, generating metaphors means associating features of a *source concept* with a *target concept*. Below, we illustrate three generative metaphors we introduced while conceiving this inhabitable phygital device. Each of them represents a paradigm able to express different design attitudes.

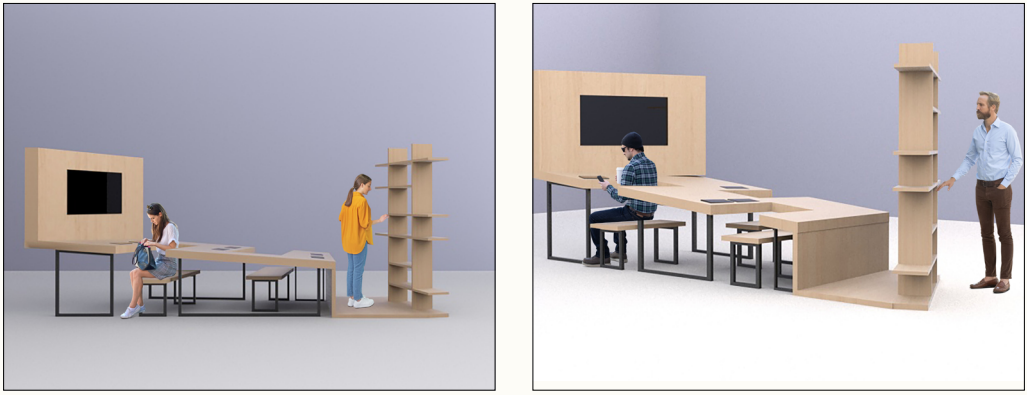
- *Telescope-Microscope*: the installation looks like a sort of inhabitable specific point of observation that allows a digital exploration *zoom in–zoom out* moving from a plural overview. It can offer reconfigurations per specific variables/filters of interest (maps, charts, complex systems of knowledge, datascapes…) to an analytical and specific sight on aspects explorable through a *magnifying glass*. Herein, the IPD will be characterized by elements ascribable to these optical tools, giving us a privileged sight.
- *Time machine*: the digital exploration changes according to a timeline highlighting the concept of threshold past-present-future. Herein, the IPD will accentuate the dimension of the threshold, evoking a *trans-temporal* experience.
- *Alphabet book:* the digital exploration is based on the se-

quence of a series of words (from A to Z), each of which corresponds to a specific narrative. The words can specifically refer to people, events, topics, and so on. Herein, the IPD will be inspired by pieces of furniture that came from the school field (school desk, blackboard, bookcases, etc.).

5.3.2 Design insights: expressing the IPD visual identity

As already mentioned, this research was addressed to the design of a Phygital Display for the promotion and access to the Digital Archive of the Design History Teaching and Research at Politecnico di Milano. It was carried out through a process that ran at the same time as the construction of the digital archive itself. Also, for this reason, IPD represented an adequate way to interpret the vocation of this *object*. As a permanent device, it was thought to be placed and multiplied in indoor or outdoor spaces as a school identity element situated within the Campus.

Figure 6.
Design proposal for an *Interactive Phygital Display* inspired by a school setting.



The concept generation process started from the three metaphors we pinpointed: *telescope/microscope*; *time machine*; *alphabet book*. The idea envisions new IPD models that communicate and valorise the design culture through unusual ways to discover narrative paths.

Even if the *alphabet book* was the central metaphor able to express the identity of the IPD, we can also recognize the other two in the cultural experience because the user explores the contents both in a horizontal (*telescope*) and vertical (*microscope*) way and it passes from past to present and vice versa (*time machine*) in a hypertextual dimension.

The first concept reminds us of a school setting (blackboard, desk, bookshelf) where all the elements are in coherence because they are part of a similar structure: blackboard-watching/attending; desk-elaborating/studying; bookshelf-searching/referring. The figurative and traditional reminder of the school setting contrasts with the digital technologies embedded in this piece of furniture. The blackboard is a screen-monitor that shows the *alphabet of the design culture* (every letter corresponds to a valuable topic in terms of masters, objects, key words). Tablets embedded on the desks allow an interactive fruition through the narrative paths of the digital archive. The bookshelf includes books and three smart objects, particularly significant for the Philology history able to unblock some sound contents: a hard hat for a construction site recalls some events; a mockup chair is linked to prototypes, and the pinny to workshops.

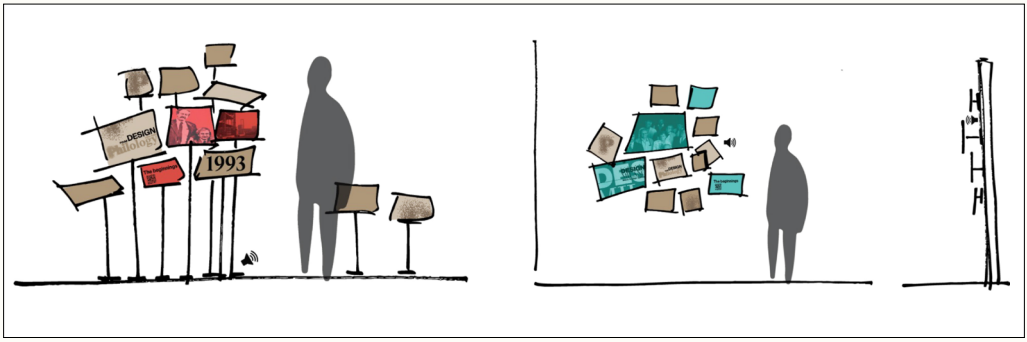


Figure 7.
Design proposal for an *Interactive Phygital Display* inspired by the Philology visual identity concept.

The research path also explored the expressive possibilities introduced by the coordinated image and logo of the Philology visual design. It represents the pulviscular and multifaceted aspect of the design discipline and the choral vision of a community that reconstructs and tells its story made of documents, projects, and testimonies. In fact, quoting the authors Umberto Tolino and Andrea Manciaracina, the graphic concept was created by breaking down the lettering of Philology into small pieces that flow out of the perimeter of the typographic form into a cloud of compositional tiles. The choice of a color palette characterized by warm brass tones evokes the atmosphere of libraries and the rigor of prints of precious volumes.

Therefore, if the concept described above refers to a study desk and a bookcase for academic consultation, a sub-architecture habitable

and cozy, at the opposite extreme, we have tried to develop an immersive landscape of varying density composed of fragments of different sizes supported by metallic thin and elastic stems with reference to the coordinated visual image based on the dichotomy of *fragmentation and unity* and adopting its colors. Consistent with this concept, short texts, images, or QR codes referring to the contents of the digital archive can be reproduced on the surface of the IPD fragments. The landscape can be developed horizontally, as a flower meadow (with reference to the Roosegaarde case study), or vertically, as a dynamic set of communicative screens emerging from a wall. Movement signals from users accessing IPD can trigger sound messages that play interviews and other narrative elements from the archive. The IPDs have been designed as permanent or long-lasting testimonies, which within the Campus can display curatorial itineraries, testimonies from community members, design masters, and students belonging to the history and present of the institution.

The various explored IPD proposals allowed some helpful key points to emerge in the process of designing phygital devices dedicated to the promotion and exploitation of complex digital products such as digital archives. Some significative key points emerge:

- the phygital dimension presupposes new proxemics, new behaviors by users, and new design attitudes;
- the gradient of *phygitality* should be balanced through a deep knowledge of the potential of digital technologies, each one employed at the maximum of its potentiality and with an analog *counterpart*;
- the variable of time and its management can guarantee different levels of fruition and interaction;
- the development of the digital content and the definition of physical installation are better designed at the same time since they are aspects of the same experience.

The interdisciplinary approach is crucial in this kind of phygital design approach: the complementary collaboration among interior design, interaction, communication design, and cultural narrative is fundamental to shaping a complex artifact that offers different levels of narrative and cultural experience.

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