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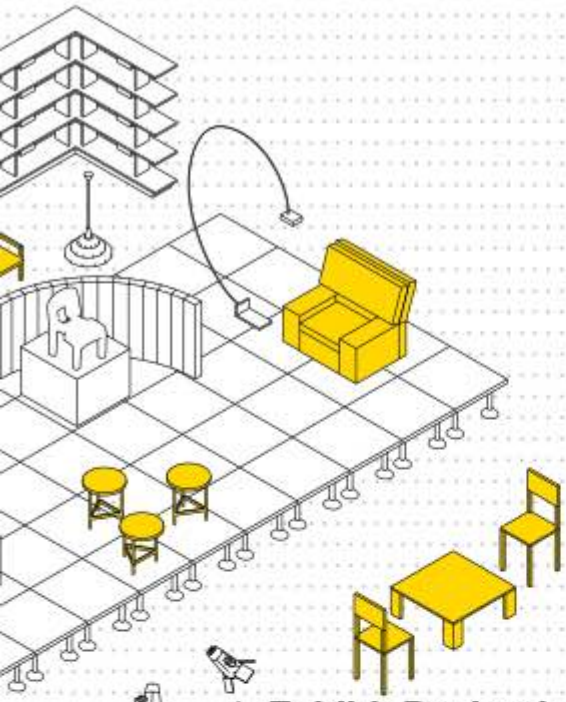
INDEX



0. Introduction 10
D. Crippa

1. Exhibit Design in a different Tradition 20
F. Ambrogio, D. Crippa

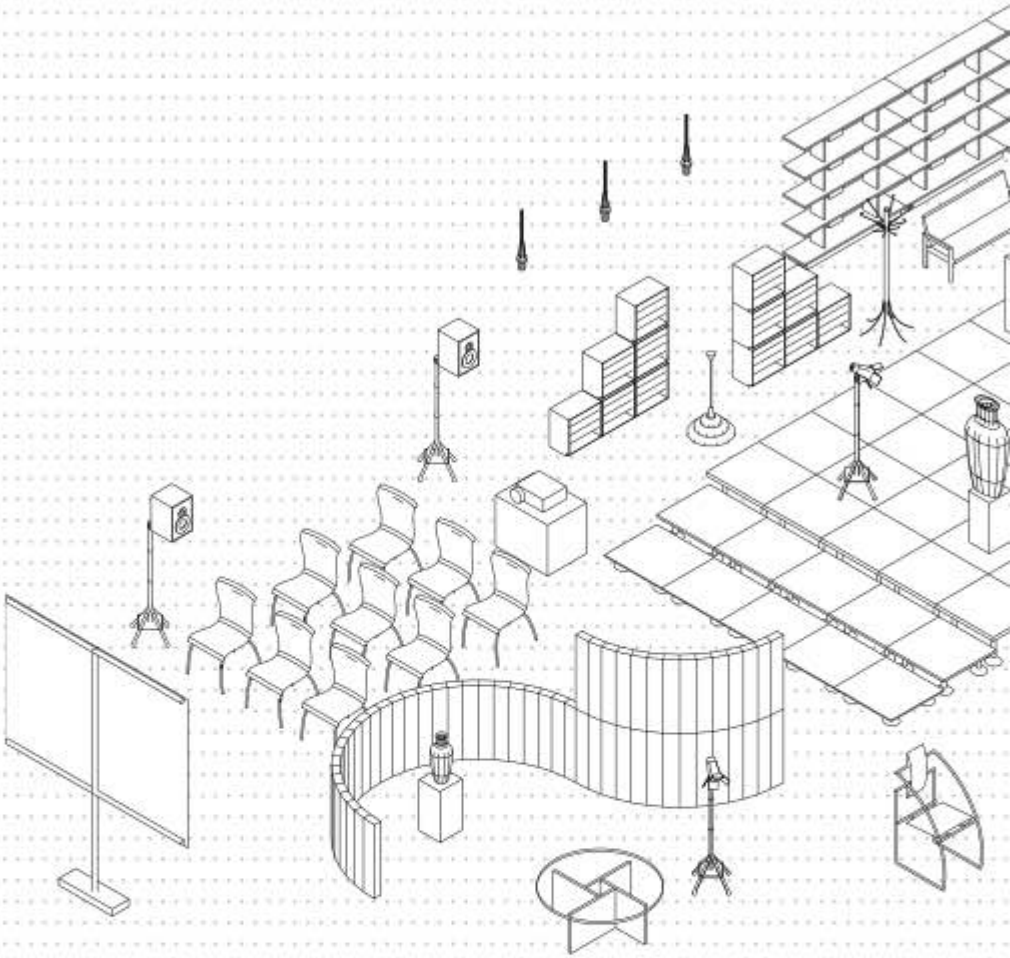
2. Experimental practices for Sustainable Exhibit 42
B. Di Prete, L. Ratti

3. Practices of Re-use in Exhibit Design 68
D. Crippa, C. Leonardi, A. Vacanti

4. Towards Digital Sustainability 88
M. Cason Villa, D. Crippa, C. Digiorgio Giannitto

5. Processes and materials for a new Ecological Awareness 110
D. Crippa, M. De Chirico, C. Digiorgio Giannitto

6. The role of museums in Sustainable Transition 134
D. Crippa, G. Ciliberto, A. Ronco Milanaccio



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INTRODUCTION

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Introduction

D. Crippa

The following text investigates a problematic issue peculiar to the contemporary, namely what role design can (and should) take on to direct more conscious choices capable of affecting the environmental, economic and social impact that built artifacts have on the context in which we live.
The current cultural debate, in fact, demonstrates the urgency of addressing the issue of sustainability by articulating it in all its dimensions (social, productive, economic, environmental), including design, which must become - like the others - a strategic driver of innovation.
It is a matter of changing the perspective with which architects and designers have traditionally operated by also beginning to consider the forecasting component for the after-life of design artifacts. Regardless of the scale, in fact, whether it is the scale proper to architecture or the more temporary scale of installations, reflections and planning choices for the end of life of the goods we are going to build can no longer be postponed (nor can they be delegated to other professionals): today more than ever, the paradigm of circularity-which from time to time can be declined as ***reuse, recycle*** or ***upcycle*** (Castagneto, Fiore, 2013)-can no longer be procrastinated.

In this framework, which advocates an increasing recourse to the principles of the circular economy, outfitting in particular is called for a disciplinary revision, since by vocation it determines a huge production of goods that are moreover ephemeral, difficult to store, often ***site-specific***, and for this reason destined for costly disposal rather than reintroduction to the market.
Fortunately, in these very last few years exhibit design is also beginning to address the question of after-life management of exhibits, whether museum, exhibition, linked to art galleries or performing arts events. The production basin of reference is indeed very large, and the solutions adopted to date are still experimental and unfortunately episodic; however, they demonstrate a gradually growing interest and sensitivity on the part of those working in the field and hopefully hint at design strategies that can be replicated and scaled to different contexts.
The goal of the book, then, is at least twofold: on the one hand, to raise the awareness of a wide audience on a sensitive contemporary issue by describing the scientific context of reference, the political-institutional framework and the ***policies*** being defined; and, on the other hand, to provide practitioners with a body of reference case studies to introduce the most effective solutions adopted to date, often still by private initiative, to promote increasingly "sustainable" stagings.
Pursuing these objectives, the volume is divided into six chapters that touch on complementary aspects of the topic of investigation, seeking to offer a broad overview of possible approaches to the subject, while also introducing technical, design and service innovation solutions. The attempt, in fact, is to place alongside a reading of the state of the art also a propositional interpretation, so that the historical-critical bearing of the text-necessary to frame a topic that is still little debated-is accompanied by a design vision capable of introducing systemic change.
In the first chapter, the theme of sustainability, a privileged and transversal gaze that recurs in the publication, offers an opportunity to reread the history of exhibiting through a category that

has hitherto been paradoxically little considered by the exhibit discipline. In fact, the choice has been made to use sustainability (environmental and economic first and foremost) as an interpretative key to redefine the history of exhibiting according to decidedly unprecedented parameters: a counter-history, Zevi (1994) would say, that by proceeding backwards allows new design invariants to emerge and, at the same time, allows the prerequisites for a new awareness capable of instructing the exhibits to come to be.

In the second chapter, the focus shifts to the contemporary and, in particular, a reading between practices and experiments in sustainable exhibits is proposed, first emphasizing the importance of "content" as a means of disseminating the values of sustainability, and then the role of the "container" as a means of concretizing these values. In the first case, several exhibition episodes are analyzed whose contents succeed in promoting a circular message or even, in the best of cases, succeed in inspiring a future that can already be read in some research of the present; in the second case, on the other hand, significant case studies are illustrated for the material treatment of exhibit artifacts, in search of a new aesthetic characteristic of reuse and recycling.

In the third chapter, the focus shifts to the complex life cycle of the exhibit, proposing virtuous alternative practices to decommissioning and procedures for managing and predicting its end-of-life. In particular, among all the cases cited, the experience of "Re-Biennale" (2008) emerges, an initiative aimed at countering the waste produced by the ***Venice Biennale International Architecture Exhibition*** by promoting experiments capable of reusing the exhibition's waste in an urban regeneration project shared with the local community.

In the fourth chapter - which maps design and process innovations capable of investigating, testing and disseminating the opportunities inherent in digital - exhibition sustainability is married to the digital dimension. On the one hand, it takes the form of the dematerialization of exhibition artifacts, which become increa-

singly virtual, augmented, and immersive; on the other hand, digital also becomes a tool of sustainability as experiments based on IT platforms and tools begin to spread. Indeed, the systemic and ubiquitous characteristic of this technology facilitates the structuring of networks among sector actors, the sharing of tangible assets and intangible knowledge, and finally interdisciplinary collaboration under the banner of the same environmental sensitivity and sustainable perspective.
In the fifth chapter, the dissertation focuses on a technical level, investigating production processes and experimental materials in the service of this new ecological paradigm. Second-generation materials, eco-friendly materials of organic or inorganic matrix, raw-second materials, innovative productions with additive technology and with experimental inserts, all already applied to the field of outfitting, outline a transition scenario that in the short-medium term will allow to move from a linear to a circular model.
The sixth and final chapter discusses sustainability from the perspective of culture, which is considered indispensable in the dialogue for today's sustainable progress, on par with economic growth, social inclusion and environmental balance. Through the analysis of case studies, the role of museums as places of culture and promoters of sustainability issues is investigated, highlighting critical issues and future opportunities that lay the foundation for the development a new modus operandi in the field of sustainable exhibit. With this in mind, toolkits currently employed in exhibit design are identified, placing emphasis on their inherent limitations and trying to suggest cues for innovative approaches that consider perspective shifts in exhibit processes.
In conclusion, the volume thus stands as a first opportunity for theoretical-design exploration that opens up numerous possible research topics, which will need in the future (a not-too-distant future given the urgency of the topic) a subsequent and further investigation.

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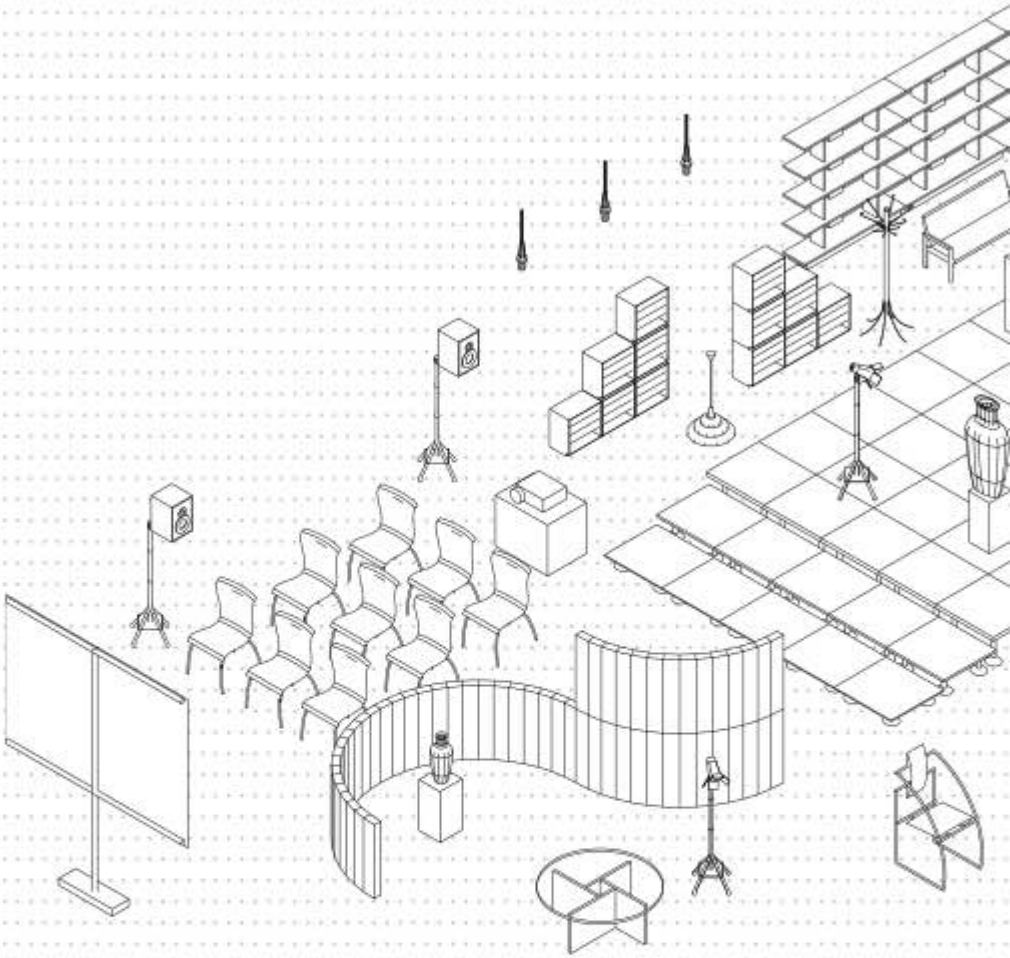

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EXHIBIT DESIGN IN A DIFFERENT TRADITION

Reasonings on a possible counter-history of exhibiting.

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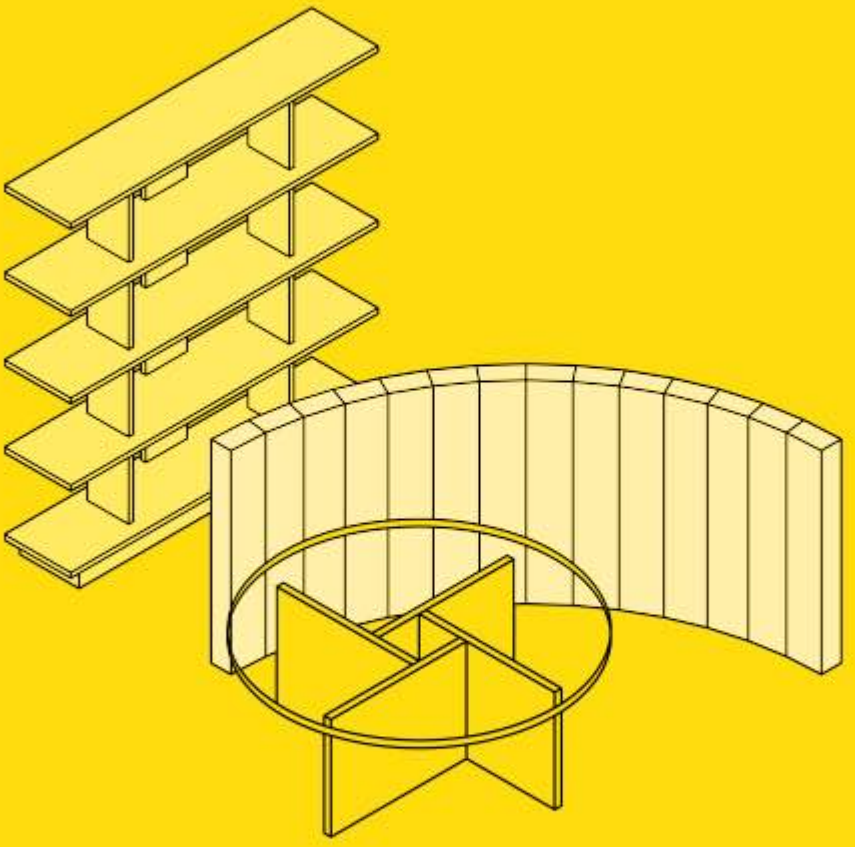
EXHIBIT DESIGN IN A DIFFERENT TRADITION

Reasoning on a possible counter-history of exhibiting.

D. Crippa, F. Ambrogio

The following text investigates a central and problematic issue of the contemporary such as the sustainability of exhibition artifacts; indeed, the current design debate demonstrates the urgency of disciplinary awareness (and revision) in this direction. In light of this need, it seems useful to define a counter-history of the exhibiting sector with the aim of (re)reading the case studies of the tradition (Docci and Chiavoni, 2017), identifying some virtuous models in order to define, downstream, guiding principles capable of directing a correct design methodology to be applied on the contemporary and to be codified for the near future.
In this context, the essay thus aims to understand whether there can subsist in the history of "showing" [1] that "different tradition" outlined by Corrado Levi [2] that today's contemporaneity demands from the design world with ever-increasing insistence. The need for a disciplinary rethinking of display, in particular, can no longer be postponed, and indeed already appears to be lagging far behind other disciplinary fields; consider, for example, how architecture (the discipline closest to design) has changed



and is changing in the last few, complicated as it is revolutionary, decades.
In particular, sustainability - with the declinations it entails in the cultural, environmental, economic, and social spheres, in light of the 17 SDGs for sustainable development of the United Nations' Agenda 2030 (Agenda 2030, 2021) - is an open challenge with which many museums have yet to grapple systematically. Inevitably, for climate, economic and social reasons being unsustainable is no longer possible (Epifani, 2020).

THE INSTITUTIONAI AND CUI TURAI CONTEXT OF REFERENCE

In this context, the question posed by the European Union to German museums in relation to the sustainability factor of the arrangements made appears to be of fundamental importance; the data collected so far are not able to quantify this impact, and the deafening silence coming from the institutions makes it clear that this specific issue has not yet been evaded by scientific research nor by the cultural system in general.
Subsequently, a survey was constructed to quantify, and consequently limit, the level of footprint of the museum sector; other systemic actions have been initiated at the European level, testifying to an awareness that is slowly permeating the institutional and political level as well: "recently launched are the New European Bauhaus (2020) - a sustainable and inclusive project promoted by the European Union and inspired by the school founded by Walter Gropius in Weimar in 1919 (European Commission, 2020) - and the Gallery Climate Coalition, a nonprofit organization founded by a group of gallery owners based in London with the aim of offering an industry response to the climate crisis, thanks in part to a special online tool (the carbon calculator) that allows them to calculate the impact galleries have on the environment in terms of CO2 production" (Maida, 2021). The Federal Cultural Foundation, in Germany, has also moved in this direction, offe-

ring museums and affiliated organizations a project to minimize the impact of their carbon emissions. It seems clear, however, that the climate change goals of the Paris Agreement, in effect since 2015, can only be achieved if they are understood as a task for society as a whole, in which all its actors must necessarily participate.

A few years ahead of its time, Michela Rota (2019) proposed an investigation into the sustainability of the museum apparatus, albeit highlighting the degree of economic and environmental sustainability of architectural shells and still giving little breathing space to research on the temporary arrangements contained therein. In fact, the goal pursued by the author is to build a ***green management*** that operates both on the current management of the museum sector and on the structuring of projects for the transformation and redevelopment of the existing.

The author proposes a range of possible approaches to start the path toward sustainability of the numerous and heterogeneous Italian museum experiences, but the fundamental contribution of her volume is that of having fostered a significant increase in awareness of the sector and, at the same time, that of having introduced professional tools, orienting the technical skills of operators and providing support to museum directors. Thanks to Michela Rota's text, for the first time in Italy, the problem of sustainability in the exhibition system has thus been addressed, migrating the reasoning that has been instructing architectural design choices for years and imagining their application to the museum system. To the virtue of having brought the good practices already in place to a new context, and of having highlighted the need for a systemic approach to the issue of sustainability, there subsists perhaps the limitation of not having addressed the typical peculiarities of temporary exhibiting: the solutions proposed are at times still generic, often not easily adaptable to the museum reality, and above all, a look at the building rather than at the activities that are carried out in it seems to prevail in the investigation.

In any case, the profound sense of this volume remains evident and valuable, as it has made it possible to initiate a scientific debate capable of raising awareness of the importance and urgency of a concrete activation of an entire compartment with respect to ecological-environmental instances (Lanziger, 2021).

THE SySTEm OF EXHIBITING AND THE ECONOmIC ImPACT IN mUSEUmS

The impact that a sustainable design of exhibiting can have in the life of exhibition spaces can be easily measured by looking at the budget items of major museums such as the Triennale or Maxxi, which show, for example, that in 2019 alone in Milan about 1.820 million euros were invested annually [3] in exhibition set-ups [4] that were then, in almost their entirety, decommissioned and destined for landfill.
Giving concrete examples, for the following exhibitions, items related only to set-up costs are inserted in parentheses:
* ***Enzo Mari*** exhibition, Milan Triennale, from October 17, 2020, to September 12, 2021 (€137.500);
* ***Vico Magistretti. Milanese architect.*** exhibition Milan Triennale, from May 11 to September 12, 2021 (€68.415);
* ***The State of Art of Architecture*** exhibition, Milan Triennale, from February 16 to March 29, 2020, (€86.407);
* ***Giancarlo De Carlo's notebooks. 1966 - 2005.*** exhibition, Triennale di Milano, Milan Triennale, from Jan. 24 to March 29, 2020, (€32.432).
Analyzing the exhibitions set up during the previous year, the figures do not decrease: considering ***Play Skatepark*** (€280.000), the setting up of the ***Museum of Design*** (€184.849) and that for the large exhibition ***Broken Nature*** (€760.717), the impact of this item of expenditure is confirmed to be high, especially if we consider that these are out-of-pocket costs.
The numbers mentioned make it easy to guess why the Milan Triennale, a museum that has design culture as its main skill,

wants to build a special project by dedicating an observatory to these issues, a place of research to foster a sharing of set-ups and thus transform what at the moment are mere cost-lives into an opportunity for other museums, even smaller ones. Innovation, which passes through the visionary "***Non Si Butta Via Niente***" project (2022), here takes on the character of a process innovation, with multiple positive impacts on both economic management and the competitiveness of the facility. It will be an interdisciplinary observatory that will see the involvement of various actors, both public and private, in which to converge the skills and needs, sometimes complementary, of both corporate subjects such as Social Factory, NSBVN and Gimac (Maida, 2022) and institutional subjects such as museums, but in perspective also research bodies and universities, including the Iuav University of Venice, in order to experiment with new good practices that will enrich the sharing of set-ups already started.

THE EXHIBIT SySTEm AND ITS ENvIRONmENTAl I mPACT

As previously illustrated, the economic impact that gravitates around the construction of temporary set-ups for exhibitions and events is huge and is difficult to minimize (Ronchi, 2021); currently, the set-up devices made for these events - often, moreover, necessarily scenographic, of great visual and communicative impact - determine a situation of not only economic but also environmental unsustainability: exhibitions, fairs, sets for fashion, music or film shows (in general we could say all those serving the cultural and creative industry) make use of materials that are often not very recyclable and that are used only for the specific time of the event, in total contrast to the principles of eco-design.
"The environmental issue, understood as the impact of production and consumption systems on the balance of ecosystems" (Vezzoli, 2017), appeared in the second half of the 1960s

as an emergency associated with the major ecological disasters recorded in the West. Although the issue is thus now rooted in time, unfortunately it seems clear that we are still unprepared today: exhibition apparatuses and devices would require storage that is often too burdensome for museums and art galleries, which rarely have ample free space to allocate for this purpose; consequently, the displays feed landfills, creating high masses of complex waste, paradoxically on par with heavy industries.

As one of the leading scholars of sustainability, John Thackara, stated in 2008, "Eighty percent of the environmental impact exerted by products [...] is determined at the design stage" (Thackara, 2008), so in recent decades there has been a gradual awareness that design activity must systematically consider the impact that the artifact, the object of design activity, has on the environment and its balance. As Ingrid Paoletti also suggests, it is therefore necessary to think about waste already upstream of design activity, anticipating the use of what she calls "remainder," hence the reflection on "designing with remainder" (Paoletti, 2021).

Although this awareness has now been acquired by practitioners, we still witness, constantly, a general "design malpractice," that is, the lack of a design focus capable of codifying from the origin of the creative act, with predictive capacity, a circular and sustainable process both economically and environmentally, without delegating it to choices to be made a posteriori (often in situations of emergency and necessity).

As a result of what has been analyzed, it therefore appears fundamental to attempt to construct a "different tradition of exhibiting," one that is enriched with content and meanings drawn from the

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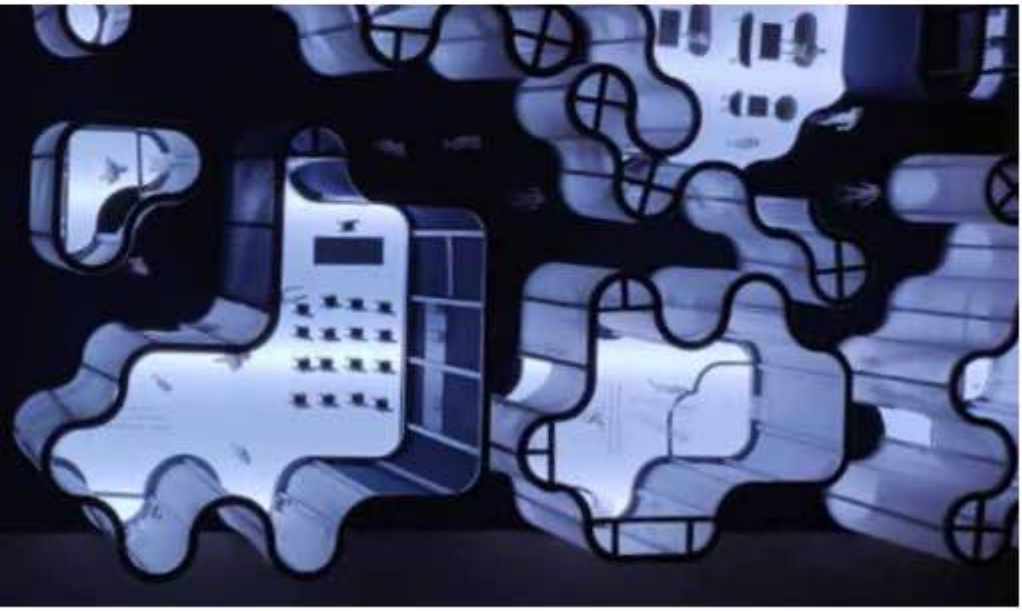
open day of the Exhibit Design laboratory of the Master's Degree course on the theme of sustainable exhibiting. Stand project for Euroluce according to the principles of eco-design. (Source: @Davide Crippa)

history of exhibiting-or rather from a "counter-history" of it-so as to be able to concretely reverse this design malpractice, founding it on a specific body of knowledge and reflections, anchored in a solid body of reference literature and some contemporary episodes of particular relevance.

TOWARD A COUNTER-HISTORy IN EXHIBITING

Is it possible to identify a counter-history of exhibiting from the sustainability point of view?
How useful might it be for more informed design, or how much might it turn out to be simply theoretical speculation?
What would be the implications for design?
These are important questions for this essay, which considers it a priority first and foremost to reform the design culture in such a way as to increase the environmental awareness of designers and their clients, consequently inducing greater attention to the end-of-life of fittings.



In seeking to pursue this goal, history can also make a valuable contribution, as some authors, including Bruno Zevi, with their brilliant analyses of spatial design, still demonstrate. Zevi's thought is marked by an exploratory direction different from his contemporaries, because he proposes to us a reverse writing of architectural history, starting from the present in order to construct an investigation backwards in time.
Imagining, therefore, a chronologically reversed history of architecture, Zevi codifies seven invariant principles (Zevi, 1997) for correct design; the following is a brief summary of the meaning of these invariants, which are defined as "methodological synthesis suitable for the formation of new generations of designers capable of grasping, through a heretical reading of the history of the project, the guidelines and references that can be implemented in contemporary behavior."

The seven invariants can be summarized as follows:
* "List of functions: zeroing out the semantics of signs and forms by creating new ones. This is a procedure that leads to the reformulation of the relationship between form and function;
* "Asymmetries and dissonances": if symmetry is the basis of the classical code, asymmetry is of the modern one;
* "Anti-perspective three-dimensionality": reducing buildings to regular prisms reveals an immense visual heritage composed of curves, asymmetries, deviations, modulations, angles other than 90°;
* "Four-dimensional decomposition": unitary space is shattered into its compositional planes. The static nature of classicism is succeeded by a dynamic, temporalized vision;
* "Overhanging structures, shells and membranes": concerns the possibility of building in a more daring way, at the limit of the possibilities provided by the technique of modern construction, in new materials and with unprecedented capabilities;
* "Temporality of space": it is the possibility of exploring a building in a temporal sense, moving within and through it;

* "Reintegration building, city, territory": this principle leads the analysis beyond the building, which, reintegrated to the city, sees traditional facades disappear and any distinction between interior and exterior space, between architecture and urbanism, collapse. From the fusion of the building-city-territory systems comes the concept of "urbatecture."
Zevi, thus, teaches how history represents a great reservoir of fundamental information in order to be able to read (and reread) the present and the future; with his counter-history, he provocatively breaks critical patterns to allow us to glimpse how backward analysis can be decisive in taking a correct point of view and an effective design method.

The same disruptive charge can be traced in the short text Corrado Levi developed to explain the fundamentals of architectural composition at the Milan Polytechnic. ***A Different Tradition*** (1985) is a book in which Levi interrogates musicians, artists and a single architect - Franco Albini - with the aim of interpreting the specific design method of each and thus identifying in contemporary design culture an alternative tradition, based on play, paradox, inexactness and nonsense. The volume is articulated by juxtaposing ten writings on different interpreters and an explanatory theoretical afterword; the writings reveal the methodological mechanisms underlying the poetics of each designer, so this book assumes both an informative role, thanks to the transcription of real monographs, and a formative one, aimed at illustrating the so-called "processes of making." The volume over the years - and perhaps even unexpectedly for its author himself - has become a fundamental and multigenerational text on design methodology.
In the insight of Bruno Zevi and Corrado Levi can be traced the presuppositions of this same essay, which aims to constitute a first basis for "a different tradition of exposition" yet to be written.

A COUNTER-HISTORy FROm A SUSTAINABl E PERSPECTIvE: AN INITIAl CO mPARATIv E

OPEN DAY 2022 - IUAV
sequence of the six models of the "sustainable" stands designed for Euroluce in the Exhibit Design studio.
(Source: @Davide Crippa)

INTERPRETATION

The usefulness of a counter-historical reading of exhibiting from a sustainable perspective can be easily discerned by analyzing the work of one of the masters of exhibiting, Achille Castiglioni, in particular by taking two of his emblematic works - Chemistry Tomorrow and Today (1967) and the 1956 RAI pavilion installation; reading them from a sustainable perspective, that is, evaluating their economic-environmental impact and potential waste, they emerge as two antithetical models. Castiglioni, a master among masters, in his long career demonstrated his ability to use the codes of display with lightness and irony, choosing from time to time to privilege the code-fitting, the code-background or the code-object [5] in order to achieve the most immediate result as fruition and the most persistent as memory; to him we owe many of the masterpieces of the discipline of display. The reading that is proposed here is therefore obviously not intended to question its value, it simply wants to add a variable (which was not contemplated at the time) for an evaluation that integrates the new instances of contemporaneity and helps us to draw from the past virtuous solutions to be taken up today, updating them.
The two cases mentioned above could be taken as conceptual extremes: the 1967 exhibition represents a disarming case in terms of its communicative effectiveness and ability to engage the

viewer, because it was able to bring a "poetics of discovery" into the system of exhibiting; through the use of false ceilings, space is compressed and thus created a seemingly infinite neutral landscape, in which the contents "rain down" from above catching the viewer unawares, amid visual deceptions and skillful mirror games. The exhibition, an undisputed masterpiece in terms of narrative power and scenographic charge, makes skillful use of the three codes of display, but if the parameter of sustainability were also introduced, the judgment would have to change.
In the light of this fourth code, in fact, Chemistry Tomorrow and Today could not be included among the most virtuous examples of exhibit design, as the critical use of high quantities of materials (e.g., to build the ceiling over the entire space), which besides being wasteful were not recoverable after the exhibition was closed, emerges clearly.
Conversely, the set-up of the 1956 RAI Pavilion turns out to be a positive example because, although adopting, as in the previous case, a very pushed code-fitting, the logic that guided its design choices follows principles that today we might call ***ecodesign***. The project, in fact, focuses on the study of a single joint with which to assemble in ever-changing ways a series of shaped tops that can flexibly accommodate graphic content, become display tops or even turn into ready-to-use furniture systems. The solution thus favors the use of a widely reconfigurable element capable of using

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sequence of the six models of the "sustainable" stands designed for Euroluce in the Exhibit Design studio.
(Source: @Davide Crippa)

"less matter and more intelligence." This design system has resulted in significant savings on many fronts, from the purchase of materials to the construction process, allowing easy disassembly and reuse for subsequent fittings; definitely, in terms of environmental sustainability this second design is more efficient. This simple comparative analysis thus provides insight into how the use of the sustainability code could rewrite the value hierarchies that history has ascribed.

CONCLUSIONS

In conclusion, the reasons why the definition of a counter-history of exhibiting has been briefly introduced here would allow us to (re)read the case studies of the tradition, especially those representatives of a different tradition, interpreting them as more or less virtuous models in order to define downstream guiding principles capable of directing a correct design methodology to be applied in the contemporary and in the future.
Constructing this counter-history through an obviously broad and articulate treatment would allow to redefine the role of the designer (capable of managing the afterlife of installations), the sense of design (increasingly systemic) and the same design methodological principles, more adequate to the new ***Sustainable Development Goals*** (SDGs) of the UN Agenda 2030.
It is therefore deemed desirable to build this new counter-history, to be written by many hands, capable of making that now so urgently needed contribution to the field of exhibit design, which for too long has seemed immobilized by disciplinary myopia.

Notes

1- "Mostrare" is an expression introduced by Sergio Polano in the book ***Mostrare. The exhibition in Italy from the 1920s to the 1980s*** (1988), which today represents one of the few publications on the history of exhibitions in Italy.

2- Expression taken from C. Levi's book ***A different tradition*** (1985), in which the Milanese master proposes a new design manual valorising those masters who in his opinion can trace an alternative trajectory to the "main story", to instead build a "playful and gentle" tradition.

3- Aggregate data, in reference to the transparency and financial statements section on the Triennale di Milano website (https://triennale.org/trasparenza/bandi)

4- The numerical data refers to the aggregate of costs deriving from the related activities of the museum system: from the setup itself to the movement of works of art, from structural maintenance to the construction of new systems, from design to the purchase of material.

5- The three codes of the installation, which are part of the lessons held by the prof. Davide Crippa, were developed to illustrate the design poetics of the various authors. The use of these codes as a criterion for reading their design attitudes is also found in various publications, including ***Design of the Ephemeral in Urban Space*** (Crippa, 2022) and ***Body. Spatial Transitions in the Scene Architecture between Space, Event and Movement*** (Crippa, 2020).

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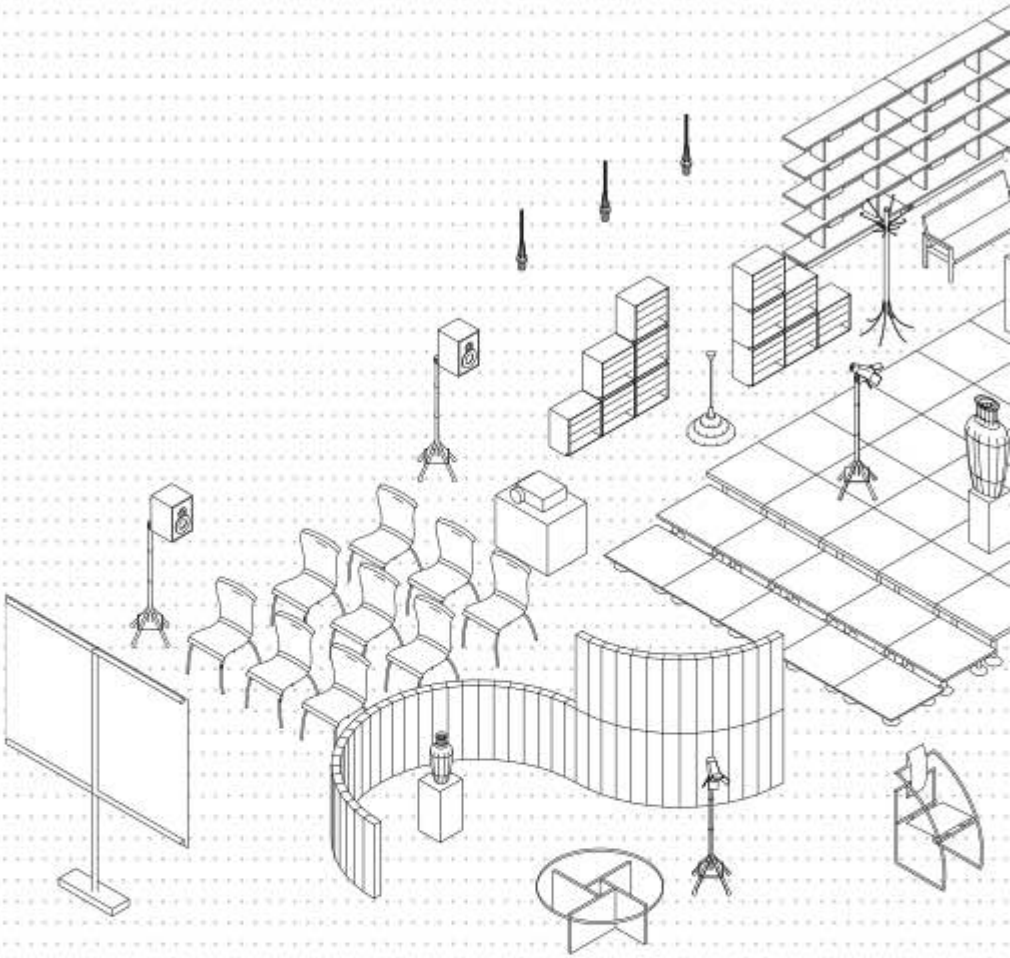

2

EXPERImENTAI PRACTICES FOR SUSTAINABIE EXHIBIT

When content and container put themselves at the service of a circular economy

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When content and container put themselves at the service of a circular economy

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In the contemporary context of an increasingly pressing climate, energy and economic crisis, it is necessary to reiterate the growing importance that environmental issues are assuming in all spheres of knowledge and, at the same time, it is useful to emphasize the urgency of addressing them on a systemic level. Recognizing the competitive advantage of circular actions at both the individual and collective levels, exhibition design is thus also called upon to confront these values that are inescapable today, promoting both awareness-raising actions and field experimentation.

Recognizing the urgency of the environmental issue, as well as the presence of obstacles - including cultural ones - to the subversion of the conditions that generate it, exhibition design can in fact act as a vehicle for sustainable messages, promoting a change in values, but at the same time it can become a field of

action for the implementation of good circular practices.
By proposing design solutions calibrated to contemporary sensibilities and needs, and harnessing its profound educational potential as a "producer of reality" (Obrist, 2014, pp. 226-227), therefore, a sustainable exhibit can act as a collector between collective and specialized knowledge, making the latter accessible and comprehensible through direct experience of its contents (Janes, 2007).
A disciplinary field with complex boundaries and an ideal place of confluence of knowledge and modes of expressing culture (Borsotti, 2017, p. 9), display already contains in its identifying connotations a number of elements akin to the values of the circular economy - flexibility, adaptability, impermanence - that allow it to approach good sustainable practices in a natural way, albeit with a potential that is often still only latent.
Indeed, the very qualities that make exhibition design a potential witness to the principles of sustainability also make it, if managed with little "circular sensibility," an impervious disciplinary field at risk of waste, with high economic and environmental impacts; it is therefore necessary to pursue conscious design choices capable of considering from the earliest ideational stages the end-of-life of the exhibition, thus minimizing the dissipative risk of spatial solutions that are by nature temporary.
There is not yet, within this framework, a codified sustainable approach to exhibition design, but technological approaches and communicative methods can be identified within the discipline that are capable of promoting requirements of environmental compatibility (Fassi, 2010), of limiting dispersive tendencies of energy and matter, and thus making exhibition occasions moments of - spontaneous but conscious - diffusion of change.
In the contemporary exhibition scene, there are at least two ways in which approaches to a sustainable exhibit can be interpreted and clustered: exhibits that communicate and convey the values of the circular economy through the very content put on display, and exhibits that, on the other hand, communicate them by put-

ting them into practice, thus adopting them as a guiding principle of design choices.
Against a survey conducted among the best practices of exhibition design attentive to circular issues, four recurring design strategies are identified here, gathered in the two clusters just mentioned, focusing on the one hand on the role of the "content" of the exhibition narrative, and on the other on the potential of the "container" itself to act as a disseminator of values.
Thus, an overview is outlined in which the conceptual and material aspects of exhibition culture concur in the communication and physical representation of new actions, new attentions and new sustainable aesthetics.

WHEN CONTENT CONVEYS THE VALUES OF SUSTAINABILITY

In the face of such urgent and "cumbersome" issues as those related to environmental issues, the integration of ecological themes into the content of exhibitions and cultural events becomes an increasingly frequent condition. Within this framework, there is recognition of the need for exhibition design to also participate in a systemic action oriented toward the dissemination of sustainability values, addressing an increasingly broad and heterogeneous audience.
Pursued with the support of ever-changing spatial tools and conceptual connections, the goal of any exhibition design is, after all, the articulation of a clear and effective (or sometimes effectively confusing) communicative message that accompanies the observer in a process of discovery, interpretation and decoding of its contents, enriched by the singularities of the proposed setting and experience.
The creation of "places" in which the viewer can "enter" the topics (Rosa, 2003, p. 256), in order to explore and experience them in ways other than simply and solitarily reading information, stands, in fact, as a useful means of achieving a level of

involvement sufficient to succeed in triggering the questioning of established opinions, emotions and habits.
Such attention proves even more important in an ecological and eco-systemic perspective, because the engaging and immersive nature of story-spaces, designed so that the totality of their components concur to tell a story, certainly possesses the communicative and emotional potential to overcome attitudinal resistance triggered by the severe and, often, overwhelming nature of the environmental issue.
Perceiving, observing, appreciating and understanding thus become, in the exhibits collected in this first category of interpretation, key actions for familiarizing the visitor with new sets of values and ideas. To this end, the exhibition projects illustrated below focus on information, problems, narratives and sustainable solutions, organized and complemented by exhibition-communicative apparatuses designed to make their meanings readable, to overcome their complexities and thus enable a broader and more conscious understanding.

Contents to promote a circular message

Among the set-up projects designed to convey sustainability issues, one recognizes exhibitions and events that make raising awareness a central strategy of the narrative and, at the same time, an ultimate goal.
In these cases, data and images are used as a tool to visualize conditions that are potentially complicated to assimilate, such as precisely those related to environmental issues, with the aim of communicating-with calibrated sensitivity-their potential and emergence. By providing an overall but readable picture, focused on the translation of thoughts and facts into visual elaborations or experiential installations, even the most complex issues can in fact come to be recognized as familiar and understandable, thus succeeding in reaching the emotional sphere of the visitor.
The circular and sustainable message of the exhibition narrative

is amplified by exploiting the direct medium of the images and the spaces that welcome them, which themselves become the main tools for sensory involvement, with the aim of stimulating the observer's capacity for abstraction and, therefore, his or her ability to understand (Borsotti, 2017, pp. 71-72).

In Giorgia Lupi's "Room of Change" set up for the XXII Triennale, for example, complex data and information layered on multiple narrative, quantitative and semantic levels are translated into a graphic composition woven into a large tapestry that completely occupies the front wall of the space and illustrates the trend of changes in the natural environment. At first glance the tapestry appears as a delicate and intricate play of geometric patterns, but by deciphering its visual codes (aided by the legend placed in the center of the room) shapes and colors take on a precise role and their arrangement in space a clear meaning. On the horizontal axis, past, present and future follow one another, while from top to bottom, stories of change are layered; thus, each vertical section of the drawing becomes a kind of photograph of an instant frozen in time. The tapestry demonstrates how data, if not treated as cold and sterile numbers but as an eloquent portrait of the world, can turn into empathic storytellers through the choral visualization of their interrelationships (Antonelli, 2019, p.186).

Data and numerical indications return to prominence in two other set-ups where, however, they are translated into three-dimensional devices for visualizing emergencies.

In the first of the two cases, the Netwerch studio designs a walkable social experiment in the Swiss pavilion at EXPO Milano 2015, activating reflections on consumerist behavior with a progressive installation complemented by direct human action. The idea that governs the public's interaction with the space is very simple: each visitor is free to take any kind of food he or she wants, but, once finished, the supplies are not replaced, thus triggering a reflection on balance, personal responsibility and the collective dimension of sustainability, since the experience of those who will come after them depends on the visitors' choi-

ces, as in a great metaphor of the world (The Post, 2015).
On the other hand, on the occasion of Milan Design Week 2021, Carlo Ratti Associati, with Italo Rota and the partnership of ENI, have transformed the Brera Botanical Garden into a "Natural Capital," a spatial infographic composed of transparent, inflatable bubbles floating among the vegetation, representing with their different diameters the amounts of CO2 captured each year by different species of trees. By placing a large dark bubble anchored to the ground at the entrance of the garden, a visualization of the CO2 emissions produced by a human in a year, Ratti makes the problem of pollution "close" and immediately understandable, and at the same time, the installation raises public awareness of the fundamental role plants play in ensuring the health of the planet (Ratti, 2021).

Contents to inspire a "present future"

In sustainability storytelling, the collective dimension, dependent on the communion of interests and sensibilities of a multitude of social actors, can become a central plot of the exhibition narrative. The idea of the concrete possibility of contributing to change can be conveyed to attentive visitors, but often unaware of their individual potential, by building around them scenarios of use and transformation that make them aware of the quality and quantity of "work in progress" for the construction of a circular future.
In this vein, as "viable catalogs" of sustainable solutions, the exhibits illustrated in this category of the essay are not "mere denunciations" or critical observations of the state of the art already introduced in the previous clustering, but present audiences with overviews of design and artistic responses to environmental issues. Thus, being confronted with the cumulative effect of innovative proposals, the visitor to these "collections" perceives the impact that individual action can have on the path to better and more widespread ecological sustainability.

In these displays, therefore, immersion in "what can be done" and "what is already being done" can inspire the visitor to participate in change, showing some of the effects that can already be seen and paving the way for everyone's future contribution.

It in the past two decades that the world's - and design's - sensitivity to sustainability issues has grown exponentially, and it is relatively recent to see the intensification of exhibitions and cultural events identifiable as collections of eco-oriented gestures, designed to illustrate the opportunities already seized by the design discipline and to broaden its reach toward an increasingly collective dimension.

The first in the national context was in 2003 when, during the 20th International Exposition of the Milan Triennale, Ezio Manzini and Francois Jégou put on display ***Sustainable Everyday Life***, showcasing a series of possible living scenarios and viable alternatives for the regeneration of physical and social contexts, placing design as a priority vector for ecological, environmental and social transition. The exhibition was participatory and proposed a review of potential responses to the problems of modernity, closing with a discussion area for the exchange of views and the collection of further propositional solutions (Manzini, Jégou, 2003).

The interest of Milan's most important design museum in sustainability issues has remained alive from there and has indeed been growing over the years. In 2019, in fact, the XXII Triennale chose the eloquent title ***Broken Nature: Design takes on human survival*** and was concerned with investigating, through the gaze of design, the ties that unite man to the environment, allowing visitors to immerse themselves in a multitude of design responses to the most pressing ecological-social issues, showing the facets of design action in their resolution (Antonelli, 2019, p.19).

In the same year, internationally renowned gallerist Rossana Orlandi promoted the first edition of the ***RO Guiltless Plastic***, a set of dissemination and exhibition initiatives proposed during Milan Design Week within the Fuorisalone, focused on the themes of

circular economy and, in particular, on the possibilities of reusing and recycling plastics. ***RO Guiltless Plastic*** includes an international competition that raises awareness among creatives of all nationalities and ages to propose innovative objects and materials designed precisely to counter the abuse and waste of plastics (Lani, 2019).
Finally, in the very recent ***Waste Age***, a group exhibition at London's Design Museum (2021-2022), the leading question is "What Can Design Do?": the London museum invited its visitors to discover how contemporary designers are redefining fashion, construction, food, electronics, packaging, and other industries through more than three hundred examples of innovative objects and services. By coming into contact with the different facets of circular design, observing its details and experiencing its practical implications, visitors to this major exhibition were thus able to grasp the fundamentally optimistic attitude of the design discipline, which is proposed as a tool toward an ***EndTheWaste-Age***, the very purpose and motto of the event (Al-Dujaili, 2021).

WHEN THE CONTAINER CONCRETIzES THE vA-I UES OF SUSTAINABII ITy

The exhibition design, precisely because it is a provisional artifact, fits fully into that ***liquid modernity*** outlined by Bauman (2000), which is increasingly flexible, uncertain, changing and iridescent. The rhythms of cities and societies in constant flux are also reflected in the dynamics of the project, which thus becomes even more aware of its lability; particularly in the sphere of exhibition design, this renewed consciousness is reflected not only in the type of content displayed and the modes of storytelling, but also in the very structures of the exhibition design: it is the design of the physical artifact that is called upon to contribute to a renewed circular sensibility. The exhibition intervention thus exploits its inherent qualities of temporariness and transformability to minimize its own impact, lightening the footprint

of the "container" and enabling it - by resorting to the ethics of reuse and the aesthetics of discard - to participate in the spread of eco-directed change.
In his contribution to the catalog of ***Sustainable Daily: Scenarios of Urban Life***, Paolo Rosa (2003, p. 256) points out how much "in the age of virtual territories, of the media system, of immaterial objects, proposing an exhibition as a vehicle of knowledge, with all its physicality, its clutter, its machinations, not only makes sense, but [is] even a necessity."
Identifying the physical characteristics of the artifact-exhibition as a further expression and vehicle of values, the founder of Studio Azzurro reiterates the importance of translating concepts and content into tangible elements that allow not only "touching the subjects" to make them explore in a deeper way, but also allow a direct testimony of a design paradigm shift. It is by recognizing this potential of the "physical," along with the need to promote the application of circular principles even in those hitherto more refractory disciplinary fields, that materials, structures, furnishings and exhibition devices are transformed into tools for conveying - themselves - the messages of sustainability, posing as tangibly perceptible best practices that further strengthen the narrative on display.
Against this backdrop, therefore, more and more projects are emerging that are attentive to all phases of the life cycle of exhibition materials, staging reversible practices of recycling and reuse, enhancing waste as an object of both functional and semantic investigation. Such projects represent a response to contemporary demands, but they become both a necessity and an

Ro Plastic Prize 2021
exhibition of the finalist projects of the RO Plastic Prize 2022, in the cloisters of the Museum of Science and Technology Leonardo da Vinci, Milan. Ph. Lucia Ratti. (Source: @Lucia Ratti)

opportunity for experimentation, paving the way for alternative uses of materials and spaces.

Reworking matter: aesthetics "from" waste

In this first meaning of exhibitions understood as sustainable "containers," it is the raw-second materials (the result of recycling waste materials) that characterize the temporary set-up, literally going to build significant parts of it.
These are materially and perceptually innovative solutions that are achieved through the use of new re-materials, often with narrative value, resulting from the process of re-processing waste from the most varied origins.
A new aesthetic - obtained from waste reworked through mechanical or chemical recycling processes - thus finds in exhibition design a particularly suitable field to explore its expressive potential, but also to build "circular" places with minimal impact.

The types of materials already ready to be redeemed by design actions aimed at sustainability are very heterogeneous, but the strategy of reworking waste allows design to reactivate latent potential even in the most unusual materials, transforming their aesthetics.

This is the case, for example, of "Merdacotta", an innovative material produced with organic waste from the Castelbosco farm, with which Luca Cipelletti created ***The Shit Evolution***, a provocative installation that won the ***Milano Design Award*** at Fuorisalone 2016. Conceived and produced by Gianantonio Locatelli, the material-which looks very similar to terracotta-was used to make every component of the installation, from the floor to the furniture to the tableware, restoring a dignity to the material that invited visitors to overcome the stereotypical conception of waste (museodellamerda.org, 2016).

Even by resorting to more usual categories of waste such as plastic, the exhibition stands as a territory for experimentation with new technical and aesthetic potential. It happened, for example, once again during the 2019 Milan Fuorisalone, when the Note Design studio collaborated with Tarkett, a French vinyl flooring company, to create ***Formations***. The large installation, made entirely of IQ Surface (a recycled and recyclable material), was set up in the rooms of the Circolo Filologico and focused on exploring and enhancing the material and narrative qualities of vinyl, traditionally relegated to cheap floor coverings, but here used in an unusual way to create an unusual labyrinth decorated by irregular patterns (www.notedesignstudio.se, 2019). The "spontaneous" texture of recycled plastic also completely invades the space in the ***Zero Waste Bistro*** commissioned by the Finnish Cultural Institute of New York for the 2018 WantedDesign fair in Manhattan. In fact, the set-up of the pop-up restaurant was made entirely of panels obtained from recycled tetrapak packaging, the details of which can still be recognized on the mottled blue-silver surfaces that go into the bistro's walls, arches, tables and stools (Trombetta, 2018).

On the other hand, the Milanese Fab Lab Design Differente, in collaboration with the CAP Group, proposed at the Leonardo da Vinci Museum of Science and Technology, in the Hall of Waste of the ***Ro Guiltless Plastic 2021,*** a stand made with panels of an innovative material with an irregular "stone effect" texture, created through a production process that is still being tested in the context of the ***CAPitoli urbani*** research program, which also sees the participation of the Milan Polytechnic - Department of Design and Department of Chemistry, Materials and Chemical Engineering. The new production procedure tested, organized by successive cycles of refined shredding and melting, makes it possible to avoid onerous initial phases of separation of plastic waste, greatly simplifying the production cycle; the differentiation at the origin of the types of materials incorporated in the same waste (typically plastic, aluminum, paper, tetra pak) represents, in fact, a burdensome step both in terms of time and cost, but, until now, it is decisive for the effectiveness of the subsequent processing. Thanks to the research promoted by CAP, the prospect is therefore to overcome this step in the processing of raw-secondary materials, maintaining a material heterogeneity that also allows obtaining surfaces with unprecedented aesthetic characteristics, (Crippa et. al, 2022).

Reinterpreting matter: aesthetics "of" waste

A further strategy of action to minimize the impact of exhibitions and temporary arrangements is identified here in projects capable of revealing the latent potential of waste, without the need to process it, but "merely" bringing to light its new functional and narrative qualities, keeping its "rejected" characteristics perceptible.
In these proposals, discarded materials and objects destined for disposal are redeemed and reinterpreted by stagings that do not try to disguise them, but exploit their full aesthetic and communicative potential. In this way, the consumption of resources and

STAND CAP
detail of the furniture made for CAP's stand, with wood scraps and inserts in an experimental plastic material.
(Source: @Davide Stanga)

energy still present in the practices - albeit virtuous - of recycling is thus avoided, replaced by creative and conscious reuse actions. Scraps and waste thus remain recognizable in form and useful in use, but are profoundly modified in value, continuing to tell their own story and thus enriching that - broader - of the exhibition. An exemplary case of this approach is the SCART initiative, born more than 20 years ago in the Tuscan company Waste Recycling, now part of the Hera Group. It involves the involvement of international artists called upon to create works and installations composed exclusively of reused waste; these include, for example, the sets for the 2014 edition of the Theater of Silence, in which sewage tanks, inner tubes, leather scraps and dumpsters were transformed into temples, statues and crumbling walls (www.scartline.it, 2020).

Industrial waste also sees its semantic bearing altered, but without losing its aesthetic characteristics, in the ***GEOPARKEN*** installation designed by Helen&Hard in 2008 for the Norwegian town of Stavanger, conceived as a "geo-landscape of reuse" in which the topography of a seabed is repurposed in the square adjacent to the Oil Museum, with the sole use of waste from local oil companies (Bürklein, 2020).

Affirming from its earliest beginnings a willingness to embrace potential new aesthetics derived from the reuse of residues from manufacturing and urban activities, the cultural associa-

tion *La Repubblica del Design* built a traversable monument at Milan Design Week 2019, an architecture of fruit crates made a manifesto of circular attitudes. In fact, thousands of plastic crates, discarded by merchants in the Bovisa area and collected to become "bricks" of the monument's archetypal geometry, were used for the construction of the portal structure, later enriched by an anamorphic interplay of discarded chipboard panels bearing the initiative's logo (Chiavaroli, 2021). Two years later, redeeming their value that had remained frozen in the pandemic period, those same crates were re-signified in the cloisters of the Leonardo da Vinci Museum of Science and Technology, becoming platforms, backdrops and pedestals of the exhibition of the finalist projects of the *RO Plastic Prize 2021*.

CONCI USIONS

Against the analysis conducted, it is possible to glimpse, in contemporary exhibit practices, a growing focus on sustainability issues, which also make the exhibit an area of increasing application of circular economy strategies. Indeed, exhibits that promote through their content an increasingly conscious environmental awareness, and (perhaps even more strongly) exhibits that use the container as a demonstration of virtuous practices of reuse and recycling, are becoming increasingly common.

STAND CAP
CAP stand at the RO Guiltless Plastic 2022. With furniture made from waste materials. (Source: @Davide Stanga)

In particular, among the categories of action proposed here, one observes with increasing intensity the interest of those who design exhibits for reuse, perhaps because in that case there are fewer process innovations, often complicated to manage. In any case, it is now noticeable in the practice of many contemporary artists and designers that the distance between the waste material and the final result of the installation that reuses it is shortening.

Finally, observing some episodes that are still singular, but already of great communicative impact, we can glimpse a further direction of development that could involve the world of exhibits in the near future; Martì Guixè first, Alejandro Aravena later, and recently also the artist Jacopo Benassi, in fact, introduce us to a still different scenario: in their most avant-garde experiments it is the exhibits themselves that become raw-second matter for the realization of new *circular scenographies*.

Although in different ways, whether in ***The War to Come is Not the First*** (an exhibition set up at the MART in Rovereto in 2014, designed by Martì Guixè), in the Foyer of the Venice Architecture Biennale curated by Alejandro Aravena, or in Jacopo Benassi's ***Junk B*** exhibition (visible in the showcases of Spazio NEUTRO in Reggio Emilia in 2022), at the basis of the design emerges as a priority a reflection on the life cycle of the staging: decommissioning, planned destruction, assembly of a collage of rubble first abandoned and then reassembled, become here the protagonists of the design gesture.

In the first case, called upon to design the layout of an exhibition on the First World War, Guixè proposed a "destructive" approach in line with the theme of the exhibition: with a gaze that already demonstrated at the beginning of the millennium a sincere sensitivity to issues of respect and preservation of the value of matter, the Catalan designer approached the design of the exhibition by paying special attention to what was present before his own and to the potential it could still offer, even in its phase of disuse. Indeed, the Catalan designer's first proposal (later modified) was

to demolish the exhibit that previously occupied the space and place its "rubble" at the entrance to the new exhibition, in an evocative representation of the destructive violence of war (Guixé, 2022).
In the second case, in 2016 Aravena used over 90 tons of waste generated by the previous year's Venice Art Biennale to create two installations in the introductory rooms of both the Arsenale and the Central Pavilion. In particular, he restored role, meaning, and use to seven miles of scrap metal and 10,000 square meters of leftover plasterboard by hanging crumpled metal conduits from the ceiling and lining the walls with cross-layered plasterboard planes, thus interpreted as novel exhibition shelves (Mairs, 2016).
Also, in the third case, Benassi has chosen to provocatively create installations produced with remnants of his previous works, literally retrieving scraps from the trash in his studio. The Ligurian photographer and artist thus proposes an "artistic recycling" that "feeds on waste: collected, archived and reworked" in a kind of three-dimensional collages that emerge from the paper-space and invite visitors to both aesthetic and ethical reflection (Maida, 2022).
These three paradigmatic examples thus anticipate a whole series of projects aimed at the reuse or recycling of the exhibit itself, and in this sense, they can be considered forerunners of an approach that, nowadays, is beginning to be recognizable and little by little increasingly widespread: they are proposals that suggest a possible new direction of research, a "line of the future" that now seems to be truly drawn and that deserves a subsequent, specific exploration.


REPUBBL
DEL DES

monument of *Repubblica del Design*
symbolic "monument" built from fruit boxes collected from the Milanese neighborhood Bovisa.
(Source: @Davide Stanga)

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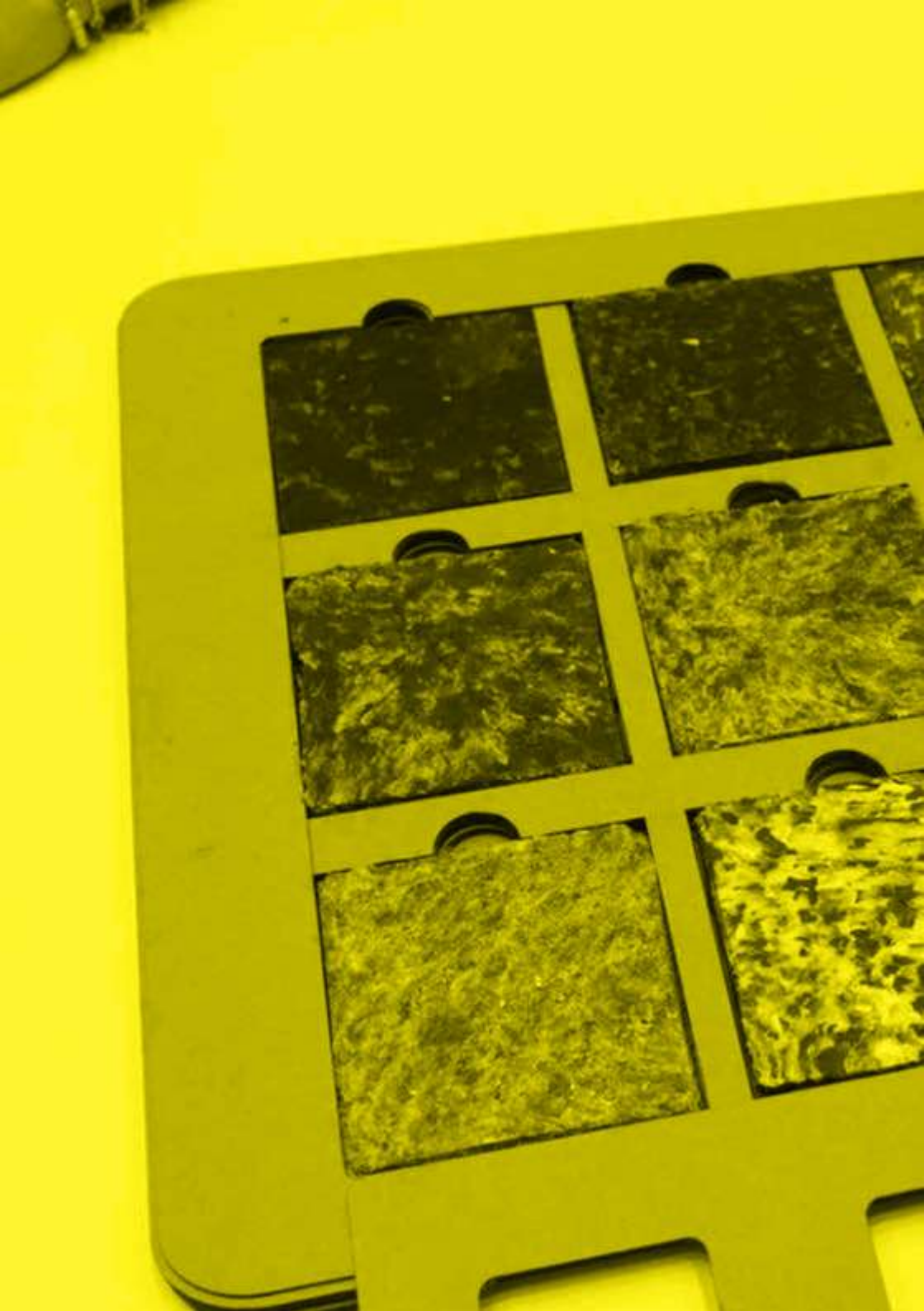

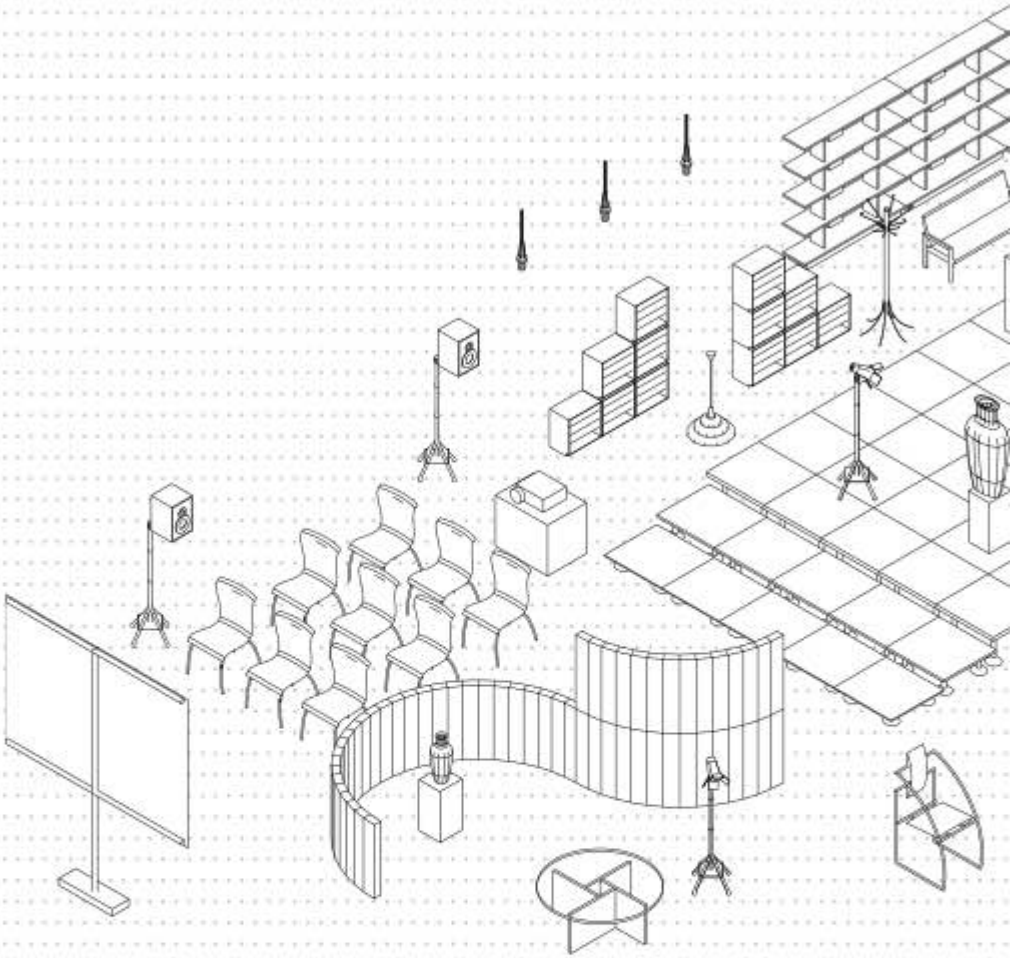

3

PRACTICES OF RE-USE IN EXHIBIT DESIGN

Toward new design scenarios

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PRACTICES OF RE-USE IN EXHIBIT DESIGN

Toward new design scenarios

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As with production processes, resources, materials and energy are used in the exhibit system and ideas are developed that produce impacts. Exhibits today represent an area in which dynamics of material inputs and outputs assume ever greater proportions because they have a relatively short life cycle and, in most cases, are decommissioned after their first use. Although in the past the environmental aspect has not been considered a priority by either designers or curators, in the current debate attention to the sustainability dimension is becoming increasingly central and necessary.

Every year, in fact, Italy alone hosts several large cultural events-exhibitions, art shows, craft fairs, design performances, theater and music-with a decidedly growing audience [1] ; consequently, the waste produced also increases with the multiplication of initiatives. Therefore, it appears necessary for the entities involved to take action so as to prevent the staging of these events from becoming the cause of an uncontrollable impact on the environment.

Thanks to the use of innovative solutions, the virtuous use of

technology, and the field application of studies on materials and their life cycle, we are now able to hypothesize new design scenarios, for example through the use of secondary raw materials and by-products or even, as we will see later, by implementing recovery and reuse actions, thus creating the conditions for minimizing the negative impacts of events and adopting ethically responsible solutions. The current global context allows, in fact, for major events such as expositions, exhibitions and concerts to become valuable opportunities to initiate a process of innovation and qualitative improvement of the socio-economic and territorial fabric that also includes ethical and environmental dimensions. The idea behind it is to use the event as an opportunity to give rise to a whole series of projects that go beyond the period of the event itself (Bianchi, Zigoi, 2015).

From this perspective, the discipline of design can make an important contribution by suggesting green practices as a guide for new display strategies, or more generally by promoting a more mature and balanced awareness regarding the use of existing resources. Since it is precisely in the design phase of the exhibition process that the greatest responsibilities (and opportunities) emerge for determining the relationships that will then exist between the final product and the environment, the figure of the designer appears to be increasingly crucial, and his or her contribution appears to be decisive in defining these relationships. In this

LA FABBRICA DEI GIOCATTOLI
mostra-workshop organizzato dalla start-up Non Si Butta Via Niente, La Triennale di Milano, 2022.
(Fonte: @Davide Crippa)

contribution, therefore, some case studies will be presented that are considered emblematic for the recycling and reuse practices they propose and which, it should be emphasized, involve not only matter and by-products, but also energy and skills.

SCIENTIFIC FRAmEWORk: BETWEEN ENvIRONmENTAl SENSITI vITy AND DESIGN SUSTAINABIlIT y

"Throughout the world, design is becoming one of the noble engines of the industrial economy: beyond the limits of its traditional aesthetic function, it is called upon to fuel (in many different forms) that charge of innovation that has become indispensable to all industrial systems; such as energy, technological research and the economy". (Branzi, 1999)

The scholarly debate around environmental issues and the problems of uncontrolled development began in the late 1970s, coinciding with the emergence of problems related to the scarcity of nonrenewable resources and the oil crisis (Meadows D. H. et. al., 1972), so much so that as early as the late 1980s the European Economic Community committed itself to adopting laws to promote the use of non-polluting technologies and new recycling standards. In 1987 the International Commission on Environment and Development published the report ***Our Common Future***, which indicated that sustainable development was the right way forward to meet the needs of people in the present without affecting those of people in the future. In 1991, on the other hand, the Strategy for Sustainable Living drafted by the World Conservation Union, the United Nations Environment Program (UNEP) and the World Wildlife Fund (WWF) was published, which contained, in addition to the General Guidelines, 130 actionable proposals for more sustainable development (UNEP, IUCN, WWF, 1991).

It was during these years that the design world also began to show attention and sensitivity to some critical issues concerning the use of resources (material and immaterial) employed in the creation of products.

For example, in 1992 Ezio Manzini inaugurated, at the Milan Triennale, an exhibition entitled ***The Garden of Things***, in which a new sustainable and possible world was proposed (Manzini, 1992) based on certain deductions that arose from the observation of nature: on this occasion, new design criteria were established that were attentive to the use of matter and the consumption of energy necessary to produce objects, but also devoted to lengthening the life of things, to giving life to recyclable objects or to transferring some of their parts into new design contexts. The exhibition highlights a qualitative, and no longer quantitative, view of the discipline, emphasizing how targeted and partial technical solutions are no longer enough, but comprehensive and sustainable scenarios over time.
The first guidelines on a new "eco" declination of design are first published in the 1995 Torino design exhibition catalog. The role of the discipline, in this "new" historical phase, was that of a guide capable of conceiving new types of production, new objects and structures, but above all new lifestyles, not thinking of things as an individual private good (Magatti, 2017). Design thus begins to shift its focus from the construction of new objects to the "deconstruction" of the product, adopting practices to avoid the use of non-biodegradable materials, devise objects with reduced internal components, and provide precise directions capable of guiding production. The paradigm shift seems evident: environmental aspects are beginning to take on equal weight with functional, performance, communication, and production aspects, and therefore must be considered of equal importance by the designer.
Continuing in this rapid analysis, one cannot fail to mention ***Closing the Circl***e, a 1990 conference held at the Milan Polytechnic

(Deganello, 1990): it represents the first awareness towards the crisis of natural resources and their being in finite numbers. The reflections led to the end of the era of "disposable" and incessant production: closing the circle means learning to manage the few resources available more efficiently and effectively, trying to recover as much as possible through reuse and recycling. It also means understanding that every new creation involves dissipation, that when an object reaches its end of life it generates waste, but also that this waste can (re)come to life by becoming a new resource (Morozzi, 1998).

Today, more than ever, the incredible volume of waste produced, the depletion of raw materials, the disturbing levels of greenhouse gas emissions and the energy crisis require a revolutionary perspective: in this dramatic context, the possibility of using waste and scrap without resorting to the consumption of new raw materials can help reduce the erosion of resources and mitigate the impact related to waste disposal, promoting a system capable of self-regeneration while ensuring its eco-sustainability.

Something, fortunately, is also beginning to get underway on the ministerial policy front. The national guidelines for the digital and green transition, designed for the cultural and creative sector, are moving in this direction: within the NRP, investment 3.3 - Capacity building for cultural operators to manage the digital and green transition - is of key importance. The intervention aims to support the recovery and innovation of the cultural and creative sectors, providing as much as 155 million euros for for-profit and nonprofit organizations in the sector, with the goal of "supporting the recovery of cultural activities,

THE TOY FACTORY
exhibition-workshop organized by the start-up Non Si Butta Via Niente, Milan Triennale, 2022..
(Source: @Davide Crippa)

encouraging innovation and the use of digital technology throughout the value chain; fostering the green approach throughout the cultural and creative supply chain" (MiC, 2022).
In this context, design can represent the starting point for generating new virtuous processes and, at the same time, a final horizon, the outcome through which different degrees of innovation can be tested. Moreover, precisely because of its inherent characteristic of being in close contact with the world of production and manufacturing, design identifies one of the most appropriate disciplines for bringing about significant changes in design processes from a circular perspective, fostering a shift from a system whose value is generated by extracted resources to one in which value remains in circulation, continuously regenerating itself. Working from this perspective means, once again, expanding the scope of design by placing every design gesture within a systemic vision.

EXHIBIT FACING "CIRCUI ARITy": PII OT PROj ECTS

In the following text we point out some projects that could be considered ***best practices*** that, hopefully, could soon spread and be replicated even in sectors tangential to those of origin: these are new practices of circular economy, recycling and creative reuse. These are examples drawn broadly from the sphere of design, but also art, fashion, film, and trade fairs in general, i.e., whenever the legacy of an event is recovered and reintroduced to the market rather than being disposed of at great environmental and economic expense. In this perspective, an interesting example is Can - Circular Arts Network, a recycling and reuse tool of particular interest for its ability to suggest new art forms by introducing the theme of reuse (canarts.org.uk). The website, established in 2020 and managed by Sculpture Placement Group (an organization specializing in the arts and sustainability), provides access to the resources needed to develop projects (e.g., transportation, equipment, time) and facilitates networking among people, organizations, and industries (particularly construction and manufacturing), thus helping creative communities access their surplus materials on the one hand and, on the other hand, supporting industry toward more sustainable processes (Crippa et. al., 2022). In the same perspective, consider ***NonSiButtaViaNiente***, an innovative start-up that proposes circular economy practices in the museum exhibition sector based on a common "virtual warehouse" under the banner of creative regeneration; La reserve des arts - pour une création circulaire et solidaire, promoted in France in 2008 to encourage professionals in the culture, craft and art sectors to support circular principles through the reuse of materials they discard (lareservedesarts. org); Spazio Meta, a Milan-based reality created in 2021 to counter the process of overproduction of waste in the field of exhibitions (related to the world of art, fashion, design or photography), which offers a service of collection, cleaning and resale of recovered material (Moro, 2021). In all of these cases, the processes are

Non Si Butta Via Niente
website, homepage.
(Source: www.nonsibuttavianiente.it, 2022)

virtuous because they incentivize suppliers to adopt sustainable recycling practices while simultaneously offering the end customer used but quality material.

UAnother significant example for the purposes of this discussion is Re-Biennale, a network of Venetian citizens-students, architects, artists and political activists-born in the year 2008 to "share methods, processes and skills related to self-construction" (rebiennale.org).The initiative developed on the occasion of the 11th *International Architecture Exhibition at Venice Biennale* and, from the beginning, sought to counter the waste produced by the great event, promoting punctual experiments capable of involving the local fabric aimed at reusing the potential waste of the exhibition in a shared project of urban regeneration. Over the years this has given rise to, among many activities: the collaboration with the Da Gino and Inda (S. Erasmo) farm, which saw the reconstruction of the barn with panels discarded from the 2015 German Pavilion, and the sharing of furniture elements from the German and Finnish Pavilions, including benches and tables, with the informal *Circolo anziano* in Giudecca. The *Re-Biennale* project, in addition to initiating branching experiments that have allowed for the investigation of some strategic issues inherent in materials and their processes to achieve more sustainable life cycles, has the great merit of having structured a collaborative network with local communities; in this way, it has promoted an

environmental sustainability capable of also conveying a strong social sustainability, recovering materials, but also giving new impetus to latent productive, aggregative and recreational activities (rebiennale.org).
Among the studios that, over the years, have exploited material from the Biennale is Barman Architects, which recycled the installation ***The Port and the Fall of Icarus***, presented at the Dutch Pavilion in 2018, transforming it into an ecomuseum in agreement with the municipality of Corbola (RO). The upcycling of the Dutch work, starting from the total reuse of the exhibition panels, has determined a new plan layout with the aim of enhancing the archaeological route of the Via Popilia, an important Roman road that from the colony of Ariminum (Rimini) passed through Ravenna until it reached Aquilea. This is one of the initiatives that is part of the larger MePart pilot-program, completed in the year 2022 by the start-up Heritage Asset Management SBRL, a spin-off of the IUAV University of Venice (iuav.it).In line with the European Green Deal, the aim of the program is to promote the transition to a circular economy by focusing precisely on the sector of ephemeral installations; specifically, the intent is to reuse temporary set-ups and structures produced by major cultural events through a networked platform, re-introducing their waste into the Veneto region to promote urban regeneration actions aimed at improving the quality of public space.
Still on the subject of large events, the Expo management, on the occasion of the 2015 edition hosted in the city of Milan, issued guidelines to direct the sustainability of the pavilions; these guidelines covered various aspects: from design to land and energy consumption, from the use of sustainable materials to the planning of their decommissioning and eventual reuse.
Many countries have been virtuous in following these guidelines, so much so that most states have since reused the exhibition facilities elsewhere. Interesting examples include the Munich Pavilion, which was relocated to Burkina Faso to become the headquarters of the Red Cross in the city of Loumbila; the Bahrain

ReBiennale
website, homepage.
(Source: rebiennale.org)

Pavilion, built of prefabricated concrete panels, which was then returned to its homeland and transformed into a botanical garden; and the Austria Pavilion, consisting of a veritable forest of more than 12,000 trees, which saw the donation of the largest plants (over 15 meters in height) to the municipality of Bolzano, which thus greened a suburban area of the city. The building that housed the Italian Pavilion, on the other hand, was the only one designed from the outset to remain permanent after the World Expo; thus in 2019 it became the headquarters of the institutional headquarters of a new research hub, the Human Technopole, which conducts studies on the human genome and will be completed before 2026 (humantechnopole.it).

The examples briefly given here demonstrate, therefore, how much in contemporary design attention is emerging as a priority the issue of reversibility of structures, reuse of resources, and after-life planning of built artifacts.

These are choices that pander to a green design, which interprets the product as something that, while temporary in its momentary use, actually finds greater durability over time by changing its intended use or relocating to another fruitive context, without ever having to be truly decommissioned.

CONCLUSIONS

The analysis conducted shows how the contribution induced by the emergence of reuse and recycling processes in the outfitting sector goes beyond an exclusively environmental sustainability, also encompassing the social, cultural and economic spheres. It can be seen that, depending on the case, these practices are applied both to the entire exhibit and to the individual elements that make it up (the furniture products, exhibition devices such as structural components): this is the same approach, but at different scales.

Moreover, the selected case studies show how, although efforts toward integrated sustainability are growing, in most of the mapped cases initiatives still remain episodic and, often, privately driven.

Finally, consider that the recycling and reuse practices analyzed retain wide margins for implementation: they can still be enormously innovated, with more effective, replicable and scalable solutions. Unfortunately, precisely within the discipline of exhibit design, no particular innovations can be detected at the strictly design stage; in fact, research has shown that solutions are almost always found in the post-consumer, in an often emergent situation, and rarely at the initial ideational stage of the exhibit itself. It is necessary, therefore, that the design also move in the direction of sustainability, whether it be of the production process, the components or the behaviors they trigger (Tamborrini, 2008). To foster this attitude, reference could be made to the typical approach of Life Cycle Design (LCD), which is the design of the life cycle of an artifact that is based on the control, at the design stage, of the entire system: from the extraction of raw materials, to decommissioning, to the evaluation of inputs and outputs (Keoleian, G. A. 1993). Specifically, this approach takes into account a number of fundamental design principles: the selection of non-toxic materials and energy sources on the one hand, but also those with less exhaustibility/major renewa-

bility on the other; the design of artifacts that last over time and are used intensively and regularly; the design in function of the valorization of the asset through recycling or composting of its components; and finally, the design by disassembly/separation of parts (Vezzoli & Manzini, 2007), paying attention to the modularity of systems and their junctions.
Until this change of course takes place, there can be no truly closed-loop systems and, therefore, genuinely sustainable exhibits, while it is precisely the discipline of exhibiting-because of its temporary dimension and limited horizon-that is urgently required to adopt pervasive recycling and recovery strategies capable of founding a new sustainable paradigm.

Notes

1- Refer to the cultural statistics extrapolated from the Istat data tables, id:239547, for which: in 2018 participation in large cultural events recorded a slight increase compared to 2017, going from 64.1 to 64.9 percent, with a growth concentrated among those who declare having participated in more than four events in the last 12 months (from 23.2 to 24.5 percent). The increase observed is mainly driven by visitors to monuments and archaeological sites (up by two percentage points compared to 2017) and by those who attended concerts of music other than classical music (up by 1.4 percent). In 2018, there were 494 museums, monuments and state archaeological areas open to the public in Italy: almost one institute (0.8) for every 100 thousand inhabitants. Visitors recorded an increase of 5 million presences, going from over 50 million in 2017 to more than 55 million in 2018, with an increase of approximately 10 percent compared to the previous year (istat.it).

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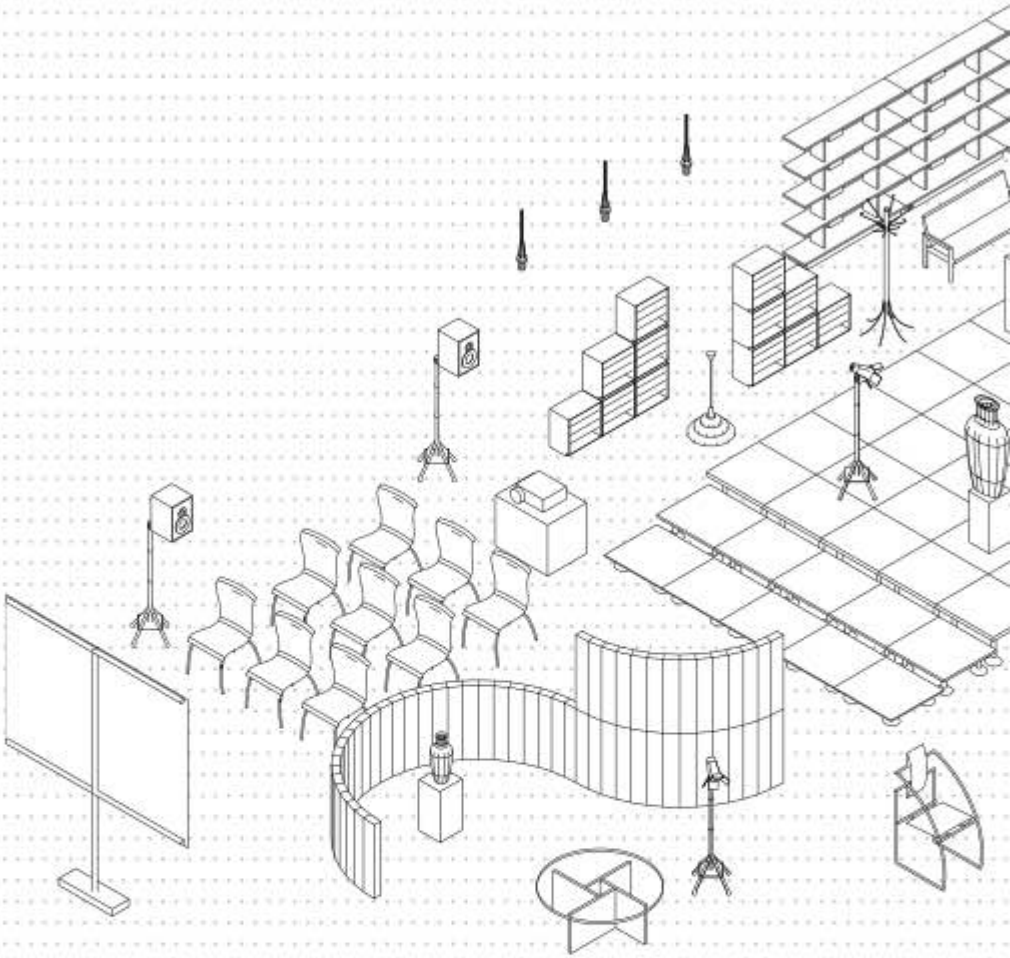
NUOVI MATERIALI



4

THE DIGITAl SUSTAINABIIITy

Synergies between digital transition and exhibition design for sustainability

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THE DIGITAI SUSTAINABIIITy

Synergies between digital transition and exhibition design for sustainability

m. Cason villa, D. Crippa, C. Digiorgio Giannitto

The concept of ecological transition has been known for some time, but especially in recent months it has become central to cultural and scientific debate. Mentioned even within the National Recovery and Resilience Plan (NRP), certainly the topic represents a great challenge and at the same time an opportunity for Italy. It is generally believed that the ecological transition involves the transformation of the production system towards a more sustainable model, with less harmful impacts on the environment. What is surprising, however, is how, in the broad discourse regarding environmental sustainability, the technological dimension is rarely contemplated and, in fact, a split between ecological and digital transition seems implicit, as if one were not instead inseparable from the other. This is all the more unexpected when one considers the problem in relation to the field of exhibit design, a traditionally hinge disciplinary field, where more than ever these two dimensions must instead follow a single direction.
Referring to the recent European Commission report *2022 Strategic Foresight Report. Twinning the green and digital transi-*

tions in the new geopolitical context (European Commission, 2021), we can see how digital and ecological transitions now appear to be two inseparable challenges: the report highlights how the former can ethically steer the opportunities of the latter and how the latter, on the other hand, can become a key tool to trigger processes that would otherwise be slow to activate, making them more pervasive and more performant (Floridi, 2020).
E lawful, then, to question the possible synergies between exhibit, ecological transition and digital, reading them in terms of energy sustainability: in a problematic geo-political context such as the current one, not even the world of exhibits can escape a redefinition of meaning, developing replicable process models with minimal environmental and economic impact. At present, the exhibit industry still struggles to combine digital innovation with design sustainability, offering few opportunities for circularity for manufactured exhibits: exhibition events, especially large-scale ones, often result in significant pressure on the environment and a huge consumption of energy and resources, the impact of which is maximized by concentration in a short period of time (Shen, 2012) and the consequent rapid reduction in the value of the material. Although there is an increase in the promotion of sustainability values conveyed by design, still few cases have adopted good tools to concretize these values into reiterable design solutions. It is precisely on this deficiency that the digital can act, offering a scenario for innovation and implementation of practices that are currently episodic: the technological component can (and must) find a more synergic dimension with the design, helping to guide the initial design choices, facilitate their reuse and plan the after-life of the manufactured objects, modifying, in perspective, their system of values. Addressing the issue in pragmatic terms, at least two different operational dimensions peculiar to digital applied to exhibits emerge: the first, in which digital itself appears to be an exhibition tool, capable of dematerializing the physical component of exhibits and thus lowering their cost, waste and environmental impact; the se-

cond, in which digital instead becomes functional to the process that precedes and follows the exhibit, supporting its tangible and intangible infrastructures (e.g., by fostering relationships among the network of actors, sharing the pool of materials to draw on, implementing prospects for reuse and recycling). In this second scenario, the digital dimension fosters the structuring of a kind of "sustainability platform," leveraging its ubiquity to act at the systemic level.

In the face of these multiple opportunities, the chapter aims to answer some questions: why are we differentially talking about an ecological and a digital transition? How is digital being used in settings? And how can the digital and ecological dimensions dialogue in order not to fall into simple ***engagement*** logics? Finally, is it possible to outline a paradigm shift, devising strategies that can capture the changes taking place, so that exhibition structures are more adept at embracing the opportunities of this dual transition?

THE ROI E OF DIGITAI IN EXHIBIT INNO vATION: CASE STUDIES

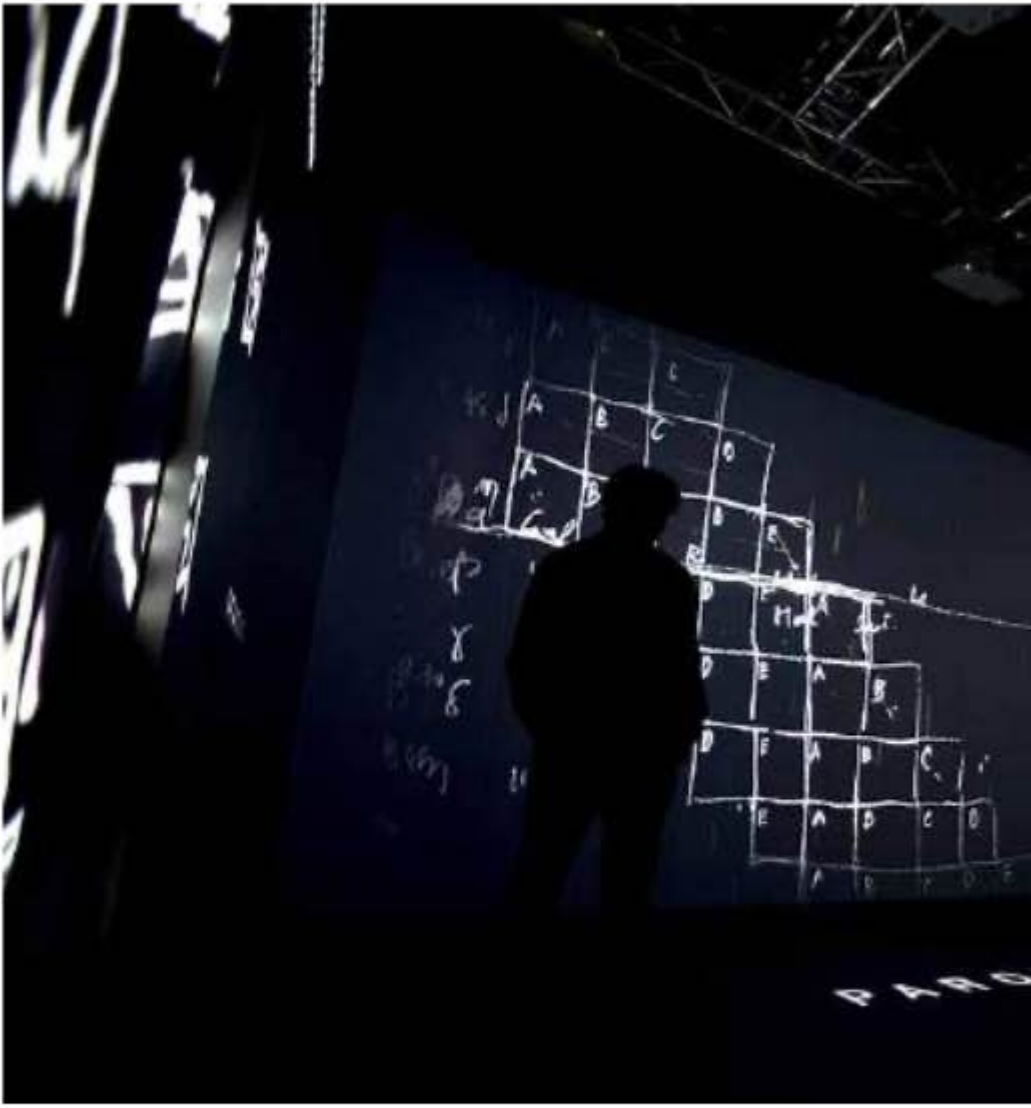
Questioning the role that digital can play in exhibit design innovation, it may be useful to recover its definition as, "at the same time, a tool and a generative actor of change processes" (Epifani, 2020, pp.31)

With this definition we refer to a distinction between two dimensions peculiar to digital: the first is vertical and specialized, expressed by the concept of 'digitization' and strictly related to technological innovation, while the second is more transversal and systemic, linked to the paradigm of 'digital transition' and connoted by an economic, psychological and social valence. The issue, more than a semantic game, is crucial to address with a broad vision the specific scope of digital technology, which makes it able to relate to an increasingly diverse range of disciplinary fields (Bloomberg, 2018), thus useful not only in the fields of research, but also and especially in those of practical application such as industries and businesses (Ciancia et al., 2019). In

particular, in the field of sustainability, a conception of technology freed from the more 'technical' aspects may be the key to answer the doubts that highlight the criticalities (Caffo, 2022), if not the impossibility, of a marriage between "the green and the blue" (Floridi, 2020).
Tracing this reading, it can therefore be argued that digital can relate to the exhibit design sector in at least two ways: a first in which it is a vertical tool that puts the innovations of technology at the service of the exhibit experience, and a second, in which it instead becomes a transversal actor in the processes of change, their trigger and support.
Synthetically, digital can thus represent both a "sustainable tool" and a "dimension of sustainability."
In the first case, as a sustainable tool, technology can make a contribution to the dematerialization of the physical component of set-ups, with a significant impact on waste and waste reduction (Ahmed et al., 2020).
In the second case, as a dimension of sustainability, in its pervasive and horizontal sense, digital can become a mediator of content, either by providing the experiential component of an exhibition-event with new tools (capable of ensuring greater inclusion and accessibility to different targets), or by conveying information through different media, or by sharing it remotely and in open-source format (Cirifino et al., 2011). In this second scenario, the digital dimension favors the structuring of a kind of "sustainability platform," taking advantage of its ubiquity to act at the systemic level.

Digital as a sustainable tool: the dematerialization of exhibition artifacts

As a reversible and provisional practice, staging can benefit from "light" apparatuses such as those inherent to digital to cope with often extremely tight implementation timelines. Although this has already been abundantly proposed over the years, it is necessary to read the initiative from a sustainable perspective: the dematerialization guaranteed by digital allows a reduction in production, installation and dismantling costs, eliminating the



SPACE, TImE, WORD
exhibition held at RovelloDue - Piccolo Spazio Politecnico, at the Piccolo Teatro in Milan.
(Source: @Ghigos Ideas)

GOD IS NATURE
AR installation by Claudio Vittorio, widespread exhibition "Leonardo's exhibition", National Museum of Science and Technology Leonardo da Vinci. (Source: www.artribune.com)

problem of waste and waste caused by site-specific exhibition artifacts that are difficult to reuse; in general, such dematerialization of the "exhibition container" minimizes its impact, eliminating most of the physical exhibition structures (Ahmed et al, 2020) and thus inducing significant savings in economic-environmental terms.

Taking this approach, the Rovello-DUE space, Piccolo Spazio Politecnico, has been set up several times since 2016 in Milan, hosting a review of different exhibitions with a strongly immersive and technological character, almost giving up physical supports.

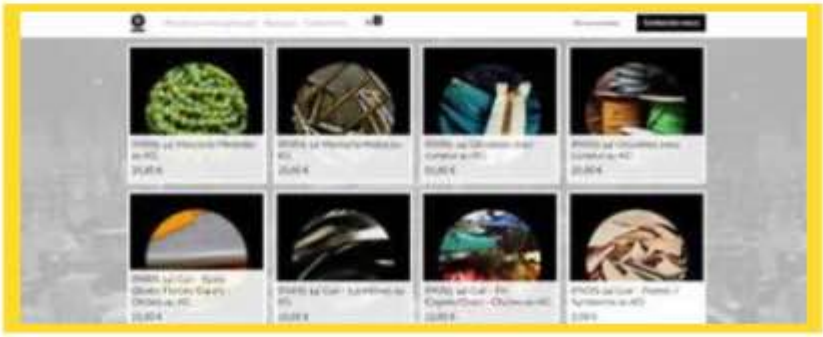
Taking this approach, the Rovello-DUE space, Piccolo Spazio Politecnico, has been set up several times since 2016 in Milan, hosting a review of different exhibitions with a strongly immersive and technological character, almost giving up physical supports. It is a small environment created to promote the culture of theater and scientific research: the space hosted various exhibitions with the aim of telling the so-called "Italian stories" in an informal, engaging and easily understandable way to a plurality of audiences, opting for the design of interactive exhibition experiences, played on video interfaces and digital surfaces capable of entirely enveloping the space, but also able to ensure a simple and inexpensive transformability of the environment. For each exhibition, hybridizations were staged between recognizable physical environments and interactive environments-responsive

to visitors' external solicitations through various technological devices integrated into the exhibition (lecterns, models, etc.)-in order to create immersive, playful, and narrative spaces (Valerio, 2015).

Also pursuing this practice of content dematerialization was the exhibition The Vision of Leonardo (2022), created by the Museum of Science and Technology of Milan in collaboration with Bepart. The goal of the exhibition was to develop a new exhibition technique starting with augmented reality technologies aimed at expanding the museum space and offering innovative experiences to visitors. The initiative involved the deployment in different public places in the city (including the Sforzesco Castle Square, the Darsena and Gae Aulenti Square) of eight digital installations with three-dimensional audio and video animations, created by artists from the contemporary scene and usable through a specially designed smartphone app (Maidà, 2022).

These projects are just a few of the countless ones that could be mentioned and that are shifting exhibition fruition to RV and AR: thanks to the use of technological devices-from online platforms to apps integrated with traditional exhibition supports-digital expands communicative possibilities, expressive languages, and the ability to convey even complex concepts in an immediate way, as well as opportunities to extend exhibition fruition to different targets, with a view to increasing inclusiveness. In particular, the opportunities

LA RESERVE DES ARTS
website, Marketplace Vitrine Paris.
(Source: www.lareservedesarts.org)



META Space
headquarter in Bovisa neighborood, Milan.
(Source: @Massimiliano Cason Villa)

conveyed by digital technologies in terms of innovation of fruition and ability to attract audiences are evident: interactive and immersive experiences greatly increase the participation of, for example, younger people, who are naturally closer to the ***tech*** dimension and less inclined to approach more traditional exhibitions.
However, technological devices are powerful magnets of interest, but by themselves they represent tools for their own sake: it is important that the digitization of content, artifacts, and processes put in place to manage digital resources be guided so that the digital transition does not remain a sporadic action involving only the communicative dimension, with no chance of becoming truly relevant (Chiocca, 2018).

Digital as a dimension of sustainability: programs, practices, experiments

In some landmark ***best practice***s, digital has already shown that it can support the establishment of platforms that can mediate the relationship with other sectors, acting at a systemic level and with an interdisciplinary gaze to identify, and solve from a sustainable perspective, certain problems intrinsic to the display system. For example, in 2008, the project La reserve des arts - pour une création circulaire et solidaire was developed in France, a program that encourages circular economy practices by taking

Non Si Butta Via Niente
website, sharing platform.
(Source: www.nonsibuttavianiente.it)

advantage of a digital platform that exclusively sells recycled materials (Moro, 2021). The model was replicated in 2021 by Spazio META in Milan, a fee-based take-back service for materials and structures used for sets, exhibitions, and installations, which thanks to Meta are collected, reprocessed, and finally displayed for sale to the public (per kg or per piece) with fees that vary according to the material's state of preservation.

Finally, a more experimental experience among those that exploit the potential of digital to suggest new practices of use is Non si Butta Via Niente, the first intra-museum platform for the reuse and recycling of exhibition resources usually destined for disposal. Proposing itself as a possible solution and an embankment to the waste typical of museum displays-temporary and often lacking end-of-life planning-the project turns the problem on its head by transforming it into an opportunity to "do more, with less, and better" (NSBVN, 2022), with the positive side effect of making museums more inclusive and more conscious about the use of their resources. The platform was launched in May 2022 by the innovative start-up and benefit company of the same name, born from Cariplo Factory's ***Innovamusei*** incubation program and winner of the related call for proposals promoted by Regione Lombardia, Unioncamere Lombardia and Fondazione Cariplo. In detail, the solution proposed by the start-up configures a museum ***sharing*** service that pools all the resources wa-

sted by museums thanks to a first inventory platform dedicated exclusively to exhibits. The project, however, represents not only an infrastructure for storing and sharing materials from fairs, exhibitions or sets, but in the future intends to become a true sustainability observatory, leading to the dissemination of new and best practices at the systemic level. Among the activities initiated or planned, many act on the themes of circularity, fostering a conscious use and consumption of museum resources: an abacus of materials produced from scraps and waste has been created; an exhibition-manifesto on the new aesthetics of sustainability is being planned; and the first experimentation center for research, conception and production of exhibits in recycled, recyclable and sustainable materials is being structured.
Waste material thus finds a new conscious meaning within this ambitious "service of culture," under the banner of ecological responsibility and sustainable and inclusive design. With Non Si Butta Via Niente (Nothing is Thrown Away) the numerous, often even prestigious, installations proposed by cultural institutions can thus continue to live on, first shared and systematized in a circuit of mutual exchange, then transformed into new resources and finally destined for new uses in a virtuous process of creative regeneration. Davide Crippa, Iuav designer and lecturer and one of the founding partners of the start-up, emphasizes, "the spin-offs of Non Si Butta Via Niente are innumerable and act on multiple levels as the network supports museums in the design of exhibitions and displays with the least possible impact on the environment, embracing aspects of sustainable tourism, inclusion, accessibility and museum education. Thanks to the support and example of Triennale Milano we will accompany the museum system on a path of renewal and attention to the environment" (Crippa et al., 2022). In this way, the project welcomes and concretely translates into the exhibit sector the vision of a "permanent platform of innovation [that] offers the greatest number of additional components, resources to recycle and raw materials to regenerate" (Carta, 2021).

The aforementioned initiatives, which, albeit in different ways, involve the introduction of digital into the management dynamics of exhibit design processes, foster new organizational dynamics and cause cultural institution leaders to rethink and reinvent their mission, but also their strategy and the very way in which they relate to the public, pursuing multi-sectoral and multidimensional innovation. At the same time, through the synergistic use of these technological tools, the reduction of bureaucratic paperwork, the creation of a network capable of linking different actors, public and private, to each other, the creation of open circular systems and the involvement of different professional figures, called upon to interact and structure interdisciplinary collaborations, are encouraged. In sum, these initiatives seem to represent a good model of mutually beneficial cohesion between digital and ecological transition.

CONCLUSIONS

In conclusion, it is important to reiterate how digital transition cannot be approached separately from ecological transition (and vice versa). It is ultimately a matter of accommodating in its breadth and complexity the extended concept of sustainability. Indeed, as is well known, it is a term that is difficult to bring back to the domain of a single discipline, but rather one that takes into account multiple dimensions simultaneously: the environmental, the social and the economic first and foremost. A number of scholars, including the aforementioned Stefano Epifani (2020), Matthias Stürmer (2014) and Ilaria Guandalini (2022), have added to this established interpretation an additional dimension, precisely the digital one, by foregrounding sustainable design that includes the use of information technology. The latter is understood as a necessary means to achieve sustainable goals, creating an inseparable relationship between the aforementioned dimensions, thus understanding sustainability as an "ethical horizon" capable of directing the possibilities of technology, and

Design Differente
the horizontal Fablab on circular economy issues (Source: @Davide Stanga)

digital as a capillary tool fundamental to its development.

Even in the outfitting sector, therefore, digital can produce decisive innovations that result in responsible solutions, improving the ecological impact of this strategic sector, minimizing the damage to the environment caused by unconscious design choices and spreading in society a common sense of respect for what surrounds us.

Alessandro Baricco, in his book ***The Game*** (2018), further reminds us that "technology alone is neither solution nor experience, but it can generate a movement for the attainment of solutions to problems"; digital, therefore, is to be exploited as an "enabler," because it precisely enables an experience or triggers a possibility. If there is much emphasis on its potential in the contemporary debate, it is because the digital paradigm is commonly recognized as an evolutionary opportunity for overcoming traditional models of management (including exhibition mana-

gement): sustainability, privacy, simplification of bureaucracy, continuity, and circularity are concepts that must necessarily accompany toward a new definition of an exhibition system. Moreover, the implementation of digital features within the exhibit allows for more efficient processing of information, increased educational resources, and increased interactive potential (Stuto, 2022).

Finally, it seems clear that, in the face of a proliferation of different (but currently episodic) applications to support existing systems, the future of exhibit design will play out in the convergence of multimedia designs, digital platforms and new ***engagement*** strategies, but it will be the task of designers, event organizers and museum managers to build an increasingly close dialogue to converge the emerging needs related to the preservation and enhancement of resources with the technological opportunities of the contemporary.

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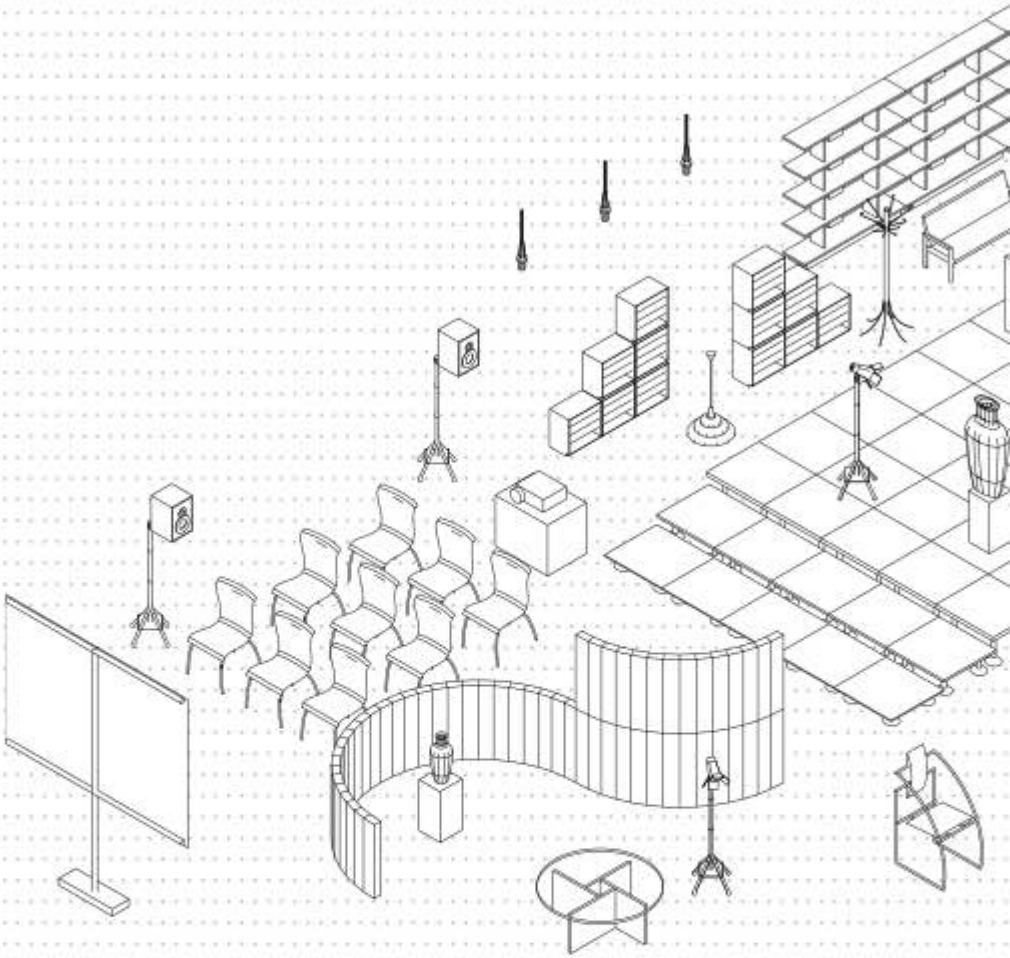
www.nonsibuttavianiente.it

www.lareservedesarts.org


STEP 2


STAMPO
ESTRUSORE
TRITATA



5

PROCESSES AND MATERIAIS FOR A NEW ECOIOGICAI AWARENESS

The construction of a new ecological sensitivity

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PROCESSES AND mATERIAIS FOR A NEW ECOIOGICAI AWARENESS

The construction of a new ecological sensitivity

C. Digiorgio Giannitto, D. Crippa, m. De Chirico

"Materials continue to be a wonderful topic of conversation and focal point of discussion about how our physical environment and its contained products were, are, could-and should-be".
(De Giorgi et al., 2020, p.11)

The ever-increasing attention to the impacts of production chains on the environment makes it essential to explore the opportunities offered by innovative materials, defining design methods and tools to build processes of transition to a circular economy, in which the understanding of the technical and expressive value of the materials themselves determines a more sustainable use of resources (Bak-Andersen, 2021). The search for a paradigm shift thus leads to considering materials in their integrity, paying attention to how they can enter circular life cycles; this, consequently, has caused the demand for all those materials

that could be understood as sustainable or circular to increase (Clèries et al., 2021). In this way, the as yet unexplored potential opportunities of raw materials and related production waste can be made explicit (Paoletti, 2021). The contemporary challenge is, therefore, to pursue a new technical culture that overcomes past consumerist logics, ephemeral needs, and the exaggerated reproducibility produced by an industrialism without any symbolic, expressive and ecological qualities (Ruffilli, 2010).
From this perspective, the discipline of design assumes a central role in the experimentation and dissemination of new production models aimed at recovering value from resources and energy through thoughtful design choices, becoming a strategic element in moving from a linear to a circular model (Ellen MacArthur Foundation, 2015). Thus, not only quantity but also quality of inputs - the starting point for possible future uses - should be explored by relating different production chains and remembering how necessary it is to think about waste upstream of design activity, thus anticipating the use of what is called "remainder" (Paoletti, 2021).

The operational scope of the discipline of design contemplates, among its many fields of application, the field of exhibition design, which makes an important contribution both as a means of communicating the values of sustainability and circularity and as a tool for developing sustainable choices in environmental, social and economic terms thanks to materials and processes that influence the realization of an event, booth or exhibition. Exhibition design can become an opportunity to experiment with new materials and technologies and "to put into practice all those criteria linked to a relatively new design culture developing in the design world" (Brunelli, 2010, p. 13). A new generation of projects is thus encouraged with the aim of regenerating resources, materials and ideas without the need to resort to the "all new."
The planning of a staging in line with the principles of eco-su-

stainability should be guided by those selection criteria that Brunelli, in his book *Eco-Design for temporary exhibits* (2010), divides into three main areas: materials (renewable or biocompatible, recycled or recyclable, with no or minimal toxicity, aimed at reducing their use), energy (limiting the use and planning the consumption of energy resources), and durability (planning and identifying elements that can be reused in other staging or in different contexts).
In the text that follows, attention will be paid to all those materials used in the field of staging and in line, both in their composition and production, with these principles of eco-sustainability, with a particular emphasis on materials that we would define as "circular" (Pellizzari & Genovesi, 2021), that is, that are developed from elements that would otherwise have to be discarded. The aim of the paper, in summary, is to define how the outfitting sector reacts, can react, and can promote new models of design and planning that are respectful of the environment, society, and economic systems, and how the discipline of design can facilitate this same transition toward a new ecological sensibility.

FROm WASTE TO RESOURCE: SECOND-GENERATION mATERIAl S

Considering the design potential of production waste means reclaiming its significance as a material resource underlying the development of novel materials and applications (Frankiln & Till, 2019); consequently, rethinking "materiality" means adopting new forms of thinking and design that respect the environment, people, and economies.
Waste, today, captures so much attention because it can be enhanced instead of abandoned, adopting upcycling processes and improving its image, giving it additional meanings and giving it uses for a new life. Secondary raw materials (abbreviated as MPS) can be fed back into the economic system as raw

materials (European Commission, 2008): the material is thus no longer just the outcome of research aimed at improving its technical and functional performance, but becomes itself a matter of invention (Manzini, 1986) and a conscious ground for design (Ferrara et al., 2009). Therefore, it is crucial to explore the opportunities offered by those innovative materials obtained from the optimization and recovery of resources (Paoletti, 2021; Brunner, 2021), making it an optimum potential for the development of work involving different disciplines (De Giorgi et al., 2020; Wilkes & Miodownik, 2018). On the one hand, common resources can be fused to give birth to new materials; on the other hand, traditional materials are reinvented through the adaptation of certain production processes and are reinterpreted as second-generation materials with a strong social, relational, and cultural impact (De Giorgi et al., 2020). They are valorized and made into a new resource, but it is up to the designer to find the most suitable productive and commercial destination that can enhance their qualities.

In general, the ever-increasing number of experiences with which the design world is flanking research and experimentation related to the development of sustainable alternatives to classical materials outlines a future that seems capable of changing the profile of tomorrow's products. It is important to emphasize that it is not just a matter of developing new materials, nor of landing relevant and functional configurations, but rather of placing each innovation in a cultural framework, adopting new forms of connection and relationality (De Chirico, 2020). It is not enough exclusively to recover waste, then, because doing so would legitimize the linear model that produces it: the important task of design is to make the impact of informed collective consciousness become capital for design in balance with resources (Paoletti, 2021).

At the same time, new areas of research and design are emerging that, as Ingrid Paoletti (2021) suggests, can still be identified as ***genius materialis*** (Nardi, 1988), thus not only related to

the material component, but to a new awareness, to an imaginary that guides a response toward the looming threats induced by climate change and biodiversity loss.
In some cases, it is precisely the discipline of design that activates experiments in which designers-in the guise of alchemists and collaborating with other professionals (De Giorgi et al., 2020)- give birth to new (or rediscovered) materials, which are for this reason defined as ***design-driven*** (Doveil, 2020). The ground for experimentation comes from ***learning-by-doing*** activities in which new skills are developed and metabolized in the field and then become recurring approaches in materials development practices; this is a now-codified research scenario because, as Max Planck already recalled in the well-known ***Scientific Autobiography and Other Papers***, "experiments are among the few ways of knowing reality, the rest is imagination, or poetry".
(Planck, 1949)

NEW RAW mATERIAl S FOR EXHIBITIONS

In the strand of research inherent in exhibits for events, museums and temporary exhibitions, attention to sustainability is increasingly becoming a crucial element. In this direction, some exhibits, referring mainly to components made of recycled materials, refer to a reasoned design from a sustainable perspective, seeking a detachment from the dependence that the extractive economic model has had on materials of fossil origin. This trend is not new to the industry, just think of the cardboard that over the years has become a cult product and the origin of many design icons: a well-known example is the Wiggle Side Chair (1972), designed by Frank Gehry and made from about sixty layers of recycled pressed cardboard.
The expressive and functional possibilities of cardboard have also been enhanced by the Milan-based A4A Design studio, which since 2002 has been designing and producing objects and furniture made of exclusively recycled, recyclable and reusable

honeycomb cardboard, creating set designs, fittings for exhibition and commercial spaces, dining and entertainment areas, thus exploring the entire scale of extension of the material, from pocket-sized objects to macro-size. Application examples include Altea's showroom set-up for Milan's "Men Fashion Week" in 2017, based on a corrugated cardboard counter-wall (which defined the various areas of the space by delimiting the showcase) and a sequence of black honeycomb cardboard platforms, used as support for the collections and as a distinctive element of the project. On the occasion of the "Viscom Italia" trade fair, held in October 2016 in Rho (MI), the studio designed the stand for Bui Giordano, a leading brand in the cardboard and cardboard processing industry, making it entirely out of 155 honeycomb cardboard panels of various thicknesses and sizes. Additionally, to reinforce the message and make it persistent, visitors were also given a practical folding stool, also made of cardboard, as a gadget (a4a.com).

A few years after A4A's intuition, the Ghigos studio, employed recycled cardboard to set up the *Gesticolando* exhibition (2006), dedicated to reflections on gestures in various cultures around the world, in homage to Munarian research. Special seating-displays were made for the occasion, functional both as an installation element to support the photographs and as a comfortable seat to be used on that or subsequent occasions.
In the cases just mentioned, the material used is recycled, but not processed before new use, because it has been directly used in such a way as to enhance its technical qualities and intact performance capabilities that would have been unnecessarily wasted in the case of disposal. Today, however, there is a growing desire to experiment with and employ new materials, going beyond simple reuse; consider, for example, the interest in renewable and bio-compatible materials from production process waste, recycled individually or coupled with virgin materials (Brunelli, 2010).

Gesticolando exhibition
detail of the sitting display, and of the photographic exhibition which brings together 120 gestures from all over the world. (Source: @Studio Ghigos)

The selection of these must take into account certain key-factors to ensure that their use does not fall into ***greenwashing*** dynamics, but can actually improve the environmental performance of an exhibit. For example, Design with Nature, the installation designed by Mario Cucinella presented at the Milan Furniture Fair 2022, showed how there is already a way to build and make products "in complicity" with nature, activating virtuous sustainable pathways. The installation paid attention to the issues of circular economy, arguing that the city can represent the possible "reserve" of the future, where to find most of the raw materials useful for construction. The same author emphasizes that "the vision of the future will have to be ecosystemic and be able to link knowledge and technologies in a new generation of materials and design [...] with the ultimate goal of making life better through a newfound respect for nature" (Cortese, 2022).

Within this conceptual framework, some case studies deemed significant are presented in the following, divided into two macro-categories: second-generation organic-based and inorganic-based materials, following the distinction already adopted for waste disposal.

Organic materials

Organic-based materials, which until a few years ago were downgraded to synthetic materials, are now a viable alternative to traditional materials because they can provide effective technical requirements for a variety of applications. They consist of organic matter and can be derived from plant, animal or microorganism substances (Pellizzari & Genovesi, 2021). Also belonging to this category are all those materials obtained from the waste of agrifood processing, fish trade, livestock farms, etc., which today assume even more importance as the result of a recovery process in line with the principles of the circular economy.
Organic materials include the famous PLA, now widely used in 3D printing processes, pioneered in its first applications by Paolo Deganello for Canestra fruit bowls (paolodeganello.it). This material, also known as polylactic acid, is a thermoplastic derived from renewable sources such as corn starch, tapioca roots or sugar cane, created in the 1930s by American chemist Wallace Carothers. PLA offers the possibility of being coupled with multiple wastes or scraps, contributing to the development of new circular materials: this is the case of the project developed by the company Felfil with Carlo Ratti Associati, Feel the Peel, a compound for 3d printing obtained through the drying and processing of orange peels, which from a very fine powder become filament for the production of new objects and components. Felfil has since initiated other similar experiments using organic waste - for example, exploiting the potential of mussel shells to obtain a filament consisting of about 20 percent shell powder, or regenerating ground coffee - again combined with PLA (felfil.

com).
Another interesting example in this regard is Ottan, a project by Turkish designer Ayse Yilmaz, who has created a collection of materials made from a process of transforming green organic waste (e.g., fruit peels, expired plant products, grass clippings, and leaves) and then used to produce furniture, partitions, walls, and building components. The start-up founded by Ayse Yilmaz for this purpose thus succeeds in harnessing the potential of plants, leaves and food waste that would otherwise have no other use, offering design professionals a credible and more sustainable alternative to wood and stone derivatives.
The importance of recycling and the value of transformation are extolled, in a less usual but not unbrilliant way, in the Piacenza countryside by artist and cow farmer Gian Antonio Locatelli, co-founder of the Shit Museum. The museum, through a series of installations, promotes interesting reflections on the theme of transformation, reuse and metamorphosis, in order to emphasize the intrinsic qualities of substances capable of regeneration, manure in primis. The latter in particular became the subject of historical and technological research in the Merdacotta project, a material obtained from cattle manure and processed as if it were terracotta, which enabled the creation of an unprecedented line of vases, tiles and tableware, winning the Milano Design Awards in 2016 (Montagnoli, 2019).

An important exemplification of this kind of research, specifically applied to the field of staging, can be found in the project for the exhibition "Unknown Unknowns," conceived by Joseph Grima of Space Caviar and realized in collaboration with Wasp for the XXIII International Exhibition of La Triennale di Milano (July 15-December 11, 2022). It is an installation that was created directly in the spaces of La Triennale through the 3D printing technique by employing "RH400-3D," a material patented by the Piedmont-based company Ricehouse (which specializes in the production of building materials of organic origin) largely derived

from by-products of the agribusiness industry. "RH400-3D" is a premix based on natural clay from rice fields, obtained in combination with rice husks and straw. Thanks to this project, for the first time an exhibit is entirely printed on site via 3D printer, with organic materials.
The approach proposed by Space Cavier in the exhibition represents a valuable research opportunity for those involved in exhibits, opening up wide-ranging reflections with repercussions that have not yet been fully explored on possible alternatives to the use of materials that are difficult to reuse (think, for example, of classic plasterboard), thus preventing the exhibit from becoming a huge pool of waste and refuse production (triennale.org).
Another material suitable for 3D printing technology was born within the laboratories of Formfutura, a renowned manufacturer of additive printing materials, and finds various forms and declinations within the EasyWood range. The latter identifies a family of filaments based on PLA and wood fibers (for about 40 percent of the total compound), which has a lower environmental impact than other thermoplastics derived from fossil fuels. A similar material has been produced by Emerging Objects' spin-off, Forust; the 3D Wood line, composed of lignin discarded from the wood industry and paper mixed with biopolymers, is designed to be 3D printed and allows for the creation of panels, components, furniture and structures. A further example is PaperStone, an environmentally valuable material made from 100 percent recycled, FSC®-certified paper and cardboard with the addition of plant resin and natural pigments. Its environmentally sustainable composition has earned it major environmental certifications, including the Forest Stewardship Council. Paperstone is not only an innovative material produced in a socially responsible way, but thanks to its technical characteristics it also guarantees high performance, proving durable and suitable for various uses (sadun.it).
Finally, within the Milan 2022 Salone a company has made sustainability a real narrative: it is Nanimarquina, a Spanish carpet

manufacturer that in its stand has created an exhibition devoted to transparency and sustainability. In fact, the stand, designed by ARQUITECTURA-G, embodied a new way of looking at waste and was divided into two different spaces: the main one formed by leftover wool accumulated in the workshops of Indian suppliers, and the secondary one that housed the new collections. Within this space, the brand also presented the Re-Rug project, an initiative born from a research process aimed at recovering waste wool and creating a new yarn suitable for carpet weaving. Each Re-Rug uses 1 kg per square meter of reprocessed wool, making a positive contribution to waste management.

Inorganic materials

In this group can be distinguished both classic recycled materials such as glass, metals, plastics, synthetic fabrics, and materials from waste that, through process experimentation and suitable transformations, re-enter the production process.
Within the manual ***Exhibition. Eco-design for Temporary Exhibits*** (Brunelli, 2010) some circular inorganic neo-materials have been suggested for use in the exhibit sector; among them is FlekPure by 3Form, a 100 percent recycled material aesthetically inspired by Venetian terrazzo. It is made from the scraps of Varia eco-resin (produced by the same company), material samples and other production waste, and is suitable for multiple applications, including panels for construction and decorative use.
Among the other players in the neo-material family, plastics take on a decidedly important role, which, despite being demonized over the years because of its difficulty in disposal, through recovery and reuse now takes on new values. The Carrara-based company Bencore is acting in this direction, for example, with Wasbottle, a material obtained by recycling plastic discarded from daily use and developed in collaboration with Autogrill, the world's leading operator in traveler food services. This material comes in three main variants, one made of 100 percent recycled

and recyclable HDPE, the other two of 100 percent recycled and recyclable PET, which are ideal for producing furniture complements and partitioning elements.
The Vitra Design Museum also addressed the theme by presenting in the year 2022 the exhibition ***Plastic: Remaking Our World***, in which the highlights of plastic production were traced (Braga, 2022). A satellite exhibition in the Museum's gallery further brought visitors' attention to the topic of recycling this material by presenting the "Precious Plastic" project, initiated by Dave Hakkens in 2013, (designdiffusion.com) which illustrates how plastic waste can be easily reintroduced into the production chain generating new value. Also noteworthy is the Schaudepot Lab, a study and research center on techniques and materials located within the Museum's new exhibition building where, among many other things, a material library set up with "thematic drawers" about sustainability and new material trends can be consulted, offering visitors the chance to explore and experiment with the novel possibilities of materials. Also housed within the laboratory is an exhibit by Material ConneXion Italia, a major research and consulting network on innovative and sustainable materials (archiproducts.com).

Finally, between June 4 and 5, 2022, inside the Milan Triennale, the start-up "Non Si Butta Via Niente" Portamateriali presented an exhibition-workshop, born from the partnership between the start-up and the Triennale, which integrated the educational and exhibition dimensions to let children discover the secrets hidden in the samples of neo-materials, but also to bring them closer to objects and experiences of use related to them. Specifically, the samples shown were obtained from the collection of plastic waste processed at the neighborhood scale, which, through their texture, denounce the sign of past uses. On site, as a workshop and experiential activity, pawns and dice were also made together with the children themselves to be used for some board games designed for the occasion.

THE TOY FACTORY
details of material samples, checkers and board games.
(Source: @Non Si Butta Via Niente)

Another example of circularity with inorganic materials is the Design Monument, created by the cultural association "La Repubblica del Design" in 2019 and composed of fruit crates discarded by Bovisa (MI) merchants. As part of Milan Design Week 2022 and still in the territory of Municipality 9, the ***Da Cosa Nasce Cosa*** project, on the other hand, made it possible to place in the public spaces of the neighborhood small artifacts derived from the assembly of exhausted beer kegs (e.g., those recovered thanks to the collaboration with Carlsberg Italia), the recovery of plastic caps, and the regeneration of surgical masks as well as bottles. The project thus pursued the experimentation of new production processes on plastic materials in order to create useful goods for the community (mainly street furniture), encouraging recycling.

mATERIAl S AND RE-mATERIAl S IN THE AFTERmATH OF THE EXHIBITION: DURABIl ITy AS A CRITERION FOR SUSTAINABI E CHOICE

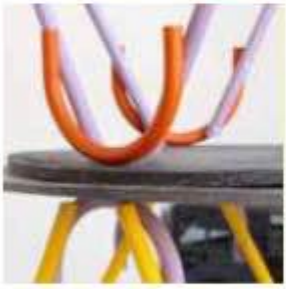
Materials research has always been recognized as a relevant area of investigation for design: new materials often determine new ways of designing, producing, and even living, generating a great impact on society (Drazin & Küchler, 2015). As we have analyzed, the choice of a material depends on the peculiar needs of the project, but looks at the entire planning process: the designer's task, therefore, is not only to choose "sustainable" materials, but also to verify that the components comply with rules

and best practices for the reduction of resource consumption, to prefer production processes that minimize waste and scrap, and to plan for their reuse or disposal. All this is also reflected in the world of fittings, which become both a means of information and a tool for reflection around the themes of sustainability and circularity, as well as a field of experimentation for the definition of new, more environmentally friendly solutions. Research has shown, in particular, a growing attention to these issues, which is gradually leading to an increasing use of fittings made of second-generation materials.

A further element that must be taken into account as a criterion of sustainability is the durability of the material; in fact, it is important to activate a virtuous supply chain that allows the raw-second material used to be able to be used even after the exhibition (not necessarily within the same sector, but, for example, in the world of construction, design, or in contiguous sectors).

Although in recent years design for "short time" has governed logic and the market from an economic and business perspective, today an undeniable trend concerns attention to the "long time" of things (Bassi, 2013). This implies a different methodological approach and induces a number of reflections to be considered: for example, cardboard, a sustainable material par excellence, being perishable and susceptible to weathering is not an integrally sustainable choice. Likewise, the role and value of plastics - demonized for years - should probably be reconsidered, since they are capable of being recycled an infinite number of times (think thermoplastics) while not losing their technical and performance capabilities. In short, the evaluation of a material cannot consider solely whether it is "environmentally friendly," "natural," or "biodegradable," but the environmental impact inherent in the various stages of its life cycle-from raw material recovery to manufacturing processes to its disposal, recovery, or remanufacturing-must be taken into account by adopting a "cradle to cradle" approach (Braungart & McDonough, 2022).

Asking these questions really means designing in balance with



Da Cosa Nasce Cosa
details of projects exhibited in the RoGUILTLESSPLASTIC exhibition, National Museum of Science and Technology Leonardo da Vinci, MDW 2021.
(Source: @Ghigos)

resources, aiming for overall system sustainability in the broadest sense of the term.

CONCI USIONS

In temporary exhibition design, it is not the best result achievable with the least effort that counts, but the effectiveness of the project itself that prevails: the ability to produce the desired effect and results throughout the entire design and implementation process, which also include the "after temporary use," that is, the after-life of the exhibition artifact.
As has been demonstrated through this discussion, there is now a clear desire in the fields of design and research to solve and curb such a concrete problem as overproduction and waste of resources in the world of outfitting. This is leading to the development of best practices at both the design and communication levels, with solutions that aim to engage the consciousness of the viewer, clients, suppliers, and all those involved.
The tendency to move beyond the "production/use/disposal" model in favor of the more contemporary "production/use/reuse" model is thus increasingly evident, in a virtuous perspective of sharing, defending and enhancing resources, energy sources and the ecosystem within which design is done (Ruffilli, 2010).

Carlsberg Bar
detail of the Carlsberg counter, set up for the RoGUILTLESSPLASTIC exhibition, National Museum of Science and Technology Leonardo da Vinci, MDW 2021. (Source: @Ghigos)

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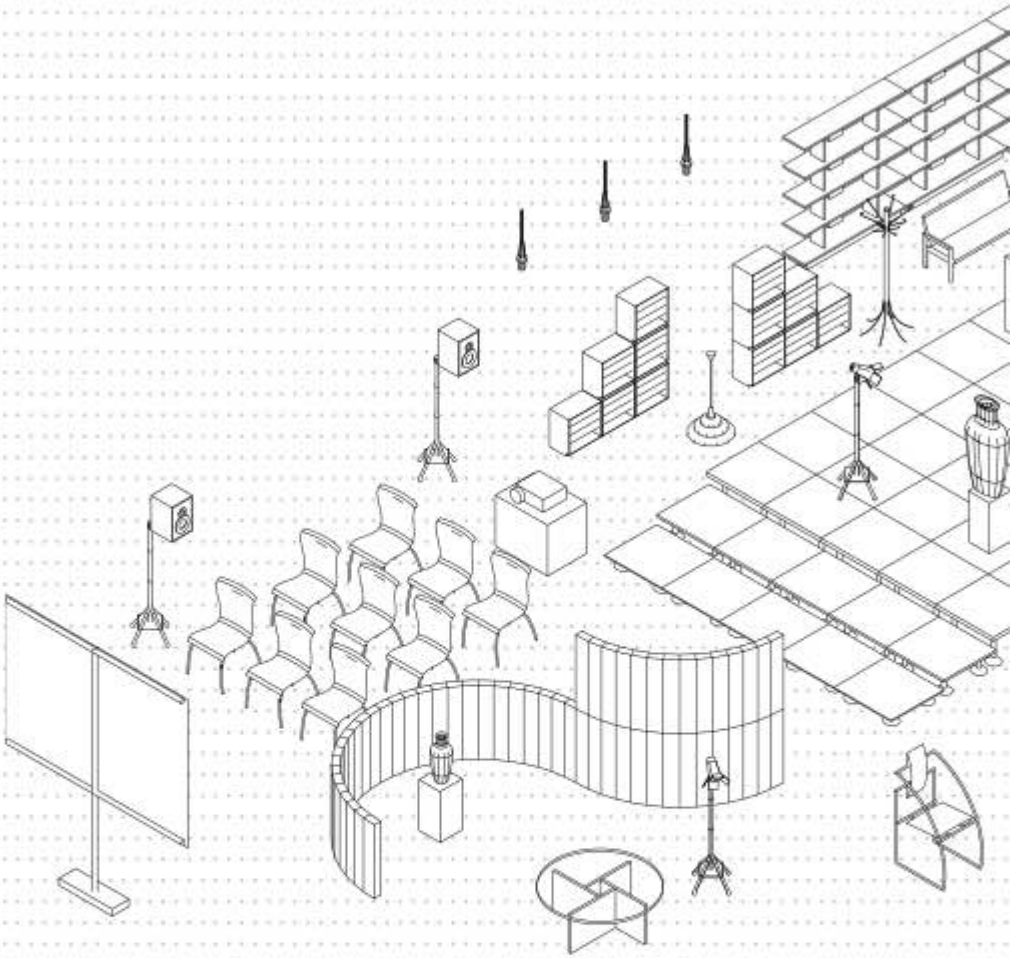

6

THE ROIE OF mUSEUmS IN SUSTAINABIE TRANSITION

From the toolkits to sustainable exhibitions

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THE ROIE OF mUSEUmS IN SUSTAINABIE TRANSITION

From the toolkits to sustainable exhibitions

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Dealing with Sustainability today essentially means (pre)occupying oneself with the needs of the future, not only focusing on environmental sustainability, but addressing the challenges of climate change in their entirety, considering aspects of economic and social sustainability as well (Culture Northwest, 2006). In addition to the aforementioned areas, there has recently emerged the need to introduce a fourth pillar of sustainability: Culture. The Agenda 21 for Culture and the United Cities and Local Governments (UCLG, 2010) Executive Bureau, in 2010, published the document 'Culture: Fourth Pillar of Sustainable Development', in which it is asserted that economic growth, social inclusion, and environmental balance no longer reflect all the dimensions of our global societies, and it is proposed to integrate the dimension of culture into policies aimed at sustainable development. The document highlights the necessity of addressing not only economic, social, or environmental challenges, but also cultural ones; creativity, diversity, and beauty are the indispensable foundations of dialogue for sustainable progress (Culture: Four-

th Pillar of Sustainable Development, 2010). Indeed, envisioning transformation implies a deeper understanding of how an individual reshapes their views of the world and shapes new modes of engagement for sustainability (N. Duxbury, 2019).
According to Duxbury, the cultural dimension is necessary because it:
* Provides new ways of perceiving and investigating the world, stimulating and promoting changes in thinking, acting, and living;
* Activates public engagement, catalyzing social relationships and evolving new ways of producing and living together;
* Physically and symbolically changes the spaces in which we live and relate, fostering greater connection with the natural and built environment (N. Duxbury, 2019).
This chapter investigates the role of museums as cultural venues and frontline promoters of sustainability issues, highlighting current challenges and future opportunities. The analysis also identifies case studies and best practices carried out by various museum organizations and identifies the main toolkits currently available to them, particularly for exhibition design.
In conclusion, several challenges related to the design of toolkits and their usage are highlighted, and future opportunities are indicated as avenues for further development of sustainability in museums.

"How can culture advance the transformation of our society towards more sustainable lifestyles?" (S. J. Kagan, 2012)

SUSTAINABILITY AND MUSEUMS: EXHIBITION SPACES OR CULTURAL HUBS ?

Since 1971, with the book 'Museums and the Environment: a Handbook for Education' by the American Alliance of Museums (AAM), many efforts have been made to define the potential role of museums in relation to sustainability and society. Today, according to the most recent definition by the International Council of Museums (ICOM), a museum is: "a permanent, non-profit institution serving society that researches, collects, preserves, interprets, and exhibits tangible and intangible heritage.

Open to the public, accessible, and inclusive, museums promote diversity and sustainability. They operate and communicate ethically, professionally, and with community involvement, offering diverse experiences for education, enjoyment, reflection, and knowledge sharing" (ICOM, 2022).

Also according to ICOM (2019), museums are seen as 'Cultural Hubs', referring to them as focal points for local and global society to experiment with new lifestyles, propose new knowledge, and create new sensitivities. In this context, it is evident that museums, including through their exhibitions, could play a significant role in influencing new, more sustainable lifestyles, both on a local and global scale, and be promoters of radical change, which, as previously discussed, is increasingly necessary. In other words, as well-established cultural infrastructures, museums support, or at least could support, a wide range of activities that can contribute to climate action. Considering that there are approximately 95,000 museums worldwide, reaching an enormous number of people every year, around 1-2 billion visits annually, museums evidently have the potential to support sustainable development. Many of them are already working in this direction, and the International Council of Museums (ICOM), with around 35,000 members, adopted the Sustainable Development Goals in 2019 as a program of activities, both through the offerings museums provide to the public and other stakeholders, and to address their own negative impacts.

Therefore, sustainability offers great opportunities to museums. It offers new ways of interpreting collections and reaching the public, new ways of thinking about old problems such as collection care, financial stability, and relationships with local communities. It offers better use of all resources, greater social responsibility, and opportunities for excellence, innovation, and creativity. It offers the possibility of providing community leadership (D. Martin, 2007).

Following the 34th General Assembly, ICOM has published a memorandum of understanding among all participants, requesting: Recognize that all museums have a role to play in shaping and creating a sustainable future through various programs, partnerships, and operations.

Acknowledge and support, in every possible way, the objectives

and milestones of the United Nations' SDGs and use the "Transforming our World" Agenda 2030 as a framework to integrate sustainability into internal and external practices and educational programming.
Empower and raise awareness among visitors and relevant communities to contribute to the achievement of the Agenda 2030 goals.
Recognize and reduce environmental impact.
Contribute to ensuring a sustainable future for all inhabitants of the planet, both human and non-human.
As a result of this memorandum, several museums globally have worked to find suitable solutions to the global climate crisis.
According to Rota (2019), two main interpretations of sustainability in museums emerge. The first is more closely related to environmental sustainability and the definition of the Brundtland Report [1] (1987, WCED), in which the museum contributes to its activities and heritage conservation for future generations with minimal resource consumption. The second interpretation is more linked to museum activities, management models, and development, starting from the museum's own definition; sustainability, in this case, is an interpretative key for the development of museum activities and operating methods in an integrated and multidisciplinary perspective, with social relevance and economically sustainable forms.
There are increasing examples of virtuous practices in technological-constructional and energy-saving fields, both nationally and internationally. Since 2005, the MART in Rovereto has initiated a program for energy efficiency in buildings and exhibition spaces, based on various interventions. Among these, the introduction of specialized software for automated lighting control in exhibition halls has led to a 25% reduction in energy consumption, or the installation of 2,400 photovoltaic modules that currently cover more than a quarter of the building's needs. Another notable example is the DEPOT Museum in Rotterdam, opened in 2021, designed to be a highly sustainable building. The museum, which is actually an art depot with more than 151,000 objects, is built with sustainable materials (such as recycled concrete) and with efficient energy consumption. It has a rainwater storage system that is reused for both toilets and watering the va-

rious green areas. Furthermore, the building is completely energy self-sufficient thanks to the photovoltaic panels on the roof and an innovative ground-coupled heat exchanger that allows for more efficient climate control inside the building. The DEPOT is certainly an excellent example of a museum building designed and built to minimize its environmental impact, a challenge given the need to conserve and exhibit so many objects.

In some cases, interventions are not only specific but also more systemic. In many of these cases, museums are part of a network that includes other entities in the sector, external organizations, and public administrations working on research projects and sustainable development strategies. One of the first and most important projects in Italy is the 'L'edificio Museo. Energia, Impianti, Sicurezza' project (Rota, Corgnati, Di Corato, 2015) carried out by the Musei Senesi Foundation (FMS) together with the Politecnico di Torino, funded by Regione Toscana. The project involved the 43 Museums of the FMS, which underwent an investigation to embark on a path towards greater museum sustainability.
It is one of the first examples in Italy of an energy survey of a museum system and, at the same time, on a territorial scale. One of the research outputs is the publication of a manual for museums in historic buildings, serving as support to disseminate a common language among museum operators on the themes of research (systems, energy, security) and for the ordinary management of the building system. The Manual covers a range of topics related to sustainability, from energy systems to renewable resources to new technologies.
In January 2021, the 'MUSEIntegrati' project was launched with the main objective of investigating the areas where museums can be positioned as cultural and civic platforms to read and promote national and regional sustainable development strategies. 'MUSEIntegrati' is the winner of the Call for Proposals for research projects to support the implementation of the National Strategy for Sustainable Development (NSSD). This is promoted by the Ministry of Ecological Transition (MiTE), while MUSE, the Science Museum of Trento, is the proposing and responsible actor. Among the partners are not only ICOM - International Council of Museums Italy but also ANMS - National Association of Scien-

ce Museums. The goal is to develop a strategy, involving the entire country, towards sustainable development at both local and urban agenda levels. Thus, a new model of "distributed museum" dedicated to the knowledge and pursuit of the 17 SDGs will emerge. An authentic museum ecosystem that, over time, can be implemented and enriched by further connections with local entities. These entities can also contribute to innovation, development policies, planning, and urban design.

As evidenced by these case studies, museums today are necessarily compelled to consider sustainability on multiple fronts. On one hand, there must be a focus on greater efficiency of the museum building and all activities conducted within it. On the other hand, there is an increasingly evident need for the museum itself to promote culture on such a complex and debated issue. In other words, as institutions, museums should propose a comprehensive sustainable design that addresses not only architectural sustainability but also consumption, production aspects, and the exhibit both as a product and as a means for cultural communication and dissemination.

In practice, according to F. Webb, this will likely entail fundamental changes in how museums plan their future development, utilize energy, consume resources, and engage with the public, community, and the world (F. Webb, 2005).

THE UNSUSTAINABILITY OF EXHIBITION AND PATHS TO CHANGE

In 2018, museums, among several other institutions, were specifically mentioned in the 'Katowice Climate Package,' which establishes essential procedures and mechanisms to operationalize the 2015 Paris Agreement. Globally, the key role museums play in education, training, public awareness, access to information, public participation, and international cooperation on climate change, fundamental to Article 6 of the UNFCCC and Article 12 of the Paris Agreement, known as Action for Climate Empowerment, has been recognized.

However, despite the clear opportunities for museums and the entire sector to actively contribute to climate action, there are

currently several obstacles that diminish their impact. For example, consider the data reported by Joyce Lee, President of the American Alliance of Museums (AAM) Carbon Benchmarking Committee, stating that in the United States alone, museums emitted approximately 12 million tons of carbon in 2019, equivalent to the emissions of 2.6 million cars in circulation.

Thanks to the work carried out by the Network of European Museums Organisations (NEMO), founded in 1992 as an independent network of museum organizations, we can have a more comprehensive view of the current situation (NEMO, 2022). NEMO, representing more than 30,000 museums in 40 European countries, conducted a survey involving 578 museums anonymously responding to various questions on sustainability between April and June 2022. From this analysis, it emerges very clearly that the opportunities and expectations placed on museums are currently far from reality and that the gap between the current situation and the role of 'Creative Hubs' advocated by ICOM in 2019 is significant.

As an illustration, when asked, "Do you believe your museum has sufficient knowledge of the Sustainable Development Goals and climate action in the museum context?" among 522 participants, 360 (about 70%) responded that their organization's knowledge of the Sustainable Development Goals and climate action is not sufficient. Additionally, 512 participants stated they do not have, or are unaware of, guidelines for sustainable procurement (66.4%) and guidelines for sustainable exhibitions (51.8%). Furthermore, while more than 5 out of 10 museums claim to consider sustainability in planning and managing museum premises and properties, only 2 out of 10 claim to use a 'green energy' provider. Only 4 out of 10 museums declare having methods or criteria to measure and evaluate their sustainable efforts, and only half of them are required to report to funding organizations on their sustainable actions. Another interesting finding relates to the presence of a team or responsible person dealing with climate-related or sustainable development activities. Among the 531 responses, 64.8% reported not having or not knowing they have such figures. According to the survey (544 responses), the obstacles to museums' sustainable transition are mainly related to lack of funding (60%) and support from public administrations

(38.8%). Interestingly, the lack of knowledge (30.5%), indicating a lack of training on the subject for staff members, and the low strategic relevance (23.9%) in museums are the third and fourth most chosen responses.
Among the main causes hindering the sustainable transition in the sector are highlighted: the lack of serious support from managers, the need for greater coordination of the museum sector by national governments and government departments, the lack of specific resources (both financial and human), and the need to change internal policies, often linked to internal matters (profit, relevance) rather than current or future global issues.

All this highlights the fragility of the museum sector, which still appears far from being points of reference and sustainable innovation. Instead, it seems necessary for the sector itself to first reconsider its objectives and find new tools to pursue sustainable transition. Museums cannot claim to serve the interests of future generations if they have a negative impact on the environment (D. Martin, 2006). In agreement with R. Janes, sustainability requires planning. Instead of trying to increase the size of collections, audiences, services, and buildings, museums should focus on excellence and the quality of what they do. The belief in unlimited and unsustainable growth should be a cause for serious concern for many museums that have set their future on attendance numbers and culture as entertainment (R. Janes, 2010).
'Blockbuster exhibitions' [2] (J. Barrett, 2011) have demonstrated their ability to attract many visitors and revenues, but in ways similar to an addictive substance. The impact is rapid and evident but quickly dissipates in the search for something else to consume, and it is never enough (R. Janes, 2005). In many of these cases, the environmental cost is not considered. Approximately every six months, a large exhibition is completely destroyed, and another is built in its place. Large amounts of reusable materials are sent to landfills while new structures are constructed.
The current working methods of museums make it difficult to recognize the economic value of reusing materials from one exhibition to another. Most temporary exhibitions have their own individual budgets and are designed without an overview.

Often, there is no mechanism to allocate the cost of a material that can be reused in multiple exhibitions. This often happens because contractors are not able, or are not enabled to, secure a contract for multiple exhibitions over several years, which clearly has a huge impact on the sustainability of individual exhibitions. As suggested by J. Bradburne, museums should look to 'lightweight' projects, flexible ones that benefit from collections (J. Bradburne, 2010), rather than projects with a high environmental impact, which reverse the priorities museums should have.

In other words, for museums to be sustainable and to stimulate a sustainable shift throughout the sector, they should reconsider many of the assumptions underpinning 'more is better.' It is increasingly evident that to achieve a significant sustainable shift in the field, it is necessary, first and foremost, to re-establish a widespread museum ethics shared by the entire sector. In particular, museum ethics must go beyond the personal and professional ethics of individuals, looking at the ability of institutions to create social change (K. Pabst, 2019).

For this reason, the ICOM, which operates through 30 international committees and 118 national committees (USA), in 2017 revised, for the third time since 1986, the 'Code of Ethics,' a document that sets minimum professional standards and encourages recognition of values shared by the international museum community. The ICOM Code of Ethics addresses various museum-related issues, such as acquisition procedures, compliance with legislation, resource management, safety, and is a reference tool providing guidance through more or less specific principles and guidelines regarding ethical standards.

As described by K. Pabst, the ICOM Code of Ethics is a relatively static document intended to be applied to as many museums as possible, drawing attention to fundamental challenges. At the same time, museums and the communities they belong to are constantly changing, which cannot be captured by abstract guidelines that can never be fully updated (K. Pabst, 2017). So far, the Code has generally concerned the management of objects and collections; but in recent years, as museums have been challenged to become active social institutions, they have had to address issues that are not directly covered by the existing Code. As evidence of this, it suffices to note that in the latest re-

vision of the document (2017), the theme of sustainability is only partially touched upon and in a very abstract manner.
In "New Directions in Museum Ethics" (2013), J. Marstine concludes that "the new museum ethics (...) is a social practice. Through debate among various stakeholders, ethical issues are identified, considered, and addressed. The contingent nature of the new museum ethics - its intrinsic mutability - suggests integrating discourse throughout the museum sector and engaging consistently." The author also emphasizes that "museum ethics today are not defined by codes" or by guidelines that are too static and that the current situation requires dynamic and creative interaction with the outside world. Therefore, continuous discussion on ethical aspects is necessary, and consequently, continuous review of ethical guidelines, staff training, and museum strategies for sustainability.

It is in this context that several museums globally, and in some cases museum networks, have begun to propose more agile and adaptable toolkits and methodologies, in an attempt to accelerate the process of sustainable transition in the sector.

mUSEUm TOOl S FOR SUSTAINABIl ITy: E XHIBI-TION TOOlk ITS

The theme of sustainability in museums is highly topical and offers various meanings and potential opportunities. This chapter specifically addresses the world of exhibitions, how they are planned, designed, and managed, and the significant role they have, or could have, in reducing emissions.
As reported in the document 'Exhibition Design for Our Time' written by the collective URGE in collaboration with the Design Museum (2023), the museum sector has various ways to think and act on the design, planning, and organization of exhibitions, with a view to reducing emissions. Firstly, interventions can be made on buildings, energy use for lighting, heating, and cooling. Furthermore, decisions need to be made regarding the content of our exhibitions, their duration, and the partners the museum chooses to collaborate with. More specifically, it is necessary to

consider the materials used for the construction of the exhibition structure and setups, as well as for our communication and learning programs, how exhibitions are built and dismantled, including the electronic devices and screens used in the exhibition itself and by the staff working on its production. And even in administrative processes, efficiency in the use of emails or other digital communications, as well as printed materials, paper, and ink used.

However, the document also highlights the almost total lack of regulations, both nationally and internationally, as one of the main obstacles to the sustainable transition of the museum world and exhibitions in particular. For example, in Italy, regarding standards, there is a reference document dating back to 2001 called "Atto di Indirizzo sui criteri tecnico scientifici e standards di funzionamento per i musei" (D.M. 10.5.2001), the validity of which has been reaffirmed in the recent D.P.C.M. 29 August 2014, n. 171 (for state museums). This document does not explicitly address sustainability issues and does not provide precise indications or parameters to be respected but is more useful for attempting to introduce such aspects so that they can be discussed, modified, and deepened in an open dialogue between central and local authorities, between museum institutions and cultural heritage, and among operators and experts in the Italian cultural sector. In this context, museums are initiating projects and experiments autonomously and in collaboration with external entities to try to self-regulate and design internal guidelines that can serve as a compass for sustainability. It is clear that discussing the sustainability of an exhibition within a museum is a topic that interfaces with many complexities. In general, the design of a temporary exhibition can be summarized in three phases: pre-exhibition; exhibition; post-exhibition. Visualizing these phases of the process can be useful for setting sustainable practices for the production of temporary setups.

In this sense, consider the work carried out by the URGE collective from October 2021 to February 2022 for the exhibition "Waste Age" at the Design Museum in London. The collective was asked to conduct an environmental audit of the exhibition and calculate the impact in order to develop a toolkit and a best practice process for future exhibitions.

The first output was the Impact Model developed by the group to monitor the three phases of an exhibition's lifecycle. This model was developed by collecting data from: stakeholder interviews, desk research, exhibition project reviews, email trackers, energy and renewable energy sources, resource consumption analysis, waste generation, production and transportation of exhibition construction materials, specific commissions for the exhibition, weight, materiality, and transportation of exhibited objects, exhibition graphics, transportation and energy requirements of technical equipment, observation of the production process, and more. This model, conceived more as a monitoring tool, proved to be very useful both for raising awareness and sensitivity among museum operators and for providing quantitative reference data. For example, the collective found that the total impact of the Waste Age exhibition was approximately 28 tons of CO2e, with 30% in construction and 50% in a single installation shipped from Ghana. The analysis also revealed that curatorial decisions have a significant impact on sustainability, particularly on the logistics footprint. It was also demonstrated that the approximately 4800 screws used had the largest carbon impact of the entire exhibition, accounting for about 7% of the total exhibition.

All this provides a reference framework for the Design Museum in London, and all its components, useful for finding specific and more sustainable solutions for the future, and it served the collective in developing a museum toolkit.

The Impact Model is currently an Excel-based tool (in beta version) intended for use by exhibition management teams, curators, and project teams to assist in decision-making during the exhibition development and production process. The model allows for measuring the carbon footprint of an exhibition in the following phases:

* project development and object selection;
* object transportation;
* construction/assembly;
* reused resources;
* museum operations;
* waste;
* tourism and visitors.

The results of this tool are estimates of the total footprint and its distribution among development, objects, tours, construction, facilities, and waste of an exhibition. The purpose is to raise awareness among exhibition staff about the potential impact of decisions made during the lifecycle of an exhibition and to stimulate questions, learning, and efforts to reduce the environmental footprint of future exhibitions.

In addition to the Impact Model, several tools have been developed in recent years to help museums lower the impact of exhibitions. For example, the Oregon Museum of Science and Industry has developed a document for producing "green" exhibits, called Exhibit SEED, which includes a "green exhibit checklist" (GEC) available online since 2012. The GEC, presented as a checklist for assessing the environmental sustainability of exhibitions, is based on five main strategies:

* ***Reduce consumption of new materials***: Use recycled materials, reuse construction materials, use wood from responsibly managed forests, use rapidly renewable materials (e.g., bamboo, etc.), construct exhibits using fewer materials.
* ***Use local resources***: Use local raw materials within 500 miles, source locally manufactured products (within 500 miles), hire local contractors for labor (within 250 miles), order products in batches to reduce packaging material.
* ***Reduce waste:*** Design components that can be reused after the end of the exhibition, choose materials that can be recycled at the end of the exhibition, choose construction methods that allow for component disassembly, eliminate the need for non-recyclable or non-reusable materials, design for durability and low maintenance, use water responsibly in the exhibition.
* ***Reduce energy consumption***: Choose electronic components and parts with high energy efficiency, reduce the number of interfaces that consume energy, use alternative energy sources, use automatic shutdown of electronic components.
* ***Reduce products with toxic emissions:*** Choose paints and finishes with zero/low VOC content, avoid PVC/styrene, use biodegradable inks on graphic panels, use products free of formaldehyde, avoid carpeting with toxic materials.

In the following years, this tool has become one of the main references at the international level and has inspired many other initiatives in the development of more specific tools.
Among these, we find the Carbon Calculator, developed by the Gallery Climate Coalition for logistics, structures, printing, and packaging calculation. The tool is open-source and very easy to use but appears rather rudimentary and limited in its calculations; notably, there is no possibility to compare different solutions for the same category, and the calculation items are reduced to eleven, not sufficient for a comprehensive management of all aspects of an exhibition. The Creative Green Tools is a similar tool proposed by the Julie's Bicycle group. In this case, the considered categories include energy consumption, water consumption, waste, travel, transportation, and materials.
The tool is designed together with an inquiry tool, the 'Beyond Carbon', which, besides providing a better understanding of the exhibition's environmental impact, allows indicating and encouraging further environmental actions in areas that may not have been explored previously. However, in this case as well, the tool proves to be too unspecific for a more professional and integrated use in the three stages of exhibition design.
A more comprehensive work has been carried out by the Creative Carbon Scotland group, which proposes a series of tools, three of which are analyzed below, based on the most updated carbon emission conversion factors provided by the British government (BEIS) in 2023. Among these, the Carbon Management tool allows comparing measurements made on individual exhibitions with the factors indicated by the British government to identify and evaluate possible emission reduction projects. Another proposed tool is the Quick Carbon Management, which allows for a quick and very specific calculation of emissions for specific actions related to energy consumption, travel and transportation, water consumption, and waste. This tool is very useful to help curators decide on the lowest impact action and to measure a snapshot of choices already made. A more advanced and comprehensive tool is the Carbon Budgeting Tool, which allows using the museum's current carbon footprint, setting a net-zero target, and designing a sustainable trajectory for the organization's emission reduction in the chosen period. This tool

is very useful to incentivize and stimulate the design of tailored strategies for the museum reality.
The case studies presented so far represent both specific tools, more or less professional, for the management of an exhibition in all its stages, and a set of guidelines and checklists supporting curators mainly in the pre-exhibition phase.
As discussed in the previous chapter, it is increasingly necessary to address the theme of sustainability in museums with continuously updated tools. For this reason, to date, the Sustainable Operational Museum Toolkit proposed by CIMAM, and implemented starting from the PIC Green Community developed in the USA, is the most comprehensive toolkit among those analyzed. The tool was launched in May 2021 and is updated monthly. It offers museums resources, tools, guidelines, and examples to promote a sustainable change towards equity, inclusion, diversity, justice, environmental respect, and sustainable economic growth. In particular, the toolkit includes seven different sections, all related to environmental, social, and economic sustainability aspects in museum practices, divided into:
* *Immediate Action Example*s: a section gathering a series of ongoing actions and solutions in museums and curatorial projects by CIMAM members since May 2022;
* *Sustainability Action Plans*: a section dedicated to successful examples and case studies;
* *Carbon Emissions Calculators and Certifications;*
* *Sustainability Consultancies*;
* *Projects, Platforms, and Inspirational Resources*: a section dedicated to platforms focused on museums and curatorial projects contributing to raising awareness in society;
* *Updated List of Specific Texts*;
* *Climate Control and Conservation in Museums*: guidelines and projects of museums and galleries.

These toolkits are representative of the dynamism and creativity (J. Marstine, 2013) of the museum sector and concretely demonstrate that the journey initiated in 1971, the year of publication of the book 'Museums and the Environment: a Handbook for Education,' is bearing fruit in a good part of the organizations.

However, the current situation presents a rather alarming picture, where there seems to be a lack of sharing and collaboration among museums for the benefit of specific guidelines and toolkits for each reality.
In addition, almost all these toolkits are still in the experimental phase, having been developed from 2019 onwards. Therefore, it seems to be necessary to wait for some time before reaching a situation in which these tools can have an actual impact on the decision-making strategies of different museums, rather than the current usage, which in several cases seems to be more propagandistic and closer to 'Greenwashing' policies.
Lastly, apart from the Sustainable Operational Museum Toolkit, the toolkits presented, after an initial usage by organizations, are no longer widely followed and seem to be projects now abandoned.

Therefore, the sector is called upon to take a further step forward from what has been built so far. The main action to be taken seems to be the development of a series of shared tools for all museums. This means, as demonstrated in other sectors adjacent to the museum one, that it is necessary, first of all, to collaborate to develop national and international regulations and legislations that serve as coordination.

CONCI USIONS

In the previous paragraphs, we discussed the various challenges and impediments museums are facing in their sustainable transition. The main obstacles in the sector can be categorized into four groups:
* *Lack of funds;*
* *Lack of support from public administrations;*
* *Lack of regulations and policy strategies;*
* *Lack of adequate knowledge.*

As seen, museums are called to play a role as 'Cultural Hubs' (ICOM, 2019), platforms where creativity merges with knowledge, and where visitors can co-create, share, and interact.

However, it's evident that the ecological transition must proceed on at least two parallel tracks. On one side, the entire museum sector is called to reorient its practices and, as indicated by H. de Varine (2006), to question its goals at both local and global levels.
On the other hand, external support, in the form of specific policies and regulations, is necessary to facilitate this transition.
Indeed, the aforementioned obstacles reveal a complexity that goes beyond simple problem-solving and demonstrates their interconnectedness. For example, the lack of funds and support from public administrations is also a consequence of inadequate knowledge about sustainability within organizations. Additionally, smaller museum institutions, lacking the necessary funding and trained personnel for managing the ecological transition, are often compelled to rapidly rotate exhibitions to generate income essential for the organization's economic sustainability, albeit detrimental to environmental and social aspects. The current challenges cannot, therefore, be addressed separately and are the result of more systemic issues, not exclusively linked to the museum sector. In this context, the use of specific toolkits for museum exhibitions could be one solution bridging the museum sector with the external world.
However, as seen, existing sector-specific toolkits have several critical issues, primarily related to: (i) Lack of testing; (ii) Excessive specificity of tools; (iii) Lack of tools shared by multiple organizations. Consequently, existing toolkits have limited relevance in strategic decision-making for managing museum exhibitions. In this regard, it may be helpful to look at other sectors adjacent to the museum sector that are achieving better results in using tools for sustainable transition.
One such example is the Albert Toolkit proposed in 2011 by Albert, an organization owned by BAFTA that supports the film and television industry in reducing environmental impact and creating content that promotes a sustainable future.
The toolkit consists of a carbon calculator and an action plan for carbon reduction, useful for formulating new ways to reduce carbon footprint. Today, thanks to the political support obtained over the years, anyone producing content for BBC, ITV, Channel 4, UKTV, Sky, TG4, or Netflix in the UK is required to use the car-

bon calculator to measure the carbon footprint of productions. Additionally, thanks to the toolkit, Albert has obtained its certification, recognized for producers demonstrating a reduction in their carbon emissions impact.
This example demonstrates how it is possible to find shared sectoral solutions supported by external entities and how such collaborations can have a greater impact.

In the very near future, museums will likely need to work collaboratively on various fronts. Among these, the entire sector will need to propose both toolkits and evaluation systems to reduce CO2 emissions from exhibitions and develop new sustainability models. Furthermore, it will be crucial to find and design new ways to obtain and attract the support of local administrations and, more generally, national politics, essential to energize museums' transition from exhibition spaces to true research centers on sustainability.
These necessary yet complex steps are probably the greatest challenge for museums and administrations in the coming years.

Notes

1- The definition given by the Brundtland Commission in 1987 states that sustainable development is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (1987, WCED).

2- Blackbuster exhibitions are exhibitions that generate great profits, due to many sold tickets among other sources, such as merchandise sales, etc. Hence there are many discussions of the danger museums are facing of becoming pro-profit organizations.

Toolkits

Impact Model. URGE Collective & Design Museum. London (UK).

Green Exhibit Checklist. Oregon Museum of Science and Industry. Portland (USA).

Carbon Calculator. Gallery Climate Coalition.

The Creative Green Tools. Gallery Climate Coalition.

Beyond Carbon. Gallery Climate Coalition.

Quick Carbon Management. Creative Carbon Scotland. Scotland.

Carbon Budgeting Tool. Creative Carbon Scotland. Scotland.

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The book investigates the exhibition sector by analyzing how it, with guilty inertia, is finally starting to address the issue of sustainability; until now, in fact, this topic has paradoxically been little considered by the exhibition discipline. However, it is a category of thought and project which, in light of the environmental crisis we are experiencing, now requires urgent and new consideration.
The text, one of the first to systematically investigate the topic - considering its economic, social and productive, as well as environmental implications - offers a detailed reading of the Italian and European context, identifying some reference best practices that can be applicable to different dimensions planning. Analyzing the museum sector in a privileged way, but also opening the perspective to the trade fair, artistic and large events sector, the book therefore aims to provide new research trajectories, pilot projects, innovative governance and management models, in order to make the system's actors fully aware of the issues at stake and equipped with new strategic and operational tools.

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