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Museums on-chain? A designerly contribution in the development of blockchain-based digital strategies in cultural institutions

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Blockchain technologies have been referred to as potential drivers for paradigm shifts in the arts and cultural sector. Their multiple applications in the cultural and creative industries have recently started to be discussed by scholars, mainly coming from social and computer science disciplines. From crypto collectibles for archiving and documentation, to rights management and digital protection, fundraising and decentralization purposes: the potential use cases of blockchain technologies are varied, so as are varied the actors in the cultural and creative ecosystems that have started experimenting with these disruptive technologies. Nevertheless, despite the turmoil experienced from the practitioners' side, cultural institutions remain largely sceptical about the expected benefit. Museums refrain from engaging with decentralized technologies like blockchain due to their perception of the numerous risks involved, as well as to the inevasible barriers to entry. The present paper relies on the hypothesis that design knowledge, methods, and tools may foster the envisioning of valuable applications of blockchain technologies within cultural institutions, and museums. It includes a systematic review of blockchain technologies use cases in cultural institutions, and the preliminary results from a set of semi-structured interviews to practitioners active in the implementation of blockchain in cultural institutions. To discuss the results, the work aims to reckon on design knowledge to stimulate reflection on alternative, and future-oriented ways of experiencing culture and cultural assets, providing museums and their stakeholders with a fulfilling cultural experience and with novel revenue sources through blockchain.

Keywords: museums; blockchain technologies; design-orienting scenarios; digital transformation

1 Introduction

The pandemic phenomenon has, albeit involuntarily, accelerated the digital transformation process in cultural institutions and museums worldwide. Museums increasingly found themselves needing to adapt to a volatile environment, which pushed for the emergence of internal learning processes and renewal mechanisms. The experience of the pandemic for museums certainly urged new flexibility and learning capabilities for managing the rising uncertainty (Taormina and Baraldi, 2022). Digital

transformation has the potential to deeply affect not only services and customer relationships, but also cultural institutions' internal organization, and cultural processes. The digital shift has also represented a change in collective narratives (Curtis, 2019), allowing museums to bring people closer to cultural heritage, through plural interpretations and interactions (Lupo, 2021). Alike other technologies, the narratives and dominant discourses around blockchain technologies (Woodall and Ringell, 2020), non-fungible tokens, cryptocurrencies, and decentralized web frameworks have been shaped either by criticism, partiality, or "hype" by the various actors in the cultural domain.

The present study presents the preliminary results emerging from the following questions:

- How, and to what extent, can a design-driven approach support museums, and more broadly cultural institutions, in envisioning valuable applications of blockchain as a disruptive technology?
- Could design knowledge contribute to the transformation of managerial and organizational practices of museums enabled by blockchain technologies?

The paper addresses the opportunity for the introduction of blockchain technology into cultural institutions and museums, and suggests a design-driven approach as a lens through which analysing the phenomenon at stake, as well as to have an agency on it. It first briefly outlines applications and use cases of blockchain technology in museums, as a result of a dedicated literature review. It follows a short methodological section, clarifying the appropriateness of the design approach to address the issue at stake, and the assumptions on which design-orienting scenarios have been structured. As regards their content, these have been developed from intertwining evidence from the mentioned literature review and empirical material collected from a set of semi-structured interviews; these involve a sample of cultural professionals currently operating with blockchain technology. The two examples of design-orienting scenarios, which envision valuable use cases of blockchain applications in museums, will be then illustrated with the attempt to reframe the meaning attached to this technology through design.

2 Literature review

Digital creative industries tend to embrace new technologies and are referred to as early adopter industries (Patrickson, 2021). The arts and cultural industry's earliest approach to blockchain technologies concerned the possibility of using this publicly accessible distributed ledger to track provenance and establish authenticity. In 2014, during the Seven on Seven Conference at New Museum, artists Kevin McCoy and Anil Dash created the first digital art token - NFT; in the following year, the Austrian Museum of Applied Arts (MAK) became the first museum to buy a digital artwork using Bitcoin from Dutch artist Harm van den Dorpel. However, around 2015, blockchain had not entered yet a phase of diffused adoption. This started to change with the development of the Ethereum ecosystem, which stimulated a plurality of applications far beyond cryptocurrency trading; the Initial Coin Offerings (ICOs) in 2017 are also believed to be a pivotal evolution. The same year saw the official launch of OpenSea platform as the first decentralized exchange marketplace for digital collectibles. The actual NFTs boom coincided with the pandemic and was driven mainly by collectibles and the opportunities they offer for virtual community-building and socialization. For digital artists, in particular, NFTs offered a precious circumstance for benefitting financially from their work: artists are

indeed easily able to claim royalties from secondary-market sales while building online collector communities around their artistic digital practices (van Haaften-Schick and Whitaker, 2022).

For the purpose of the present exploratory study, a systematic literature review has been performed based on the keywords "blockchain*","NFT*","metaverse","DAO*","museum*","GLAM*","cultural institution*", entered on Scopus database. The publications have been filtered to articles and conference proceedings, given the newness of this phenomenon. Title, keywords, and abstract screening allowed the exclusion of articles and conference proceedings concerning blockchain applications restricted to financial and business environments, which was out of scope of the research. The resulting bulk of papers was partially integrated with snowball sampling, and other recent and relevant publications on the topic.

Blockchain has core use cases in the arts and cultural industries, including enabled digital scarcity for new media (O'Dwyer, 2020) and generative art (Franceschet et al, 2021), fractional equity (Whitaker and Kräussl, 2020), and new forms of copyright registry (Whitaker 2019). A more recent literature review by Vacchio and Bifulco (2022) listed a) provenance and authenticity, b) tokenization and fractional equity, c) rights management and digital protection as the key themes emerging from the academic literature concerning blockchain adoption in the cultural heritage field. Among these areas of application, the authors confirm that blockchain technology is still, at present, mostly applied for ensuring the authenticity and intellectual property of artworks.

Nonetheless, blockchain technologies can offer more: they are indeed intensely stimulating the discourse around new reorganized social settings and diverse economic paradigms, leveraging on its polycentric and decentralized governance system. Indeed, for Catlow and Rafferty (2002): "*for people interested in an expanded idea of culture and global democracy, DAOs, not NFTs, are the bigger blockchain story*."[1] Blockchain-based systems are defined as socio-technological "assemblages" (De Filippi, Mannan and Reijers, 2020) made up of different actors, from miners, validators, programmers, crypto-currency and token holders, to end-users, and, even if still to a lesser extent, regulators. This technology enables the trust of each actor towards the whole aggregation of network actors contributing to operating and maintaining the system. It is not by chance that the most recent developments of blockchain have cultivated the possibility to engage with infrastructural experiments within cultural organizations, thus impacting their cultural and socio-economic dimension through Decentralized Autonomous Organizations[2]. These recent explorations have the potential to challenge the very meaning of "public value" within the web3 economy. Cultural ecosystems, in comparison to the more instrumental infrastructures of finance and industry, are indeed porous and experimental spaces, being the ground for more horizontal and collaborative imaginaries. The analysis carried out by Vacchio and Bifulco (2022) shows that there are not yet academic contributions offering

[1] Catlow, R. and Rafferty, P. (2022). Introduction: What is a radical friendship made of? in Radical Friends. Decentralized Autonomous Organizations and the Arts, Edited by Catlow, R. and Rafferty, P., Torque Editions. Pp. 26-51

[2] *"Later iterations of DAOs can be viewed as software tools that encourage coordination through decision-making mechanisms and allocating funding. As peer-to-peer institutions, DAOs have the potential to significantly decrease the barriers to and costs of starting an organization"* by K. Kreutler (2022), Eight Qualities of Decentralized Autonomous Organizations, in Radical Friends. Decentralized Autonomous Organizations and the Arts, ed. By Ruth Catlow and Penny Rafferty. Torque Editions. Pp. 94-101

clarification on how the procedures that guide the operations of the actors involved in the management of cultural heritage (e.g. operators, collectors, curators) have changed for the adoption of blockchain technology. As the authors underline, all technological revolutions have undeniably brought with them a paradigm shift in terms of working methodology, and organization-wise. Moreover, blockchain technologies in particular are struggling to develop precisely due to internal resistance within the cultural heritage domain. To the best of our knowledge, there are no studies at the moment that clarify how and if the introduction of blockchain in museums has changed their organizations, strategies, and business model (see Valeonti et al., 2021; Vacchio and Bifulco, 2022), and the empirical evidence to properly address this gap of knowledge is currently scarce. Therefore, future academic production should develop guidelines for cultural professionals willing to adopt a blockchain-based digital strategy in their institution. At the same time, a review of the applications of blockchain in the arts and cultural sector revealed a consistent gap between the empirical variety of experimentations on a practitioner's level and the current state of the art of academic research on the topic.

Empirical evidence showed how a design-driven approach can support strategy development and execution, through the integration of design knowledge into the practice of strategic management (Verganti, 2009; Simeone and D'Ippolito, 2022). Scholars are starting to inquire how can design knowledge contribute to support digital transformation in the cultural heritage field, in particular in museums (Avram, Ciolfi and Maye, 2020; Mason and Vavoula, 2021; Mason, 2022), and to what extent design research and practice can innovate cultural management – even if these work have not explicitly concerned disruptive technologies like blockchain through design. The design research community is thus still lacking empirical testing of its methods and tools with blockchain technologies in the cultural heritage domain, even though its contribution could be dramatically precious.

3 Research design

Results from the Systematic Literature Review (SLR) for mapping the variety of use cases and the level of adoption of blockchain technologies in the cultural ecosystem has been discussed with the results from exploratory semi-structured interviews to a sample of professionals, including museum curators, artists, providers experimenting with blockchain in their professional experience and institutions. The SLR on the applications of blockchain in the cultural sector revealed a consistent gap between the empirical multiplicity and variety of experimentations on a practitioners' level, and the state of the art of the laggard academic research. Indeed, the SLR has been not enough to understand which are the strategic challenges in blockchain-based digital strategy development and implementation, given the few scholarly knowledge on the topic due to the newness of the phenomenon in the cultural sector.

For this reason, exploratory interviews are meant to grasp current adoption experiments, enabling and hindering factors experienced by practitioners; the selected sample is heterogeneous in order to reflect the complexity of this new phenomenon and the plurality of experiences and viewpoints of the cultural ecosystem.

A social constructionist approach was adopted to conduct the first part of the present research. Social constructionism is a theory of knowledge whose basis is structured around the notion that all social reality is constructed and created by social actors (Gergen and Davis, 1995): this perspective is focused on relations, it sustains the individual's role in the social construction of realities (Galbin, 2014), and

is concerned with subjective and shared meanings (Eriksson and Kovalainen, 2008). Early findings were attempted to be drawn based on the respondents' interpretations of their worldview, carrying out a Coding Analysis (Saldaña, 2009). These considerations are coherent with the reasons why for the purpose of the research semi-structured interviews were conducted as a primary source of empirical data collection. Therefore, a combination of theories drawn from the literature, existing data collected from different sources with a desk-research, and the coding analysis of empirical data obtained through the semi-structured interviews will be used in combination to contribute to finding new meaning on the topic. The triangulation of preliminary results of the exploratory interviews and the literature review have informed the scenarios developed afterwards.

The semi-structured interviews have been conducted individually on a sample composed of 11 interviewees. Each interview lasted between 45 and 60 minutes; they have been carried through videocalls, recorded with the interviewees' permission, fully transcribed and coded. In this exploratory phase, the sample has been selected to be as heterogeneous as possible, to reflect the complexity of the blockchain phenomenon in the cultural ecosystem, showing how this technology intrinsically interconnects cultural players.

The sample selection has been done with respect to the following criteria:

- Artists and providers working with blockchain and collaborating with cultural organizations.
- Cultural organization and museums which have tried to adopt blockchain (regardless of if they were successful or not, as the challenges for the implementation have been considered a precious focus); this subsample includes also fully virtual museums.

N	Actor	Based in
1	Professional Artist	Vancouver, Canada
2	Co-founder - Virtual Museum	Mix
3	Curator - Public Art Museum	Bonn, Germany
4	Curator - Public Art Museum	Linz, Austria
5	Professional Artist	Aba, Nigeria
6	Curator - Public Art Museum	Vienna, Austria
7	Provider	Florence and Milan, Italy
8	Provider; Founder of Virtual Museum	Milan, Italy; London, UK
9	Director Sales and Marketing - Private Art Market Organization	Basel, Switzerland
10	Artist	Montreal, Canada
11	Provider + private virtual museum	Mix

Figure 1: Composition of the semi-structured interviews sample

The semi-structured interviews gave intermediary results concerning the main hindering and enabling factors of blockchain adoption in cultural institutions.

4 Preliminary results

First, from the interviews emerged consistency with respect to the literature in using blockchain technology for archiving and documentation purposes, as an "*incredible resource enabling safety*" [int.

2]. For example, NFTs may be used as "labels" that represent a real object, follow it, and allow all aspects of the history of the given object to be collected and made evident and being registered on the blockchain counterpart of the physical object: "*we have a usage for NFTs and digital art that are natively connected to a digital world, and I totally see a reason why they could represent physical artworks; e.g. it could be interesting for tracing the history of an artwork, and really be the contract for this artwork to be sold with the artwork.*" [int. 4]. This use case is, in fact, connected to prove authenticity: "*If the collector buys the work, the certificate passes ownership from the artist's wallet to the collector: this has major consequences on tracking the provenance, all the passages of the work are reported on the blockchain and on the certificate of authenticity, so that it is totally anonymous by default or in the form that the parties decide.*" [int. 9]; in this perspective, the certificate of authenticity based on blockchain can exist both the digital certificate of the work and the certification of its history. Therefore, the history, the provenance, and the uniqueness of the artwork can be represented effectively with an NFT. Blockchain has the advantage "*to be a transparent and public ledger – and that is the way we are using it for.*" [int. 11]; smart contracts can be used to handle property rights, copyrights, and contracts [int. 6]. This is connected to the fact that blockchain technology is a groundbreaking tool for decentralized management of digital data, and with reference to digitalized artworks, "*if these objects are on the blockchain everyone can access it*." [int. 5]. Blockchain therefore may enable also worldwide access to digitized information.

According to some interviewees, museums would be willing to adopt blockchain to leverage their collection; moreover, a few examples of fundraising through selling NFTs have occurred also for restoration purposes: "*They sort of make NFTs of those right, which is a great way of documenting the process of restoring a painting. And actually that's work that should be transparent and visible to all*" [int. 1]. NFT could be conceived as a "caretaker" of original artworks, or of a "share" "*that goes to the museum, the original vs the copy: the copy can be a sort of caretaker that sends money home, right? A refugee that sends money home*" [int. 3].

Moreover, blockchain has been addressed in the interviews as a tool for audience development and community engagement for museums: researching in the field of new technologies, such as the blockchain technology, is meant to establish innovative digital formats to enter a relationship with a more diverse audience. An interesting example is the one of MAK, in Vienna, which is using tokens "t*o give the community the opportunity to help shape MAK: the more one gets involved, the more one can participate in decision-making processes. The organization functions like a community that also carries a social initiative by using one's own tokens, for example, to enable others to visit museums. By testing innovative application areas, such as the MAK DAO, change processes can be initiated in the museum context and potentials for digital culture and participation in the museum of the 21st century can be opened up*" [int. 6]. These experimentations occurring in museums and cultural institutions are in line with the fact that there is "*a new audience for art as well, as they are not necessarily people that have engaged with fine arts before; […] we have an audience that was more engaged with contemporary art, so it was easier for them, but we know that from virtual exhibitions we are engaging new audiences, especially young audience*." [int. 4]. Blockchain can therefore be used as a technology to increase participation, and "*to democratize museums and get people to participate to curatorial processes*." [int. 11].

These use cases, especially those concerning blockchain adoption affecting the democratization of processes to pursue audience development, have of course organizational implications for museums. Novel decision-making processes can be activated, for example in collecting and exhibiting through a participatory approach with stakeholders: *"It is going to be interesting to transform the kind of mechanism where a very few people decide. I definitely could imagine that there are interesting ways and approaches to opening it up and making it transparent: to share with the wider public why certain pieces where collected, why certain exhibitions were planned, and be part of the decision making process and dust off the reputation of some museums*" [int. 10]. Blockchain may have implications in the cultural field through the stimulation of new business models, such as in the virtual museums and blockchain-native art museums case [int 2; 8]. It is thus evident that adopting blockchain may touch every single area of a museum [int. 10], allowing for multiple experimentations on the field [int 6]. Indeed, it is in the mission of museums "to disseminate it to the broader public" [int. 1], and to connect with other actors of the artworld [int. 9].

The possibilities are very much varied, especially if museums are conceived within a broader ecosystem of actors and potential partners: "*You can go for solutions towards "creation". You can do residency within museums, or even now there is the DIY movement, you can be part and mint works, motion-controlled works, these are interesting things which can be explored more... And could be more interesting than buying fractionalized pieces of a digitalized artworks, not very exhibiting. How exciting it could before museums to establish some sort of collaborations, for example with artists?"* [int 10].

The following tables summarize the major use cases emerging from the interviews, as well as the emerging enabling and hindering factors of blockchain technology adoption in the museums' field. Some use cases mentioned in the table find evidence in the literature; they are not mutually exclusive, and often co-exist in the same blockchain-based digitalization endeavor.

Concerning the enabling and hindering factors, these are summarized in the tables through first and second order concepts obtained from the coding analysis.

Use Cases for Museums emerged from the Interviewees	Blockchain application	Impacted Internal Functions of the Museum	Evidence in LR
Acquisition and Collection of Tokenized Artworks	Blockchain as a tool to manage digitalized data	Collections Management	Duca et al (2020); Valeonti et al (2021); Vacchio & Bifulco (2022)
Dissemination of the Work of Crypto-Artists using the Blockchain through Exhibitions (either online or offline)	-	Curating and Exhibitions	Van Haaften-Schick, L., & Whitaker, A. (2022)
Use NFTs for fundraising for restoration of the collection: NFTs as shares that fund the museum for conservation purposes	Blockchain to prove digital ownership and selling digital artworks	Fundraising	Ch'ng (2018); Valeonti et al (2021); Vacchio & Bifulco (2022)
Use NFTs for Archiving and Documentation: documenting the story of restoration of the artworks	Blockchain as a tool to manage digitalized data	Collections Management	Valeonti et al (2021); Vacchio

			& Bifulco (2022)
Attempt to bring a cultural institution on-chain (e.g. Museums as DAOs)	Blockchain as a tool to increase transparency and reach distributed governance	Governance	-
Fully Virtual Museum based on Blockchain	Blockchain as a tool to manage digitalized data; Blockchain as a tool to increase transparency and reach distributed governance	Governance; Collections Management; Curating and Exhibitions; Audience Engagement; Partnerships	-
Virtual Exhibitions in the Metaverse	Blockchain as a tool to increase participation	Curating and Exhibitions; Audience Engagement	-
Tokens for Collective Participation to Curatorial and Exhibition choices (artist, collectors, community, etc.)	Blockchain as a tool to increase participation; Blockchain as a tool to increase transparency and reach distributed governance	Governance; Collections Management; Curating and Exhibitions; Audience Engagement; Partnerships	Patrickson (2021); Vacchio & Bifulco (2022)
Exhibition about DAOs and Crypto Art	Blockchain as a Medium	Collections Management; Curating and Exhibitions; Audience Engagement; Partnerships	Ch'ng (2018); Franceschet et al (2020)
Attempt to fully implement a DAO	Blockchain as a tool to increase transparency and reach distributed governance	Governance; Collections Management; Curating and Exhibitions; Audience Engagement; Partnerships	-
NFTs as shares held partially by the museums and partially by the collective community: tokens used as a reward for members of the community engaged with the museum's curatorial choices	Blockchain as a tool to increase participation; Blockchain as a tool to increase transparency and reach distributed governance	Governance; Collections Management; Curating and Exhibitions; Audience Engagement; Partnerships; Fundraising	Ch'ng (2018); Patrickson (2021); Vacchio & Bifulco (2022)
Blockchain as a technology for Bookeeping	Blockchain as a tool to manage digitalized data	Collections Management	Duca et al (2020); Vacchio & Bifulco (2022)
Digitalize and put the collection on blockchain for increasing revenues	Blockchain to prove digital ownership and selling digital artworks	Fundraising	Valeonti et al (2021); Vacchio & Bifulco (2022)

Digitalize and put the collection on blockchain to make the collection accessible worldwide	Blockchain as a tool to increase participation	Collections Management; Curating and Exhibitions; Audience Engagement	Ch'ng (2018); Duca et al (2020)
Museum curated by People through participation in public DAO, democratizing curatorial choices	Blockchain as a tool to increase participation	Collections Management; Curating and Exhibitions; Audience Engagement	-

Enabling Factors	**Related Codes and Subcode(s)**
Blockchain applications as easy to use tools	Low BTE to create a wallet and use blockchain-based applications > No need of technical engineering training to use blockchain tools
Culture of digital technology within the museum	Dedicated section of museums devoted to digital culture > Dedicated team in the museum for blockchain art Presence of digital professionals > Hire new people + alignment of the rest of the staff > Collaborations with External programmers Multidisciplinary approach fostered in the museums organization
International Audience	International recognition Value system is changing for new audiences New younger audience worldwide is interested in collecting cryptoart
Networking opportunities provided by blockchain technology implementation	Good networks of artists and curators If museums enter the blockchain system they are able to communicate with the rest of the world (Partnerships > Art market ecosystem players > strategic partners)
Use of Permissioned Blockchain	Safer technological option for public sector actors

Hindering Factors	**Related Codes and Subcode(s)**
Conflicts of interest and high level of bureaucracy hinder the adoption of DAOs	Voting mechanisms too complicated for museums > Crypto-voting hard to do DAOs interesting from an artistic perspective and not organizationally-wise for museums
Customer-driven choices	Alternative technologies offer safer options to collectors and public institutions Risk of excluding the public not used to crypto
Hacking and security issues	Immutability and safety > Quality and safety of information on blockchain is not granted Storage on blockchain does not protect the file, risk of wallet hacking

High perceived threshold to participate and adopt blockchain for museums	Definitions are important: widespread lack of tech education on blockchain The language and process to use blockchain should be easier and more streamlined Cultural rejection of crypto-related assets > Beliefs about NFTs of Cultural Institutions > NFT reproduction of original art is vulgar; NFTs are ok only for minor digitised artworks; NFTs do not protect the content of artworks > Hyper financialization and speculation of art
Museums do not have the structure to integrate blockchain	Museums do not have the proper management system to adopt blockchain Museums do not have the proper personnel to adopt blockchain
Policy and Legal barriers	Blockchain is not a regulated technology > legal issues around the use of blockchain technology and rights management > Rights management with NFT and original works Bureaucratic issues without a central Ministry support Museum not always allowed to deal with cryptocurrencies

Concerning the major challenges of cultural institutions and museums in this panorama, as previously mentioned there is a gap among academic and applied blockchain knowledge on the field: " *Academic research is behind because every knowledge that is being produced is immediately implemented. So blockchain world seems self-sufficient, the discourse around it is so specialized already that is mostly for people that are involved in the blockchain space already, with technical understanding of stuff; they immediately build businesses and not academic knowledge.*" [int 3]. In this context, museums' challenge is to mediate between the general public and academic knowledge.

This point is very much connected to knowledge: mediating this knowledge is a challenge, but also a mission, for museums: "*We as a public institution should engage the public in these new challenges, we have an educational responsibility, also pulling this very specific and specialized knowledge into public discourse*" [int. 3]. Museums could benefit from formalized tools and methods, such as guidelines (Del Vacchio, Bifulco 2022), which enable them to envision meaningful blockchain-based digital strategies and prepares their organizations to adopt them: "*Cultural actors are bringing up projects: in 2017 at the early stage of NFTs, the question was 'How can we put art on the blockchain', now the question will become 'How can organization like museums take advantage of NFTs to make something out of the collection, and of blockchain as a technology that democratizes processes, and enjoy and learn from it."* [int. 5].

Cultural Institutions challenges	**Related Code and Subcode(s)**
Blockchain adoption from art market to cultural institutions and museums is still an unexplored territory	Cases of success in private realities and not in public ones Doing institutional operations with blockchain is premature > Online market is not communicating with institutional market Sophisticated mechanisms of blockchain use cases outside the cultural sector
Blockchain is an optional for museums	Avoid crypto, use only fiat currencies to break down cognitive barriers Blockchain did not solve pre-existing problems Governance of Museums does not need DAO implementation
Centralisation vs Decentralisation	Risk of giving up the legitimation of public institutions

Data protection within the artworld	Challenge in standardisation of data Input data on blockchain by single provider Property rights connected to digital data
Different culture of the digital within the same organisation	Each department of the museum deals with digital technology differently
Digital society but people are not acquainted enough to digital technology	Challenge to speak with very different audiences Need to push for technological education > Making people understand crypto > Misconception about usability of blockchain-based tools Geographic area variations

From the interviews, it emerges that the online private market does not communicate with the institutional "market": "*But there is always a director who decides, this thing is connected to a different economy and inevitably there are issues that as long as they are not resolved there will be an online market that will not communicate with an institutional market*." [int 8]. For this reason, there is the need for new policies allowing platforms to emerge and for museums to properly manage digitalized data [int 5]. Even if we live in a digital society, according to interviewees we are not acquainted enough to digital technology: "*it is super hard to make visitors trust, there is a distrust towards blockchain. I totally can understand this. I think we have to find new better ways to present art to people, […] and for art mediatio*n" [int 4]. There is therefore the need to push for technological education [int 9], and work on the misconception about the usability of these tools [int. 1;11]. Museums "*do not have the know how to do it; […] they should understand that we are not doing it for speculation, but to increase transparency, provenance protocol that allows to track the collection, that conversation will allow people to be more receptive. We are not against existing museums, we are trying to establish healthy relationships with them*" [int. 11].

A further decisive aspect is the use of the data to be put on the blockchain: "*This is the most challenging aspect of using the blockchain in institutions*." [int. 9], together with decentralization, especially in the public sector: "*The blockchain system I personally am very much in favour of decentralization, it is something that I follow and admire very much, but I realize that there are huge gaps because wallets can be hacked, I discover every day that thefts occur in this sense ... and there are so many risks, pros, and cons. While certainly on the one hand the decentralized system is more innovative, and fascinating - something technologically more fascinating and innovative, on the other* it can have a thousand defects, it is not controllable and manageable, it is difficult to say" [int 8]; a permissioned blockchain, where the nodes are actors in the art world with a security that no one else can provide [int 9], can therefore be a viable solution to test.

5 Discussion

Given the preliminary results emerging from the described analysis, it is worth to be asked if and how can design knowledge contribute to the mentioned challenges that cultural institutions and museums are experiencing in the process of developing a blockchain-based digital strategy, and if these challenges could be addressed and reframed by a human-cented approach. There is evidence in the literature of the fact that design brings into the organizational routine new mindsets, capabilities, and practices (Bertola and Teixeira, 2002; Verganti, 2010; Mason, 2022), and strategizes digital transformation. Design practices are both shaping and being shaped by the integration of the digital within museum practices (Mason and Vavoula, 2021).

Design research practices within cultural institutions and museums are increasingly maturing, especially as the sector undergoes transformation due to the tendency of museums to embed digital thinking and activity within their practices (Mason, 2022). Digital cultural heritage design practices are driven by the production of integrated physical and digital visitor services, which need to be supported by the digital upskilling of museum professionals (Royston and Parry, 2019). Museums have always been "hotspots" of digital transformation flourishing, even if this increasingly requires new skills and envisioning capabilities to pursue novel digital strategies (Wiebe et al., 2018). A design-driven approach can represent a driving force within the wider outlook of museum digital transformation3, enabling museums to embrace change. According to Mason (2022), human-centered design can be an agent for digital transformation. Design knowledge may thus contribute to underwriting museums' ability to catch the opportunities enabled by blockchain technology, embracing the related complexities and challenges: a human-centred and problem-framing approach (Dorst and Cross 2001) may enable museums to meaningfully adopt blockchain-based digital strategies. One example of design knowledge contribution can be represented by futures thinking and scenario development, as described in the following section.

6 Design-orienting scenarios

Design-orienting scenarios allow the development of articulated and motivated pictures (Jégou and Manzini, 2006), which should be meant as shared visions that, in our case, museums, cultural institutions, and society as a whole require today. The method of science-fiction prototyping has been implied for dealing with emerging technologies by Dourish and Bell (2014) as tools for design research that could not only anticipate but also actively shape the technological futures, being tools to orient today's decisions and inform future strategies. The following scenarios will be short narrative descriptions (McCabe et al., 2012) divided into steps of how users, which in our case are museums and their stakeholders, might interact with blockchain technology in the possible future. The scenarios are constructed through the combination of their basic elements (Manzini, 2001), the reality layer and the story layer (Lindley and Coulton, 2014), to balance the current state of the art of phenomena and knowledge related to blockchain technologies' applications, and the extrapolation of facts to enhance them into a plausible fiction dimension.

The content informing the future scenarios is the result of the combination of what emerges from both the literature previously considered in the present paper, and the preliminary results from the empirical data collected from the semi-structured interviews with curators, artists, and tech providers who are currently engaging with blockchain technologies in their practice and institutional activity. The purpose of using design-orienting scenarios is to engage multiple users (visitors, stakeholders, internal departments of the museum), reflecting ideally a collaborative environment within museums in the context of a digitalization process through blockchain.

[3] See the work by Cooper Hewitt, Smithsonian Design Museum (2021) to transform museum experience through design.

6.1 Scenario 1: shared ownership

Premise: Blockchain technologies are leading to novel project financing patterns, such as fractionalized ownership, crowdfunding mechanisms, and automated financial distribution. Moreover, the separation between ownership and access to digital assets allows the same artwork to inhabit parallel "economies": for it to be traded for its financial value, but to remain accessible to other users as a piece of public data on the blockchain.

What if…?: What if artworks in museums and cultural institutions could be held as NFTs, employed as assets, and split into shares, so that they can belong partially to the museums, and partially to the collective community and its representatives?

Vision: The NFTs of the artworks belonging to the collection of a museum are held as fractional tokens in part by the museum itself, and in part by its members and communities. The museum stimulates through its digitized and tokenized collection the collective participation in the activities of the institution: the tokens involve stakeholders in collective curatorial and exhibition choices (as it is already happening for virtual exhibitions in the metaverse), and in fundraising, to crowdfund for restoration purposes. The NFTs are the digital version of both digitally-native artworks provided by crypto artists, as well as minted versions of already existing artworks, thus contributing to the valorization and preservation of already existing cultural heritage.

Motivation: This scenario is grounded on the possibility to foresee potential new investment sources, including the option of collective and micro sponsorship, micropayments, new funding schemes (e.g. "pay what you want"), and peer-to-peer finance (Patrickson, 2020). Indeed, the development of new payment, funding, and revenue models is urged by cultural institutions, especially after the Covid-19 pandemic. Moreover, blockchain technologies enable the exclusion of intermediaries, facilitating peer-to-peer payment models, which may include new approaches to raising capital, such as crowdfunding (De Filippi, 2015).

Proposals: For conservation purposes, the museum records on blockchain all the previous pre-restoration states of the selected artworks from its collection, and the related minted NFTs can document the process of its restoration, as well as other data (provenance, collectors, etc.), thus increasing the perceived value of the artwork. The museum pursues this process so that *"information should be transparent and visible to all. And then, of course, cultural institutions sell the NFT to raise money for the restoration of the next work. They make this permanent certificate of ownership for the state of a painting that they're about to restore. Cultural artifacts can be commodified through NFTs and cultural institutions can come up with these fundraising solutions"* [Interviewee#1]. The ownership of the NFT representing the artwork is fractionalized (F-NFT, see Valeonti et al, 2021), and split among community members: in this world, citizens, members, and communities, both online and offline, engage with the museum and take part to its mission. The museum has already decided upon how to distribute the revenues from the royalties. The museum pursues a strategy that is both aimed at raising funds to be reinvested into its operations, and on the other side at involving and developing potentially new audiences (e.g. digital collectors). This protocol "*allows these NFT artworks to circulate, and benefit many, around virtual worlds that people can increase not only individual wealth but the collective community, public wealth... The idea of a share that goes to the museum is great for conservation purposes, the original vs the copy: the copy can be a sort of "caretaker" that sends money home"* [Interviewee #3]. In this world, the proceeds from the selling of the tokenized artworks can be

devolved both to conservation purposes, to which participants of the collective community can actively contribute, but also to fund other community-based projects pushed by the museum.

6.2 Scenario 2: collective intelligence

Premise: Decentralized Autonomous Organizations development already exists in the art world as collectives of artists, collectors, curators, and other cultural actors, that are exploring new rules for distributing agency and resources, simultaneously communal and decentralized.

What if…?: What if the recent outbreak of decentralized experiments in cultural institutions yields tools to imagine polycentric forms of organizations that are socially, politically, and financially sustainable?

Vision: In this world, the cultural institution implements a DAO to experiment with a new collaborative data-sharing "*and more open 'collective intelligence' business models*" [Interviewee #2]. The cultural institution is willing to be part of a social agenda where traditional organizational patterns and power structures are transformed: by designing networks based on blockchain, new patterns for social infrastructure are pushed and favour bottom-up socio-political organizing. Cultural institutions benefit from the co-creation strategy pursued with stakeholders and other members of the network in the public space.

Motivation: The aim is to build a peer-produced digital infrastructure for museums, and to create a new environment for collaboration and support in the cultural sector. Cultural institutions and their stakeholders share the production and organization of resources, and DAOs are a safe way to commit funds to a specific cause in the web3. In this application of blockchain, multi-signature crypto wallets are becoming a default tool for collectively managing crypto assets by members of the DAOs.

Proposals: In this world, users (museum professionals, stakeholders, visitors, etc.) shape their technological tools, in contrast with top-down systems that may not act in their interests. Museums can engage with collective and curatorial DAOs, but also with commissioning DAOs to establish a stronger relationship with artists and creators. The DAO "belonging" to the cultural organization is a decentralized community of interest where tokens can be generated through citizens' engagement with the organization, which can be used for a variety of purposes: to co-develop topics for discussion in the DAO for the museum curatorial program, to participatory cultural mediation activities, or to enable museum visits for diversified members of the community. The cultural organization is co-created with the community: this community is decentralized and collaborative, it brings people together from around the world, and increases the international reputation of the institution [Interviewee #4]. In this way, "*the tokens allow the community to help shape the museum: the more one gets involved, the more one can participate in decision-making processes*" [Interviewee #6]. In this world the museum is opened to democratic participation by digitally integrating different visitor groups, but also connecting them: networking is meant to be hybrid and connect online and analog communities to shape the DAO experience together.

7 Concluding remarks

The present work represents a preliminary attempt to explore the role that design research can play in the development of blockchain-based digital strategies in museums, through envisioning future scenarios for the adoption of blockchain technologies in this empirical context. The described scenarios treated two selected applications of this technology, which are both grounded on the

current state of the art of technological development; nevertheless, they are far from being accepted and spread in the arts and cultural domain. The scenarios are flawed by the omission of technical details, for example regulatory, legal, and copyright issues, which nonetheless emerge from the interviews. Indeed, according to the early results, museum organizations impose some barriers in developing blockchain-based digital strategies, not only connected to policies, but mostly to organizational culture, lack of knowledge and management support, and lack of collaboration and coordination. Adopting Blockchain technologies is also hindered by some technological barriers, such as technological immaturity, reluctance to change, and scalability issues.

Moreover, the developed design-orienting scenarios could be improved through integrating the point of views of the interviewed actors in their development: the data collected from the interviews has been used so far in support of the developed scenarios, but these have not been discussed with the interviewees yet; future developments of the present work could include testing the prototyped scenarios with the interviewees, in order to foster effective collaboration in their development and validation. Indeed, in the literature we find theoretical proposals of applications of blockchain in the cultural and creative industries, which have not been tested yet. Further studies should therefore expand the empirical research on the topic, to fill the academic-practitioners knowledge gap emerged both by the literature and by interviews: "Academic research is behind because every knowledge that is being produced is immediately implemented. So blockchain world seems self-sufficient, the discourse around it is so specialized already that is mostly for people that are involved in the blockchain space already, with technical understanding; they immediately build businesses and not academic knowledge. The feedback that you get inside the blockchain community is so specific and intense that is more qualified that what you get in Academia; this is a huge problem for academia and the general public, because you need audience to mediate between specialized blockchain knowledge and the general public" [int.3]. Here is where a design-driven approach is believed to give its contribution, and to enable transformation of museums' strategic practices.

References

Agostino, D. and Costantini, C. (2021) 'A measurement framework for assessing the digital transformation of cultural institutions: the Italian case', Meditari Accountancy Research. Available at: https://doi.org/10.1108/MEDAR-02-2021-1207.

Agostino, D., Arnaboldi, M. and Lema, M.D. (2020) 'New development: COVID-19 as an accelerator of digital transformation in public service delivery', Public Money and Management, pp. 1–4. Available at: https://doi.org/10.1080/09540962.2020.1764206.

Avram, G., Ciolfi, L. and Maye, L. (2020) 'Creating tangible interactions with cultural heritage: lessons learned from a large-scale, long-term co-design project', CoDesign, 16(3), pp. 251–266. Available at: https://doi.org/10.1080/15710882.2019.1596288.

Bertacchini, E. and Morando, F. (2013) 'The future of museums in the digital age: New models for access to and use of digital collections', International Journal of Arts Management, 15(2), pp. 60–72.

Bertola, P. and Teixeira, J.C. (2003) 'Design as a knowledge agent', Design Studies, 24(2), pp. 181–194. Available at: https://doi.org/10.1016/S0142-694X(02)00036-4.

Catlow, R. and Rafferty, P. (2022). 'Introduction: What is a radical friendship made of?' in Radical Friends. Decentralized Autonomous Organizations and the Arts, Edited by Catlow, R. and Rafferty, P., Torque Editions. Pp. 26-51

Cooper Hewitt, Smithsonian Design Museum (2021). Tools and Approaches for Transforming Museum Experience, Cooper Hewitt Interaction Lab

Curtis, S. (2019). Digital transformation—the silver bullet to public service improvement?, Public Money & Management, 39:5, 322-324, DOI: 10.1080/09540962.2019.1611233

De Filippi, P., Mannan, M. and Reijers, W. (2020) 'Blockchain as a confidence machine: The problem of trust & challenges of governance', Technology in Society, 62, p. 101284. Available at: https://doi.org/10.1016/j.techsoc.2020.101284.
Decentralized Autonomous Organizations (DAOs) (2022) ethereum.org. Available at: https://ethereum.org/en/dao/
Dorst, K. and Cross, N. (2001). Creativity in the design process: co-evolution of problem–solution, Design Studies, 22(5), pp. 425–437. Available at: https://doi.org/10.1016/S0142-694X(01)00009-6.
Dourish, P., Bell, G. (2014). "Resistance Is Futile": Reading Science Fiction alongside Ubiquitous Computing. Personal and Ubiquitous Computing 18(4). DOI:10.1007/s00779-013-0678-7
Dunne, A. and Raby, F. (2013) Speculative everything: design, fiction, and social dreaming. Cambridge, Massachusetts; London: The MIT Press.
Filippi, P.D. (2015). Blockchain-based Crowdfunding: what impact on artistic production and art consumption?, Observatório Itaú Cultural, Issue 19.
Franceschet, M. et al. (2020) 'Crypto Art: A Decentralized View', Leonardo, 54, pp. 1–8. Available at: https://doi.org/10.1162/leon_a_02003.
Kreutler, K. (2022), 'Eight Qualities of Decentralized Autonomous Organizations', in Radical Friends. Decentralized Autonomous Organizations and the Arts, ed. By Ruth Catlow and Penny Rafferty. Torque Editions (2022)
Lindley, J. and Coulton, P. (2014). Modelling Design Fiction: what's the story? In StoryStorm Workshop at ACM conference on Designing Interactive Systems in 2014. Association for Computing Machinery, New York (2014).
Lupo, E. (2021) 'Design e innovazione del Patrimonio culturale. Connessioni phygital per un Patrimonio di prossimità | Design and innovation for the Cultural Heritage. Phygital connections for a Heritage of proximity', Agathòn 10, pp. 186–199. Available at: https://doi.org/10.19229/2464-9309/10172021.
Manzini, E. (2001) 'Sustainability and scenario building. Scenarios of sustainable wellbeing and sustainable solutions development', in Proceedings Second International Symposium on Environmentally Conscious Design and Inverse Manufacturing. Second International Symposium on Environmentally Conscious Design and Inverse Manufacturing, Tokyo, Japan: IEEE Comput. Soc, pp. 97–102. Available at: https://doi.org/10.1109/ECODIM.2001.992324.
Manzini, E., Jégou, F. (2006). Design degli scenari. Pp 189-196 In Design Multiverso, Appunti di fenomenologia del design. P. Bertola, E. Manzini, Edizioni Poli Design
Mason, M. (2022) 'The Contribution of Design Thinking to Museum Digital Transformation in Post-Pandemic Times', Multimodal Technologies and Interaction, 6(9), p. 79. Available at: https://doi.org/10.3390/mti6090079.
Mason, M. and Vavoula, G. (2021) 'Digital Cultural Heritage Design Practice: A Conceptual Framework', The Design Journal, 24(3), pp. 405–424. Available at: https://doi.org/10.1080/14606925.2021.1889738.
McCabe, S., Sharples, M. and Foster, C. (2012) 'Stakeholder engagement in the design of scenarios of technology-enhanced tourism services', Tourism Management Perspectives, 4, pp. 36–44. Available at: https://doi.org/10.1016/j.tmp.2012.04.007.
McNeilly, N. (2021) Defining digital transformation for the Cultural Heritage Sector, Europeana Pro. Available at: https://pro.europeana.eu/post/defining-digital-transformation-for-the-cultural-heritage-sector
O'Dwyer, R. (2020) 'Limited edition: Producing artificial scarcity for digital art on the blockchain and its implications for the cultural industries', Convergence: The International Journal of Research into New Media Technologies, 26(4), pp. 874–894. Available at: https://doi.org/10.1177/1354856518795097.
Ostachowski, M. L. (2022). History of Crypto Art. Available at: https://mlo.art/research/history-of-crypto-art/
Patrickson, B. (2021) 'What do blockchain technologies imply for digital creative industries?', Creativity and Innovation Management, 30(3), pp. 585–595. Available at: https://doi.org/10.1111/caim.12456.
Royston, C. Parry, R. (2019). Building a framework: The museum sector needs to rethink digital skills - from the ground up. University of Leicester https://hdl.handle.net/2381/43726
Simeone, L. and D'Ippolito, B. (2022) 'The potential of design-driven foresight to support strategy articulation through experiential learning', Long Range Planning, p. 102181. Available at: https://doi.org/10.1016/j.lrp.2021.102181.
Taormina, F. and Baraldi, S.B. (2022) 'Museums and digital technology: a literature review on organizational issues', European Planning Studies [Preprint]. Available at: https://doi.org/10.1080/09654313.2021.2023110.

Vacchio, E.D. and Bifulco, F. (2022) 'Blockchain in Cultural Heritage: Insights from Literature Review', Sustainability, 14(4), p. 2324. Available at: https://doi.org/10.3390/su14042324.
Valeonti, F. et al. (2021) 'Crypto Collectibles, Museum Funding and OpenGLAM: Challenges, Opportunities and the Potential of Non-Fungible Tokens (NFTs)', Applied Sciences, 11(21), p. 9931. Available at: https://doi.org/10.3390/app11219931.
van Haaften-Schick, L. and Whitaker, A. (2022) 'From the Artist's Contract to the blockchain ledger: new forms of artists' funding using equity and resale royalties', Journal of Cultural Economics, 46(2), pp. 287–315. Available at: https://doi.org/10.1007/s10824-022-09445-8.
Verganti, R. (2009) Design-driven innovation: changing the rules of competition by radically innovating what things mean. Harvard Business School Publishing Corporation.
Verganti, R. (2010) 'Design as brokering of languages: Innovation strategies in Italian firms', Design Management Journal (Former Series), 14(3), pp. 34–42. Available at: https://doi.org/10.1111/j.1948-7169.2003.tb00050.x.
Whitaker, A. (2019) 'Art and Blockchain: A Primer, History, and Taxonomy of Blockchain Use Cases in the Arts', Artivate: A Journal of Entrepreneurship in the Arts, 8(2). Available at: https://doi.org/10.34053/artivate.8.2.2.
Whitaker, A. and Kräussl, R. (2020) 'Fractional Equity, Blockchain, and the Future of Creative Work', Management Science, 66(10), pp. 4594–4611. Available at: https://doi.org/10.1287/mnsc.2020.3633.
Wiebe, K. et al. (2018) 'Scenario Development and Foresight Analysis: Exploring Options to Inform Choices', Annual Review of Environment and Resources, 43(1), pp. 545–570. Available at: https://doi.org/10.1146/annurev-environ-102017-030109.
Woodall, A. and Ringel, S. (2020) 'Blockchain archival discourse: Trust and the imaginaries of digital preservation', New Media & Society, 22(12), pp. 2200–2217. Available at: https://doi.org/10.1177/1461444819888756.

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