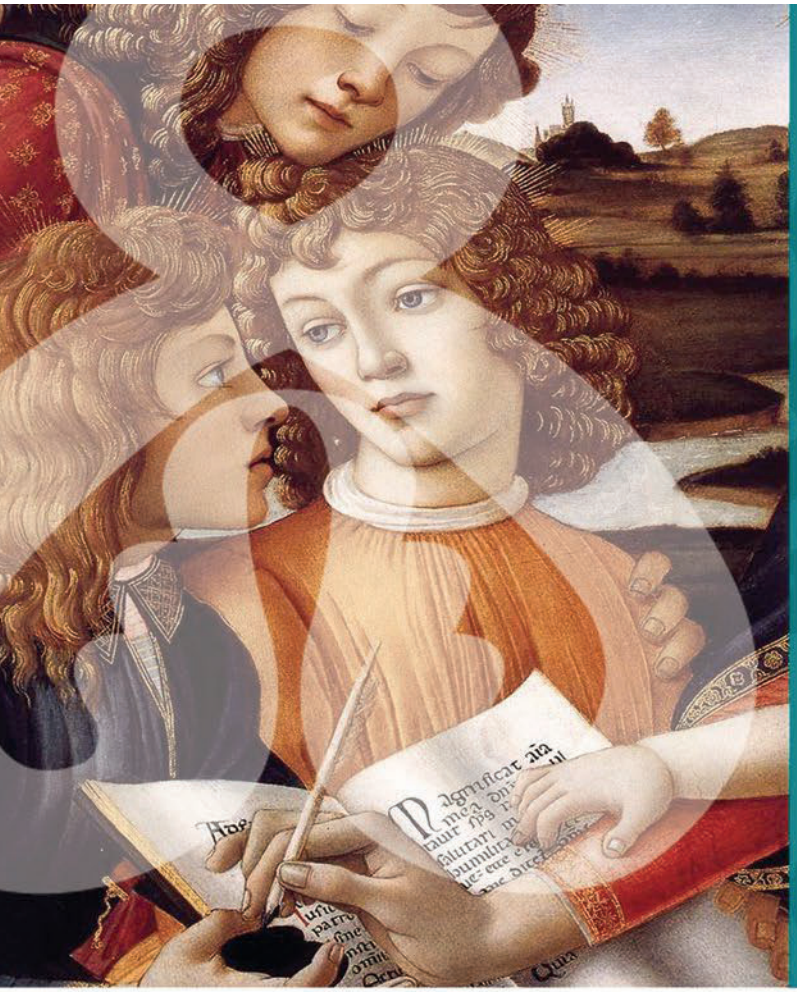

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Design-driven strategies for integrating emerging technologies in cultural institutions

Davide Spallazzo

Cultural institutions, particularly museums, are at a pivotal juncture in addressing the rapid proliferation of emerging technologies such as artificial intelligence (AI), augmented reality (AR), and virtual reality (VR). These tools possess the potential to revolutionize visitor engagement, streamline institutional processes, and reinterpret cultural narratives. However, their adoption introduces challenges, including technological complexity and a pervasive need for more technical expertise within the sector. Furthermore, many institutions need help to align these technologies with their overarching missions, resulting in fragmented or superficial digital interventions (Parry *et al*., 2018; Nikolaou, 2024).

This paper argues that a design-driven approach — rooted in systemic thinking and co-design methodologies — may provide a framework for coping with these challenges (Mason, 2022). Design is uniquely positioned to address the ill-defined or "wicked" problems (Buchanan, 1992) inherent in digital transformation, enabling institutions to introduce technology effectively while remaining aligned with their cultural and educational mandates.

Emerging technologies, particularly AI and immersive tools, are characterized by steep learning curves and intricate implementation requirements. AI, for example, necessitates expertise in data science, algorithm development, and ethical considerations, while AR and VR demand proficiency in spatial computing, 3D modeling, and user experience design. These requirements can appear insurmountable for museums operating with constrained budgets and limited technical staff (Aristou *et al*., 2024). Furthermore, many technological solutions must be more cohesive and integrate cohesively into broader institutional strategies (Dragoni *et al*., 2017).

A significant barrier to technological adoption lies in the knowledge and skills deficits prevalent within cultural institutions. Museum professionals often need more expertise to conceptualize, implement, and sustain digital projects, leaving them reliant on external vendors (NEMO, 2021). This dependence risks misalignment between technological solutions and institutional goals and raises concerns about long-term sustainability and autonomy (Lupo *et al*., 2023).

In this sense, the aim is to foster the adoption of digital strategies in museums and cultural institutions, not merely as a technological enhancement but as a fundamental organizational transformation (Agostino & Costantini, 2021). These strategies may leverage digital tools to preserve cultural heritage, enhance audience engagement, and ensure institutional relevance in a rapidly evolving context.

The role of Design in crafting digital strategies

Design has long been recognized as a discipline that addresses complex, multifaceted challenges. Rittel and Webber (1973) introduced the concept of "wicked problems" — issues characterized by competing interests, high uncertainty, and a lack of clear solutions — and design has since been heralded as a critical tool for tackling such problems. Within the museum context, design thinking also enables institutions to prototype and refine technological solutions iteratively, ensuring that innovations align with operational realities and cultural missions (Mason, 2022).
In this framework, strategic design extends traditional design principles into organizational strategy, focusing on systemic solutions and stakeholder engagement. Buchanan (1992) highlights that design operates on a "fourth order," shaping relationships and systems rather than just physical artifacts. This systemic perspective is essential for museums, which operate in complex ecosystems involving curators, educators, visitors, and external partners. Strategic design encourages institutions to adopt a systemic view, mapping interactions among stakeholders to identify opportunities for value creation. For example, integrating digital tools across exhibition design, educational programming, and community outreach creates a cohesive experience that enhances accessibility and inclusivity. Norman and Verganti's (2014) distinction between incremental and radical innovation further underscores the importance of using design thinking to reframe problems and discover transformative solutions.
In the strategic design framework, co-design is critical, particularly in fostering user-centered approaches to adopting digital technology. It involves diverse stakeholders — e.g., visitors, educators, curators, and technologists — in the design and implementation process. This approach ensures that digital strategies reflect the needs, expectations, and cultural values of all parties involved.
Co-design methodologies further enhance the capacity of museums to address the technological transformation. By involving diverse stakeholders — including museum staff, technologists, visitors, and community members — co-design may foster

collective intelligence and ensure that solutions are relevant and inclusive (Sanders & Stappers, 2008).
Co-design may also allow cultural institutions to move beyond top-down technological implementation by creating spaces for shared creativity and collective problem-solving. Stakeholders are no longer passive consumers of digital tools but active contributors to their design, development, and application. This engagement can increase institutional transparency, trust, and relevance as audiences see their voices directly reflected in digital strategies (Ciolfi *et al*., 2016). Co-design aligns with strategic design principles by emphasizing empathy, collaboration, and iterative learning (Sanders & Stappers, 2008).
It also facilitates adaptive responses to technological change by fostering a culture of experimentation. Stakeholders collaborate to explore prototypes, evaluate their performance, and iterate on design solutions (Ciolfi *et al*., 2016). This reduces the risk of digital strategies failing due to misalignment with audience expectations or institutional missions.
Strategic design and co-design frameworks can ensure that digital tools are introduced thoughtfully, with a shared vision and inclusive processes that foster innovation and engagement. By adopting a comprehensive digital strategy — grounded in strategic vision, co-design, and systemic thinking — museums and cultural institutions can maximize the potential of technology. This approach may ensure ethical engagement, efficient use of resources, stakeholder collaboration, and transformative outcomes, allowing these institutions to maintain relevance and resilience.
In this light, digital tools must be implemented with foresight, informed planning, and a vision articulated through comprehensive digital strategies. These are necessary for cultural institutions, often deploying solutions that are innovative in isolation but fail to achieve transformative outcomes. As Kaplan and Norton (1996) discussed, strategic management principles highlight the impor-

tance of multidimensional performance planning to address technology's full potential, considering customer engagement, operational processes, innovation pathways, and financial sustainability.
Since a digital strategy is a guiding framework that integrates technological adoption with institutional priorities, it should articulate the organizational objectives by aligning technology with mission goals, audience engagement, and operational effectiveness. It may use data and insights to ensure that technology meets diverse communities' and stakeholders' expectations and needs. It should also ensure that internal structures, staff expertise, and processes can support adopting digital technologies. Moreover, it should address accessibility, inclusivity, and ethical digital engagement in deploying new technologies.

Barriers to implementing a design-driven approach

Despite the advantages that a design-driven approach may bring to cultural institutions, it may encounter various barriers that can hinder the successful implementation of this approach. These obstacles range from structural, financial, technological, and cultural factors to the complex dynamics of collaboration and change management.
Implementing a design-driven approach often requires financial and human resources for training, design experimentation, prototyping, and iterative testing. Many museums operate under tight budget constraints, with limited capacity to allocate funds for innovative projects (Lupo *et al*., 2023). Additionally, design-driven methods rely on skilled professionals (e.g., designers, technologists, and strategists) whose expertise may be limited within the museum's current workforce, further exacerbating resource limitations.
The design-driven approach relies on cross-sector collaboration and co-design, but collaboration can be challenging in complex organizational structures like museums. Fragmentation among departments (e.g., curatorial, education, IT, and administration) and external partners (e.g., tech companies, design consultancies) can create communication silos, slowing the process of joint ideation and problem-solving (Ciolfi *et al*., 2016).
Furthermore, the traditional public procurement and tendering systems can also present challenges. These models often prioritize cost-efficiency, compliance, and predictability, undermining the flexibility and adaptability central to a design-driven approach (Chicot & Matt, 2018). These systems can hinder the iterative and collaborative nature of co-design by fragmenting the design and implementation phases, leading to disjointed outcomes. Traditional procurement models often isolate the design and implementation phases, resulting in incoherent and

inefficient outcomes. This condition may eventually limit the opportunity for stakeholder input during critical stages: restrictive timelines and rigid project frameworks may hinder stakeholder engagement, reducing the relevance and applicability of proposed solutions. In contrast, Inclusive collaboration throughout the project lifecycle is essential for ensuring success.
Furthermore, institutional resistance to new methodologies can hinder the adoption of co-design practices. Cultural institutions deeply rooted in cultural heritage and traditional workflows need help shifting toward a design-driven approach emphasizing experimentation, iteration, and user-centered design. Staff may fear the uncertainty associated with new methods, technologies, or collaborative processes, creating hesitation within the organization (Olesen *et al*., 2018).

Strategies for overcoming implementation challenges

Adopting a design-driven approach within museums and cultural institutions may offer excellent potential for fostering innovation, enhancing audience experiences, and supporting digital transformation. However, cultural institutions may face significant challenges (Nikolaou, 2024). Overcoming these obstacles requires strategic actions and a systemic approach to integrating collaborative practices into museum operations.

Integrating co-design principles and digital strategies into procurement processes
One of the first strategies may be integrating co-design principles into procurement processes. Traditional procurement models often operate linearly and rigidly, focusing solely on deliverables rather than collaboration. Cultural institutions should adapt these models to incorporate design-driven concepts such as participatory workshops and iterative prototyping. These tools allow museums to involve stakeholders early in the process, gathering diverse perspectives and ensuring that technological solutions align with the actual needs of users and the institutional context. By embedding co-design into the procurement process, museums can foster a more inclusive, flexible, and responsive approach to innovation, addressing the unique needs of their audiences and stakeholders.

Establishing long-term partnerships
Another key strategy may be establishing long-term partnerships with technology providers, design experts, and consultancies. Building sustained, trust-based partnerships ensures continuity, shared vision, and the ability to respond to evolving challenges over

time. These partnerships create opportunities for ongoing collaboration, knowledge sharing, and shared problem-solving. Long-term relationships allow museums and external partners to learn from each other, build capabilities, and create shared solutions.

Adopting outcome-oriented contracts
In addition to partnerships, museums can benefit from adopting outcome-oriented contracts. This strategy represents a shift from traditional procurement agreements focusing solely on specific deliverables and predefined outputs. Instead, outcome-oriented frameworks prioritize strategic goals and institutional impact. This approach enables greater flexibility by focusing on the results rather than rigid project milestones. For example, rather than focusing solely on delivering a specific technological solution, outcome-oriented contracts would emphasize broader goals such as improving audience engagement, enhancing digital accessibility, or enabling new forms of audience interaction. This flexibility allows museums to adapt their strategies to feedback, technological developments, and changing audience needs.

Build resilience through capacity building.
Building internal organizational strength through capacity building is another crucial approach. One of the most common barriers to implementing a design-driven approach is the need for more familiarity with co-design methods and the absence of trained personnel who can lead these efforts. Investing in staff training can empower museum employees to adopt and apply design-driven methodologies effectively. Furthermore, by establishing internal teams dedicated to co-design and participatory processes, museums can reduce their dependence on external vendors while fostering a culture of innovation and continuous learning. Training initiatives could include workshops on design thinking, user-centered design methodologies, or technology adoption strategies. This approach may foster institutional resilience by ensuring that novel capabilities are embedded within the organization and are not solely reliant on external expertise.

Piloting co-design initiatives
Starting with small-scale, experimental pilot projects allows museums to demonstrate the value of design-driven practices in a manageable and low-risk context. These pilot projects serve

as proof of concept, allowing museums and stakeholders to see how co-design processes can generate innovative solutions and improve audience experiences. Additionally, these small-scale projects provide valuable insights into challenges and opportunities, offering lessons that can inform and shape future initiatives on a larger scale. Piloting allows museums to build confidence in co-design methodologies, identify practical obstacles, and adapt processes as needed before committing to broader implementation.

Conclusion

Digital transformation in museums is not merely a matter of adopting emerging technologies; it signifies a comprehensive reevaluation of institutional missions, workflows, and stakeholder engagement practices. Unlike general technological adoption, digital transformation entails aligning these elements into a cohesive framework that enhances cultural relevance.

Design-driven approaches may stand at the core of this shift. With their capacity to tackle wicked problems, facilitate iterative learning, and foster cross-disciplinary collaboration, these methodologies offer tools for implementing technology and reimagining institutional identities and practices. The inclusion of co-design amplifies this potential, ensuring that digital strategies are inclusive, context-sensitive, and adaptable to evolving needs.

However, achieving this transformation requires addressing persistent structural barriers. Museums should reconfigure procurement models, champion stakeholder inclusion, and develop long-term partnerships prioritizing shared goals over transactional relationships. Investments in staff training and leadership development further ensure that institutions can sustain and adapt their digital initiatives over time.

These strategies enhance institutional resilience and redefine the cultural sector's role in society by prioritizing scalability, inclusivity, and alignment with core missions. By adopting design-driven approaches to digital transformation, they can create innovative, inclusive, and sustainable frameworks that resonate deeply with contemporary audiences and set the stage for continued relevance in a rapidly changing world.

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