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Digital Exhibition Design: Boundary Crossing, Intermediary Design Deliverables, and Processes of Consent

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ABSTRACT

We present an exploratory case study of the nature and role of Intermediary Design Deliverables (IDDs) in digital exhibition design. Specifically, how they mediate boundary crossing across museum-designer teams; and facilitate the evolution of a shared exhibition-idea by mediating future and embodying past processes of consent. We bring together literatures on intermediary objects, boundary objects and design representations to conceptualise IDD as representations of an evolving shared exhibition-idea and, thereby, as progressive objectifications of the digital exhibition. Through the case study, we demonstrate how deliverables capture progress in the exploration of the design space by embodying the consents that propel the exploration. The role of the museum team in these processes of consent (and thus in the production of the deliverable) is emphasised, suggesting a shift of focus for museum teams from appraising digital products to contributing to the digital exhibition design process.

Keywords: digital exhibition design, collaborative design, boundary crossing, Emerging Issues Commons exhibition, processes of consent, intermediary design deliverables

1. Introduction

No design problem has a unique design solution. In fact, design is more than the crafting of *the* solution: it is also the exploration of alternative solutions in the ‘design space’ and the making of choices amongst them (MacLean et al. 1991). The design space is multidimensional, with dimensions defined by criteria. In the context of designing museum¹ exhibitions that integrate physical and digital interactions (henceforth ‘digital exhibitions’), these criteria may include visitor engagement, level of detail and historical accuracy of content, and so on. Design criteria can be competing – for example, a highly accurate and detailed account of an object’s history may disengage and alienate non-expert visitors. The purpose of design is to arrive at a design solution that satisfies as many of these criteria as possible (Whitworth and Ahmad 2014).

Design space exploration is far from a deterministic process; on the contrary, trade-offs and choices are consent-based, and that consent is the outcome of collaborative exchanges – discussions, negotiations and compromises. These processes of consent influence the design product as much as the creative work that goes into the generation of alternative design solutions, yet they receive marginal attention in design studies (Ball and Ormerod 2000). By examining these processes of consent in the course of digital exhibition design, this paper offers an alternative lens through which museum teams can look at their involvement in digital projects: as direct, expert contributors to the digital design process rather than appraisers of digital design products. This lens can in turn refocus attention from perceived barriers to digital

¹ We use the term ‘museum’ to refer to heritage and cultural institutions generally.

adoption such as lack of technical knowledge and skills (Petrelli et al. 2013, 62) or lack of skills in digital commissioning and management (Digital R&D Fund for the Arts 2015), both of which may reduce museum teams' confidence in appraising digital products; to an appreciation of the museum team's existing expertise and its central role in the design activity itself.

We thus view digital exhibition design as a collaborative effort between the museum team and the digital team. Collaboration among diverse teams in design requires orchestration of competences, visions and viewpoints (Bratteteig and Stolterman 1997). Design is an inherently social process (Cross and Cross 1995) that brings into dialogue creative individuals from different disciplinary backgrounds and traditions (Holmlid 2009) and, therefore, sociocultural contexts (Peeters et al. 2007). In digital exhibition design, these sociocultural contexts converge under the shared objective of creating an engaging and meaningful experience for visitors, where, for example, both the curator and the digital developer aim to satisfy visitors. Both curator and digital developer, however, will define and quantify visitor satisfaction differently according to the sociocultural contexts of their respective disciplines and professions. Successful design will thus depend as much on the curator's and the digital developer's individual competencies as on the successful alignment of their disciplinary contexts and objectives. Such alignment is only possible when one can transcend the boundaries of their own discipline to understand and appreciate the other's disciplinary framework and contribution. Importantly, it is also the basis for the processes of consent that steer the collaborating teams' exploration of the design space.

This paper aims to exemplify boundary crossing in digital exhibition design by asking: where and how does boundary crossing occur in digital exhibition design? What and who facilitates it? In exploring these questions, the paper highlights, on the one hand, the centrality of the museum team's contribution; and on the other hand, the role of design representations in the boundary crossing process.

Boundary crossing catalyses the synthesis of sociocultural differences to lead to shared knowledge, viewpoints and approaches (Akkerman and Bakker 2011). In crossing boundaries, teams and individuals contribute to and benefit from, other disciplines' methods, tools, approaches and knowledge systems. Boundary crossing is facilitated by physical and/or conceptual constructs known as boundary objects, whose interpretive flexibility allows their appropriation by individuals and groups from different sides of the disciplinary boundary; while offering a common representation that facilitates collaborative communication among the cross-disciplinary team (Star 2010).

This paper analyses a particular type of boundary object, Intermediary Design Deliverables (IDDs), focusing on their role in facilitating processes of consent and how they are shaped by the museum team's participation in boundary crossing. By 'design deliverables' we mean the agreed outputs of the various design phases, delivered by the designer (digital team) to the client (museum team). We distinguish these from design representations that may be used internally within the digital team (e.g. conceptual diagrams, wireframes, etc.) as, although deliverables may contain elements of such internal representations, their primary purpose is to communicate design progress, process and outcomes *across teams*. As such, they are bound to result from and contribute to processes of consent. We use the adjective 'intermediary', on the one hand, to include all the deliverables of the different phases of the design project (ideation, conceptualisation, etc.), rather than the final deliverable (design product, i.e. digital exhibition) only; and on the other hand, to conceptualise design deliverables as intermediary objects that represent, translate and mediate design activity (Vinck 2012).

IDDs are thus akin to those of Blanco's (2003) 'rough drafts' that mark the beginning of a new stage in the design process: objects that stabilise and transform the design problem by rearticulating it as (a set of) solutions (p192), objects of 'relative solidity' whose meaning 'will never be re-negotiated' (p193).

We use the design of the Emerging Issues Commons (EIC) exhibition of the Institute for Emerging Issues (IEI) in North Carolina, USA, as an exploratory case study. The analysis of the case study draws on social science and design literatures, specifically concept analytic studies of boundary crossing, boundary objects, and the intermediary role of design representations. This literature is reviewed in Section 2. Section 3 presents the methodology and Section 4 introduces the case study. Sections 5 and 6 present the findings, focusing on processes of boundary crossing and on the role of IDD, respectively. Section 7 concludes the paper with a reflection on IDD as progressive objectifications of the digital exhibition and their important role in the processes of consent that propel design activity.

2. Boundary objects, design deliverables and intermediacy

The design of digital exhibitions involves collaboration between a range of professionals who are typically based in different organisations: curators and subject specialists, educators, learning and engagement officers, managers, and marketing specialists from the museum; experience designers, multimedia producers, graphic designers, information architects, and programmers from a digital design studio; exhibition designers and sometimes architects from an exhibition design studio; and so on. Each of these professionals brings different kinds of expertise, skills and sociocultural backgrounds to the project. The interactions between such diverse groups are best understood when examined holistically, viewing individuals and their mediated actions in the historical context of the organisations involved, and of the design activity itself (Engeström 2014).

The inevitable differences between individuals' and teams' sociocultural contexts can lead to discontinuities in (inter)action. This is where boundaries become noticeable and their negotiation becomes central to successful interdisciplinary work. The digital designer wants users to be satisfied with the digital experience; the museum wants visitors to be satisfied with their museum experience. Both talk about the same people experiencing the same event, but view it through their disciplinary practice lenses. Negotiating vocabularies (user-visitor) and viewpoints (digital-museum experience) is part of the collaborative work, and involves crossing and negotiating boundaries. Key facilitators for the negotiation of meanings, the alignment of objectives, and the coordination of action, are the objects at these boundaries (Akkerman and Bakker 2011). Of particular interest in this paper are those boundary objects that facilitate processes of consent in the exploration of the design space.

Boundary objects are mediating concepts or artefacts that are "both plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites" (Star and Griesemer 1989, 393). Through their inherent interpretive flexibility they enable groups of actors with divergent viewpoints to adjust them to their needs; while remaining ill-structured or sketchy communicative devices when sitting in the middle, between the groups (Star 2010). To paraphrase Star's (2010) example of a map as boundary object: consider a floor plan as a boundary object between the digital exhibition designers' and the museum curators' 'worlds'. The same object that shows the digital exhibition designer the flow of user traffic, for the museum curator is a spatial representation of objects and

collections. When designers and curators come together, these specificities are somewhat lost and the floor plan's communicative power transpires as both can use it to talk about what exhibit A on the ground floor might look like. Yet, as Akkerman and Bakker (2011, 141) stress, although successful boundary objects capture multiple meanings and perspectives, they "can never fully displace communication and collaboration". On the contrary, their *raison d'être* is to *mediate* rather than displace. Beyond the act of mediating the discussion between digital designer and curator, the floor plan ceases to be a boundary object. Wenger (2000, 236) argues that "some objects find their value, not just as artefacts of one practice, but mostly to the extent that they support connections between different practices". Our focus in this paper is on one specific type of design artefacts as boundary objects: the document-based design representations that form deliverables of the different phases in a digital exhibition design project (IDDs).

Galle (1999) argues for a view of design as the production of design representations by human actions of interpretation and production, driven by ideas. In this view, a design representation is "a thing which [...] the designer produces, driven by the designer's artefact-idea" and intending it to be interpreted by the client, the maker, and the user, as well as being interpreted by the designer herself (Galle 1999, 75). By associating the design representation with an 'artefact-idea' rather than with the 'design artefact', Galle effectively eliminates the philosophical problem of the 'absent artefact' (*ibid.*) and helps to focus the discussion on the nature of the design representation itself. The value then of a design representation transpires in its interpretation by other actors with reference to their own, potentially different 'artefact-ideas'. These interpretations enable progressive alignment of the different actors' 'artefact-ideas' until they all converge in what will subsequently become the design outcome. In our context, curators' and designers' digital exhibition-ideas are progressively aligned through the production and interpretation of IDD's, until they all converge in what will become the digital exhibition.

Bucciarelli considers design representations as linguistic artefacts that "may be pulled out [of the individual 'worlds'], put on the table, and become part of the exchange of ideas across worlds" (2002, 228) and, in this sense he argues, they are boundary objects as they "provide a milieu for inquisition and exploration of the whole and its interfaces within, as well serving to illustrate hard technical features or function when deployed by participants from different object worlds" (231). It is also useful, however, to look at the deliverables that we are concerned with in this paper, through the lens of Vinck and Jeantet's concept of intermediary object, which they describe as:

an object that lies in between several elements, several actors or successive stages of a work process (intermediary result). [It designates] drawings, files, prototypes which mark the transition from one stage to another, circulate from one group to another or around which various actors and instruments revolve... So these objects are both resulting from previous relations, mobilised as new resources in negotiations and shaping future developments... [T]hey create irreversibilities, stabilise [the project] or institutionalise it. (1995, 118-120)

Vinck (2012) traces the concept of intermediary objects in research conducted in the 1980s on large scientific cooperation networks. Intermediary objects in this context emerged as objects that moved between actors and contributed, extended or transformed action through (a) representing their authors' intentions and the sociotechnical conditions of their authoring; (b) triggering translations of the new elements introduced by virtue of their materialisation; and (c) mediating the socio-cognitive processes of

interactions among actors that lead to building of compromises. Importantly, intermediary objects "mark the stages of work performed and render its evolution less reversible" (Vinck 2012, 98).

The IDD analysed in this paper satisfy these conditions: they lie between digital and exhibition designers and curators; they lie between design phases and mark the transition from one phase to the next; and importantly, by virtue of the agreement over them required of designers and curators to conclude the design phase where they are produced, IDD create irreversibilities in the evolution of the design. Sitting across designer and curator cultures, our analysis extends Vinck's (2012) ethnographies of design, which focus on intermediary objects that facilitate collaboration *within* the design team, by focusing instead on a specific 'breed' of design object – design deliverables – and how they facilitate designer–curator collaboration.

Our IDD also conform to Galle's symbolic representations of the designers' 'artefact-ideas': they are document-based descriptions of an exhibition-idea; they include diagrams, abstractions and spatial studies (rather than museum objects, labels, devices and interfaces); they represent the designers' ideas about the exhibition rather than the exhibition itself. We will argue that, furthermore, IDD embody the outcomes of negotiations, discussions and exchanges – the outcomes of the processes of consent that took place during the design phase that produced them. This seals their irreversibility and requires that any alterations to any partner's exhibition-ideas in one design phase align with the IDD of the preceding design phase. We will argue that critical to this subsequent alignment is that IDD continue to play a mediational role in the collaboration in the next design phase: that they are used as boundary objects.

3. Methodology

Our analysis is based on an exploratory case study (Streb 2010): the design of the EIC permanent exhibition of the IEI, which is housed in the J.R. Hunt Library of North Carolina State University, USA. Taking the design of the digital exhibition as our unit of analysis, we examined the role of IDD in mediating interactions and propelling collaboration among teams of diverse expertise. Data were collected between October 2012 and August 2014 and included copies of document-based design deliverables (each comprising concept diagrams, experience flowcharts, exhibit plans, 3D flythrough views and perspectives, interactive media conceptualisation maps, etc.); project management records on Basecamp; and 21 in-depth interviews with professionals who were involved in the digital exhibition design process. Four of these interviews are referenced in this paper: Wendy Burkland, IEI special events manager and EIC project leader; Melinda Walker, IEI communications manager; Norman Lau, Senior experience Designer, Second Story; and Sujit Tolat, Lead AP, Gallagher & Associates. All the interviews were conducted by the second author during 2013, following informed consent procedures.

The project was completed in four main phases from spring 2010 to spring 2012, each of which resulted in one or more IDD (Table 1). These were preceded by a phase of preparatory work by the IEI which involved consultation with stakeholders and external experts (Phase 0). Phase 1 then started with the commission by the Institute of two external design firms, the digital design studio Second Story, and the museum planning and design firm Gallagher & Associates. The analysis presented here focuses mainly on Phases 0 and 1, and the main deliverable of Phase 1 – a design document titled *Initial Concepts and Strategy* – delivered jointly by the two firms.

Design phase	IDDs
Phase 0: IEI prep work	Design brief
Phase 1: Discovery	Initial Concepts and Strategy
Phase 2: Conceptual	Concept Submittal
Phase 3: Design	Interactive Media Submittal 100% Design Development
Phase 4: Development	EIC exhibition

Table 1. EIC design phases and respective IDDs

Our analysis involved three steps:

Step 1: Analyse the IDD from Phase 1 to identify (a) the collaborative processes and analysis activities that fed into its construction and (b) how it related to outcomes / IDDs in preceding/subsequent phases.

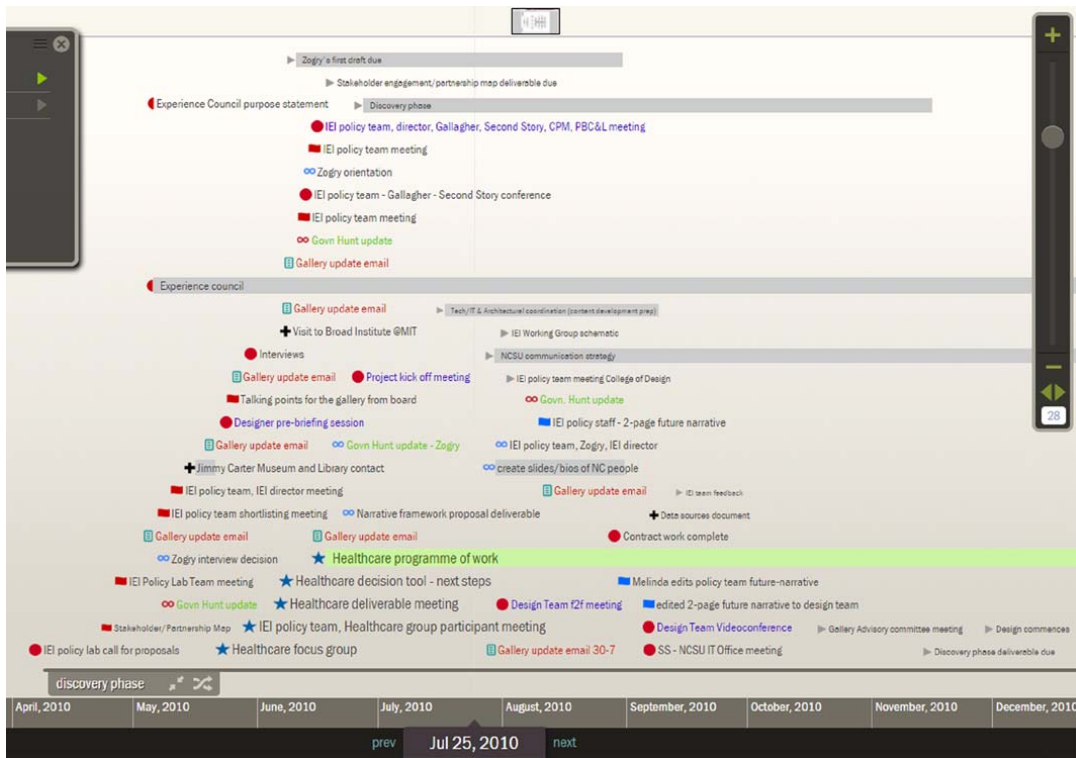
Step 2: ‘Translate’ project management records into a series of events (e.g. meetings between groups and sub-groups) and organise them into strands of activity (e.g. historical consultancy), then organise them chronologically using Timeglider² (Figure 1a). Different colours and icons were used to code different types of events and strands of activity.

Steps 1 and 2 combined enabled us to discern how, on the one hand, different strands of activity fitted together and informed the Institute’s decision-making; and on the other hand, how the Phase 1 IDD emerged as an outcome of collaborative activity and subsequently supported further collaborative activity. For example, the ‘meta-narrative’ section of Phase 1 IDD (described in more detail later in the article) prompted us to look for activity that led to its articulation (Figure 1b). IDDs thus served as a methodological ‘enriching’ tool as suggested by Vinck (2012).

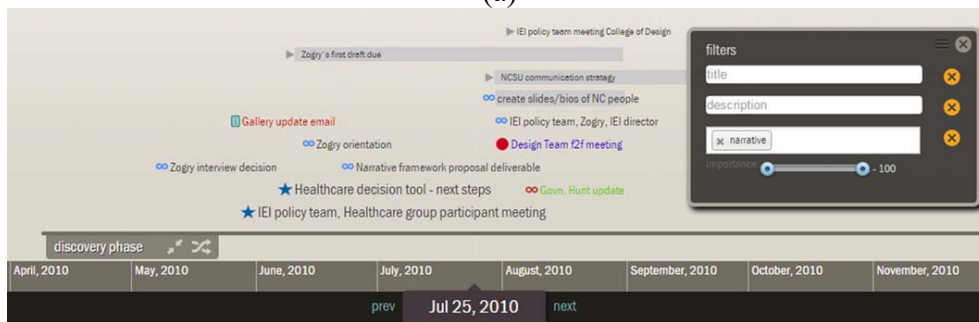
Step 3: Augment the timeline of activity with relevant excerpts from the interview transcripts, for example excerpts that reference a meeting or series of meetings on the timeline. These annotations (see Figure 1c) helped to trace how a design representation mediated design negotiations, or where a design representation was conceptualised and its construction was planned to facilitate the design process.

The following section briefly presents the EIC exhibition before moving on to the presentation of the findings in Section 5.

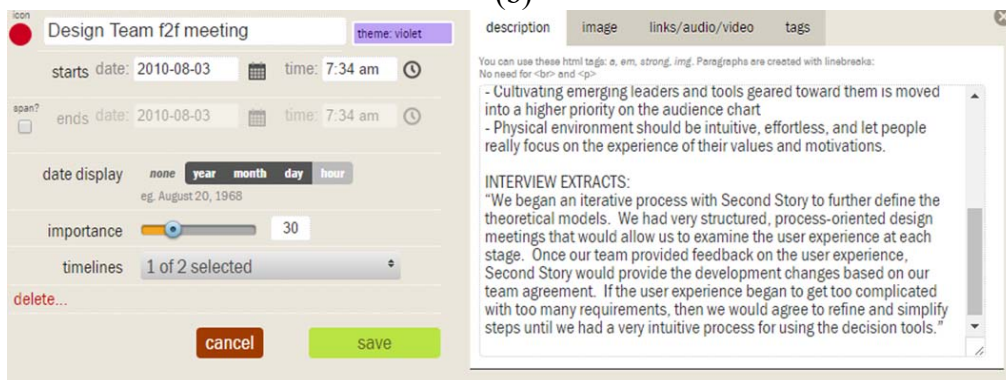
² Timeglider (<http://www.timeglider.com/>) is a web-based timeline software with applications in education, genealogy, project management, and history. We adopted its use for the analysis of collaborative design activity.



(a)



(b)



(c)

Figure 1. (a) Timeglider view of events, activities and actions that took place during the EIC's discovery phase of design (b) Example filtered view of events, activities and actions that related to the construction of a specific design representation, the meta-narrative (c) Augmented record for a timeline event.

4. The Emerging Issues Commons exhibition

In 2007, the North Carolina State University's Hunt Library secured funding to support a major redevelopment programme. The vision for the new library emphasised both the building and its uses, and identified 'a deep understanding of its prospective users [in order] to exceed their expectations' as key to realising the vision (NCSU Libraries 2007). The project resulted (Figure 2) in an 'iconic building for the University ... dedicated to ongoing innovation across disciplinary boundaries [and] designed for open use in experimentation, creation, and research in [a range of disciplines]' (NCSU Libraries 2014, 5-6). In addition to a range of collections and services, the new library would house the Institute for Emerging Issues (IEI).



Figure 2. The North Carolina State University's Hunt Library.

Founded in 2002, the IEI aims to address civic disengagement: 'too few of our citizens are willing to contribute their civic ideas, and those that do worry that their thoughts are not being heard or supported by people with the capacity to implement them' (Institute for Emerging Issues 2015). Aiming to break down barriers to participation and grassroots collaboration, the IEI matched the Hunt Library's mission and aimed 'to become North Carolina's premier public policy hub. This hub will be a crucible where the state's policy ideas and innovation are fired and tested' (North Carolina State University 2010). The result was Emerging Issues Commons (EIC), an interactive exhibition space within the library with a fully integrated website that focuses on public policy in North Carolina (Figure 3).



Figure 3. Emerging Issues Commons (EIC) gallery © Second Story Interactive Studios, used with permission.

Visitors come to EIC to learn, collaborate and share ideas. It is located at the main entrance of the Hunt Library and comprises digital interactives and physical components that share the narrative of the State. The exhibition focuses on the core issues of Economy, Education, Environment and Health. Visitors can navigate the

physical space to explore statistical data-driven interactives, digital personal stories of prominent North Carolina figures, and social media interactions; all orchestrated to tell the story of North Carolina. Installations include multi-touch tables (Ideas Table and Connections Table – Figure 4a and 4b), a large interactive wall display (Connections Wall – Figure 4c), multi-touch screens (Story Stations and Action Stations – Figure 4d and 4e), a large screen (Overture Film), a sculptural digital display (the Pulse – Figure 4f), and a Donor Wall. A website mirrors the on-site experience and opens it up to a broader audience (in our analysis, we focus on the design of the on-site exhibition only).



(a)



(b)



(c)



(d)



(e)



(f)

Figure 4. Installations within the EIC exhibition: (a) Ideas Table; (b) Connections Table; (c) Connections Wall; (d) Story Station; (e) Actions Station; (f) The Pulse. Image © Second Story Interactive Studios, used with permission.

5. Boundary crossing when “You don’t know what you don’t know”

The relocation of the IEI into the new library building meant that the Institute had additional new space for its users but no firm ideas about how to use it: *We didn’t have any concept... it was just, what are we going to do with this space?* (Melinda). Uncertainty over what to do with the space also meant uncertainty over whom to hire to make it. Wendy talks about the uncertainties they faced over what contractor expertise they should be looking for, and how to assess it:

We didn’t know who we want ... How would [we] know who to hire when we really didn’t know what we were going to do. ... So you don’t know what you don’t know and that’s ... the scariest part, not knowing. ... You can’t be worried about something if you ... don’t even know it exists ... you don’t even know that you should be worried ... [S]o that’s kind of how things started ... we just kept working [and in] the process talking to many people.

The IEI team knew that they need to cross their institutional boundaries and seek expertise elsewhere; but at the starting point, they did not know where ‘elsewhere’ was and who were the best experts there to reach out to. The availability of an exhibition space brought discontinuity for the team, who were not in a position to articulate it in such terms that would clearly mark the boundary that needed crossing. At the beginning of the project, the manager and the team were in search of that boundary and the manager led as *boundary discoverer*. In the early days of the project, the IEI therefore engaged in a series of activities that helped to articulate a clearer vision of the EIC gallery. Wendy highlights, for example, the importance of the research she did while visiting other museums and libraries and talking to staff about their experiences:

I did a lot of research, I did as much as possible. I was selecting these people, but I had never done this before and ... I was just relying on my own resourcefulness. And so I went up to Washington and I visited as many museums back of house, talked to the directors. I did as much informational interviewing as possible.

The IEI also hired external consultants (brand design, exhibition planning, cultural resource development) who worked with them for several months, helping the team and the Institute to reflect upon the IEI identity and how the gallery should communicate it. Consultancy work included the facilitation of brainstorming sessions, focus groups with IEI staff and external stakeholders, master planning exercises; all of which pushed the organisation to articulate its needs and desires and, in the process, to identify its boundaries and what lies beyond.

One example of such an exchange can be found in Wendy’s notes from a gallery team meeting with the brand design consultant in late April 2010, where the consultant asked the team: *How can the [new gallery] fit into the model public policy process [that the IEI pioneers]*. The question prompted the team to reflect internally upon policy process as *the pillar of what we do, we get conversations on the table/informal agenda setting/civic engagement* and to articulate the values that the gallery will serve: *democracy; freedom; empathy; values choices; authenticity; aligning actions with values*. This exchange pushed the team to identify IEI’s potential as *a catalyst to create a ‘public policy mind’* and the gallery space as *a snapshot of public policy mind*. The brand design consultant here prompted an (ongoing) internal reconstruction of

boundaries that is similar to Akkerman & Bakker's (2011) *Identification* but is distinct from the processes of 'othering' (a dialogical process of defining one practice in light of another) or 'legitimizing co-existence' (mutual acceptance and recognition), as it took place entirely internally, without the presence of an 'other'. It was almost a process of *self-definition* for the Institute that was prompted to look at itself afresh, through the lens of its new public space.

Phase 0 thus gave the IEI renewed understanding of its internal expertise in facilitating public policy-making and the role it could play in engaging the public. The new gallery space was conceptualised in the design brief as a 'policy lab' for leaders, with all citizens in the state invited to engage through an 'integrated website':

This will allow IEI to continue growth to become North Carolina's premier public policy hub. This hub will be a crucible where the state's policy ideas and innovation are fired and tested. Within this space, an Emerging Issues policy lab will allow leaders to craft their own learning experiences through interactive exhibits. A fully integrated website will afford all North Carolinians critical opportunities to convene, debate, and collaborate with others. (Design brief)

The design brief identified the external expertise that the IEI needed in *designing an interactive, innovative space for IEI that addresses the goals and audiences for the policy lab; successful use of technology and media treatments; experience and interest in working with other consultants for developing decision-making tools and other interactive media treatments*. The Institute was looking for design expertise that would translate its goals and philosophy into interactive, technology-based, decision-making experiences for its audiences.

The preparatory phase then appears to entail significant (almost agonising) boundary preparation work that enables the articulation of internal discontinuity problems and the identification of required types of expertise. Importantly for the IEI, this phase prepared the team for exhibiting what Engeström et al. call 'horizontal expertise' which requires experts to 'face the challenge of negotiating and combining ingredients from different contexts to achieve hybrid solutions' (1995, 319). Simply put, it required the ability to exit disciplinary and institutional silos and move across domains to transfer (and import) knowledge and skills.

The benefits of Phase 0 transpire once the actual design collaboration commences in Phase 1. The two design firms, Second Story and Gallagher & Associates, came to the project with an approach where boundary crossing was central. Norman explains Second Story's approach:

our studio takes an approach that's very collaborative with the client ... Our concepts end up being iterative, and the typical pattern is we start with a conversation about audience, about what their goals are for the space, about what sorts of content in particular areas is available but they also want to present in the space, and then from that conversation, we put out some sort of document, typically very high level conceptual documents. Early on, we call it a discovery phase, and they [the museum] get the opportunity to respond and when we present it to them it's ... a way to facilitate that conversation.

Second Story engaged in 'conversation' with the Institute to gain an understanding of its needs and objectives and used 'conceptual documents' to facilitate that conversation. Sujit explains that Gallagher use a comparable approach to elicit

curators' expertise in the subject matter and blend it with their own expertise in crafting visitor experiences in space:

You may be a curator who has all the history but, [by] understanding what you want to do and what the story is and knowing what I know about how visitors might behave, I can draw you out from your historical perspective by asking questions, 'Why is this important for you to tell?' Or 'what is important in that story that you want the visitors to know?' ... Some of the best interactions, at least for me, is when the client is set on some idea, but you ... make [them] fly up to a certain point [with an alternative idea] ... you acknowledge that there is that tension, that you're setting up a debate, not just internally [among] curators, but [encouraging them to consider] 'what are the visitors going to think?'

Understanding user needs is an integral part of design and requires designers to fully explore both the customer and the end-user worlds. Suji's questions ('why is this important for you to tell?' 'What is important in that story that you want the visitors to know?') and Norman's conceptual documents were *tools* that enabled this process, while prompting the IEI team to continue the self-definition process that had started in the preparatory phase. In this sense both firms' designers fit Wenger's (2000) description of *boundary spanners*. Conversations facilitated by questions and conceptual documents enable each party to probe the other's boundaries, assumptions, and ways of work, and result in aligned objectives and consents. Norman explains how this happened:

We end up losing a lot of how messy [the design process] actually was because ... I think those ideas actually emerged out of very long conversations ... [I]nternally within the team we would maybe make up some rough sketches, some rough wireframes maybe even, and then present those to the client. The client would come back and say, 'Yes but this is wrong, or this is wrong but we like this idea', and we'd talk with them about it to try to understand the root of their concerns. And then we'd go back and iterate on those ... concepts.

Exchange of documents, joint brainstorming sessions, suggestions and responses – all input to the designers' creative work in a 'messy' process that makes it hard to identify the origin of design ideas. Importantly, the process probed the IEI to refine their conceptions of the space collaboratively with the designers. Wendy explains:

When we hired Second Story we had a big concept of the decision tools we were interested in creating. After meeting with Second Story for the first time, they were able to take our original goals and expand them into a concrete model that could be implemented. Second Story used this model as a team "discovery" exercise with us to get us thinking and talking more about what we wanted in the space. We learned that the collaborative design process requires a strong vision/concept which will help determine all the user experience decisions throughout the project.

By the end of Phase 1 the new space was thus reconceptualised, from the 'policy lab' for use by policy-making 'leaders' described in the design brief to a *IEI Collaborative ... where people meet and talk about problems and solutions, with effects and influence in North Carolina (and beyond) as ideas spread and solutions are implemented* in the Phase 1 deliverable. The reconceptualisation was the result of collaborative work at the boundary that led to consent, and was facilitated by the

designers' probing questions and conceptual documents. Subsequent project phases continued in a similar fashion to flesh out the concept and transform it into an exhibition.

Before focusing further in Section 6 on the role of Norman's 'conceptual documents' in this process, let us look closer at who worked at that boundary. Not everyone in the IEI team did, and not all of the time. The project leader, Wendy, describes a point where she decided to step back and allow other members of the team who had the required expertise and aptitudes for that stage of the project, to lead the boundary crossing:

At that point some of the other people on my team needed to make the decisions that I couldn't make. So, I ... took a step back as just keeping the process moving rather than giving my input. At that point, I'm out of my content area so Melinda was very good at websites, and [other IEI team members] were very good at knowing how the user experience would fit with their group needs. So it got so detailed at that point that my input really wasn't as important. You know, I had my content experts there and set them up to [interact directly with the digital designers] and all I needed to do was listen.

Melinda, who was one of the 'content experts', gives her view on this:

I think because I understood both the policy side, what I was trying to do, and I could get the technology design side, what Second Story was proposing ... I was often a bridge. We had a lot of back and forth ... [Second Story] did a lot of wireframes, so we would have something to respond to ... And so I was, a lot of the time, their partner in how to navigate to the next phase. So I played kind of an interpreter role.

Melinda talks about her role in terms that resonate strongly with that of a boundary crosser: she sees herself as an 'interpreter' between the two cultures; as a 'bridge' whose foundations lie in her understanding of both domains, and which is supported by the prompts provided by the digital design firm (wireframes). Wendy's stepping back to allow Melinda to take over as boundary crosser was more than task delegation: it was identifying the skills that would make the boundary crossing successful, identifying the team members who possessed those skills, and enabling them to assume that role – it was *boundary delegation*. This skilful orchestration of the IEI's boundary crossing activity was essential to the success of the project.

Our analysis so far has highlighted boundary crossing as an essential element of the digital exhibition design process, and how it was facilitated by the IEI's preparatory work and the designers' interventions through probing questions and conceptual documents. The next section will further dissect the role of conceptual documents, in particular IDD's, to show how they were both facilitators and outcomes of boundary work.

6. Production and use of Intermediary Design Deliverables

The IDD of Phase 1, *Initial Concepts and Strategy*, presented a 'framework for discussing strategic and conceptual development' and comprised five sections. The first section ('Overview') captures IEI's new mission and branding that the EIC exhibition (not yet named *Emerging Issues Commons* at the time) would convey; perceived challenges and opportunities in doing so; and an analysis of IEI's existing audiences.

The second section ('Assumptions') presents a conceptualisation of IEI's objectives and targets regarding its visitor base, the visitors' experience, and the physical and virtual spaces that facilitate the experience. The third section ('Meta-Narrative') includes a schematic representation (Figure 5a) of a three-step model of public policy making and, by extension, of the Institute itself. Building on the meta-narrative, the same section includes a metaphor: the Institute and the process of public policy are paralleled to a textile and its making. Drawing on North Carolina's textile industry heritage, this metaphor had also been adopted in the architecture of the new library building that was to house the gallery and provided something familiar and, therefore, recognisable and understandable (Carroll and Mack 1985) for North Carolinians to hook their emerging understanding of the IEI.

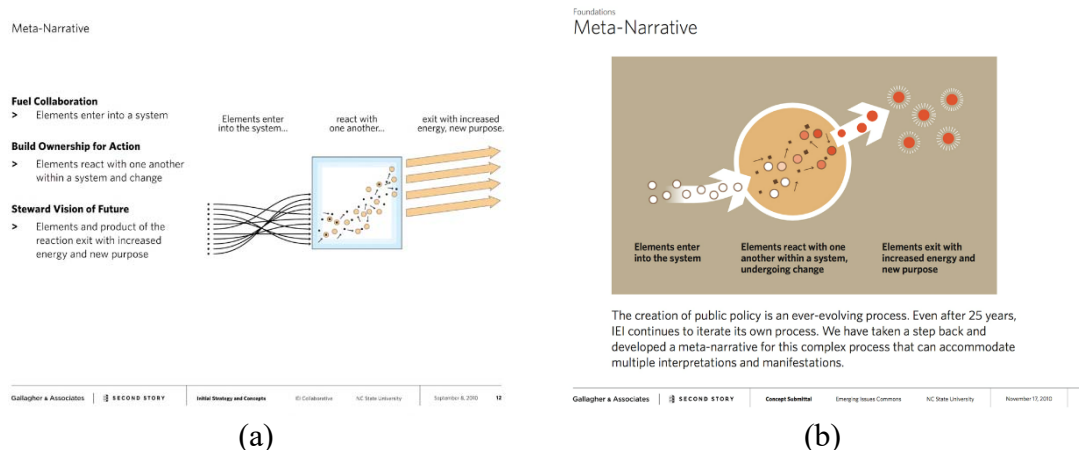


Figure 5. Meta-Narrative diagram in (a) Initial Concept and Strategy deliverable from Discovery phase; and (b) Concept Submittal deliverable from Conceptual phase (reproduced with permission).

Section four follows with a series of spatial studies as 'early ideations of how the concepts and metaphors may be expressed in the physical space'. As an exploration of the design space, these studies include sketches of floor plans which are meant to trigger conversations about the scale and quality of the physical space. The document ends with a fifth section that summarises next steps for the project, including the exchange of ideas and gathering feedback from IEI to inform subsequent work on the interactive media strategy.

As discussed in the previous section, by the end of Phase 0, the IEI team had conceptualised the gallery as a policy lab that offers a collection of specialist decision-making tools to facilitate the work of public policy leaders. The designers challenged this conceptualisation in Phase 1 by highlighting constraints and assumptions (budgetary, technological, spatial, visitor) while not losing sight of the self-understanding the Institute achieved. As a result, the emphasis shifted from the making of public policy, to participation in, and engagement with public policy; from specialist decision-making tools, to people's engagement with decision-making. The first three parts of the IDD capture the rationale behind this shift in the form of agreed assumptions, anticipated challenges and opportunities. These three sections capture the common ground established in Phase 1 between the IEI and the designers – they capture the consents reached so far. The spatial studies of section four are design representations that illustrate possible translations of these agreements into exhibition-ideas. Section five outlines Phase 2 discussions that the IDD will fuel and which will contribute to further negotiations, agreements and deliberations – they will lead to further consents over the course of refining the exhibition-ideas.

There was clear evidence of the IDD's interpretive flexibility: they facilitated get-together sessions between the designers' and the museum worlds – there is, for example, ample evidence of follow-on discussions among the IEI team and between the IEI team and the designers that were based on this deliverable. At the same time, the deliverable embodied world-specific meanings – for example, Norman, who came on the project later, described how he 'had to catch up on the project so, actually it is [this IDD] that really allowed [him] to do that'. The IDD's were evidently *boundary objects* insofar as they did facilitate communicative action aiming to align the different exhibition-ideas of the actors and worlds involved.

Representations in the IDD's of the Connections Wall can illustrate this. In the *Concept Submittal* deliverable from Phase 2, the Wall is 'intended to show data on a large scale. Visitors will see important and surprising information shown in new ways, on a large map of the state'. In this deliverable the visitor experience with the Connections Wall is described in 124 words; in the Phase 3 deliverable (*Interactive Media Submittal*), the description becomes 552 words long. From 'the visitor can select one or more data sets and see them plotted on a map of the state' in Phase 2, we get to 'as the visitor moves left and right, they reveal different topics and the connections can be seen to jump from topic to topic. This is the deepest level of interaction. The experience will feel magical and encourage the visitor to get involved in the content – the interaction is happening as the visitor moves his or her body through the space, which is a highly active and engaging experience' in Phase 3. Melinda explains that what happened between the two deliverables were exchanges, negotiations and consultations that helped to refine the concept:

Second Story would come for an in-person visit here, on the Connections area ... and then they would go off and work on it ... Then they would come back here and report, 'okay this is what we've been doing since this time on this one' ... They would give us handouts every time they came back, they would put together a new set of documentation on what they were thinking and then we would respond to it with ... our reactions.

Melinda's description suggests that there may have been other representations exchanged between the partners, which prompted exchanges but did not make it into a deliverable. The question arises: what makes a representation distinct enough to become an IDD? Deliverables such as the *Initial Concept and Strategy* are interpretively flexible enough to facilitate further conversations in subsequent phases, but, as Norman explains, they also embody negotiations, agreements, shared understandings and common ground – they embody consents:

If [a deliverable] can be a unifying model within the team, then it's something you can go back to each time to explain what the design problem is. ... These [documents] are kind of a rallying cry for the project, or a common point that everyone can understand [and] say, 'Yes, I agree with that'. ... It's tough to pinpoint exactly where concepts come from, I feel, because certainly user experience designers are the ones who are ... documenting it and kind of making it coherent in these [documents], but I would say that ... the actual ideas are always created out of conversation in the team. Ideas go back and forth; people build on each other's ideas. ... Our skills are good at, a lot of times, setting the stage for that. But I think also ... afterwards, after everyone's had their say, being able to take all that information – which might be these messy ideas, these drawings on the white board, these notes that people make – taking all that information and trying to

make it into an understandable package for everyone to look back on and say, ‘Yes, I think that’s a good way of saying what we were trying to say’.

While embodying ‘messy ideas’, ‘drawings on the board’ and ‘notes that people make’, the *Initial Concept and Strategy* deliverable marked the beginning of the second Phase of the project, which in turn had to take these outcomes as its starting point (as ‘an understandable package for everyone to look back on and say, “Yes, I think that’s a good way of saying what we were trying to say.”’). In this sense, the document importantly embodies consents and is *irreversible*.

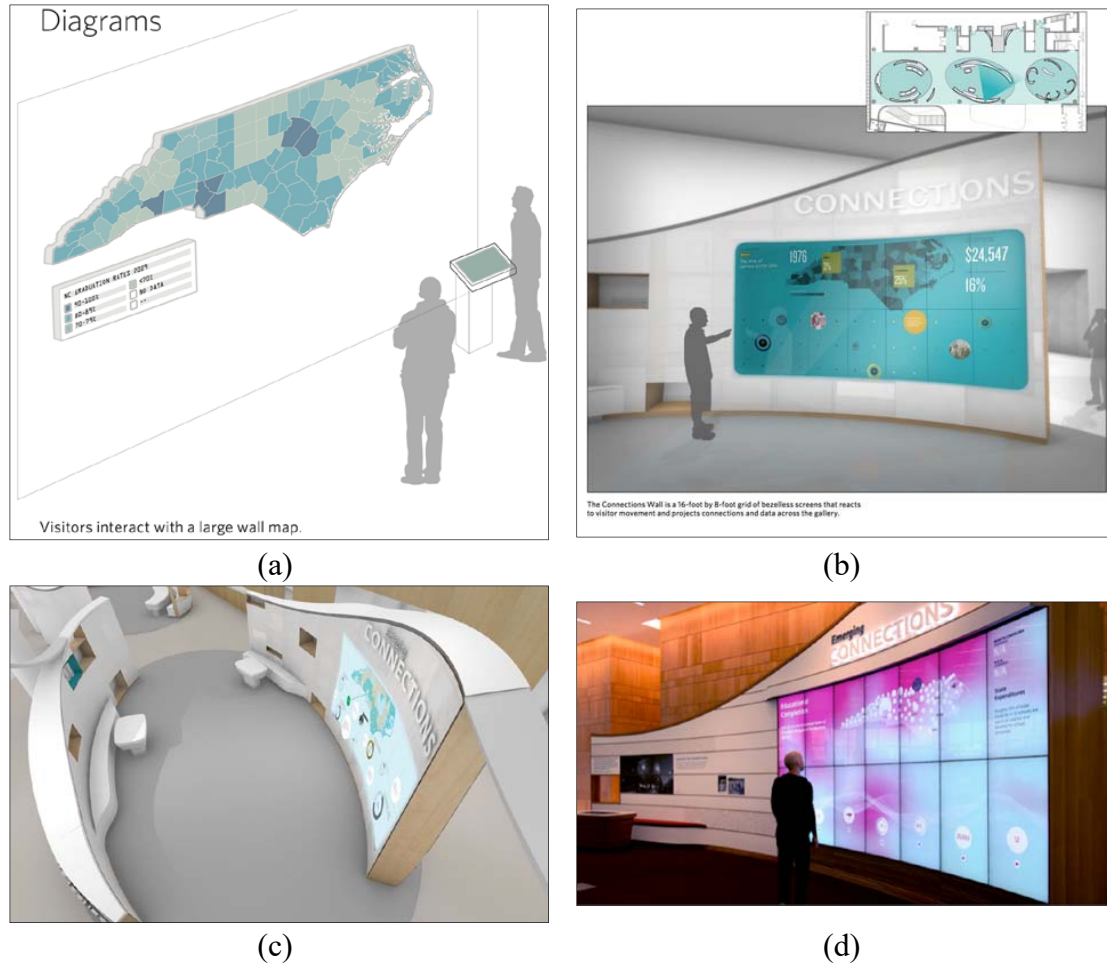


Figure 6. Progressive objectification of the EIC’s Connections Wall in successive design deliverables (reproduced with permission): (a) Concept Submittal, (b) Interactive Media Submittal, (c) 100% Design Development, (d) final exhibition (© Second Story Interactive Studios, used with permission).

As assumptions become internalised and ambiguities clarified by the design collaborators, IDD embed related decisions, consents and concepts and, as a result, their specificity increases. Each of the four document-based deliverables from Phases 1, 2 and 3 is an evolved version of the previous phase’s deliverable – one that exhibits increased specificity and a refined set of design options in both its textual and visual representations of the exhibition-idea. These deliverables are sure to represent numerous other design representations produced by the design firms and used internally within and between the two firms as ‘successive objectifications of the design’ to compensate

for a ‘field of work [that] does not exist *objectively* in advance, but is constructed in and through the process of design and planning and, ultimately, construction’ (Schmidt and Wagner 2004, 363, original italics). This progressive ‘objectification of things-to-come’ (Schmidt and Wagner 2004, 364), that is, the progressive objectification of the EIC exhibition through design representations and deliverables, is observable in the deliverables’ increased semblance of the final exhibition space (see for example Figure 6).

7. Discussion and conclusion

To conclude, we return to our research questions to summarise what we learned about the role of boundary crossing in the processes of consent in digital design projects, and how IDD’s facilitate it. Our analysis highlighted the importance of preparatory work in digital exhibition design projects. The search for boundaries beyond which the IEI needed external expertise facilitated and was facilitated by a process of self-definition. This work served as *boundary preparation*, and enabled the IEI to meet the external designers at the boundary and be receptive to their catalysing its self-definition further in the context of the collaboration. One of the museum team leader’s most important tasks was *boundary delegation*: the selection of the right people in her team for the right exchanges, and the orchestration of the boundary crossing activity. Conceptual documents, probing questions, and other design artefacts were mobilised by the external designers to facilitate boundary work and exchanges.

Unlike the design firms, both of which had established processes and approaches for collaborations of the type required for the design of the EIC exhibition, for the IEI it was the first digital exhibition design project of this scale and scope. The IEI lacked the infrastructure (Star 2010, 1999, Trompette and Vinck 2009) to support the boundary crossing needed in digital exhibition design: there were no pre-existing processes for the distribution of boundary work among the IEI team, no documented roles for IEI team members, and no track record of involvement in large scale digital design projects to guide work. The boundary preparation work – which was guided to a large extent by the design firms’ processes and approaches and which was consolidated through IEI’s engagement with IDDs as boundary objects – provided the basis for the IEI to lay the foundations for the development of such infrastructure. Processes of self-understanding and self-articulation and their outcomes were a central part of the IEI’s emerging infrastructure, as they provided an interpretive framework for the boundary crossing that followed.

Boundary objects are not boundary objects continuously (Akkerman and Bakker 2011) nor do they remain at the boundary forever: eventually, they become institutionalised, standardised, part of the infrastructure (Star 2010). However, design collaborations like the EIC are infrequent if not one-off for the institution. In such a single instance of design collaboration, related boundary crossing may come across as ephemeral and utilitarian, allowing little opportunity for observable long-term, transformative effects on institutional practice. This is not to say that such transformative effects are not present – having engaged in self-definition and looked at its own practice through the lens of another ‘trade’, the IEI has come out of the collaboration transformed, with greater understandings of itself and its practices. The infrastructure developed for the design of the EIC and the experience of working with IDDs as boundary objects are bound to support the IEI team’s future cross-disciplinary collaborative efforts.

Our analysis of the role of IDD in digital exhibition design suggests that they are boundary objects by nature, destined as they are to bring partners on the same page, to agree future directions – and thereby reject others. Our case study examples illustrate their interpretive flexibility. As artefacts produced for the purposes of negotiating design ideas and concepts in subsequent phases, interpretive flexibility must be intentionally built into IDDs.

Indeed, their communicative power is far from accidental. IDDs from early stages of design are polysemic (De Vries and Masclet 2013), inviting varying interpretations and offering multiple options: the *Initial Concept and Strategy* deliverable from Phase 1 included seven spatial studies. These were based on exchanges during that phase as much as on designers' creativity, and thus represented the multifaceted nature of the collective exhibit-idea as it stood at that point in time; and over which the deliverable invited further deliberation. As the project progresses, points are clarified, decisions made, agreements reached, compromises accepted, and options chosen or rejected. The conclusion of these processes of consent marks irreversibilities that are embodied in subsequent IDDs: following cross-group design meetings and exchanges, only one of these seven spatial studies made it into the Phase 2 deliverable. IDDs are design representations that mark the end of a design phase and, with it, points of agreement on progress and direction of the design idea. They are thus true intermediary objects that capture consents, raise calls for further consents, and mark the project timeline with points of irreversible agreements (Vinck 2012).

At the same time, IDDs progressively stabilise and transform the design problem into the digital exhibition (Blanco 2003). As the margins of change decrease, as more and more decisions are made and embodied, the IDDs resemble more the final thing. The shared exhibition-idea is crystallised progressively in successive IDDs, giving the EIC an increasingly object-like identity which is expressed within the IDD as visual and textual representations of increasing detail. The example of the Connections Wall in Figure 6 vividly shows the progressive objectification of the exhibit-idea throughout the series of intermediary deliverables, with the process culminating in a fully-fledged, tangible object: the exhibition itself. Thus, the EIC exhibition, itself the final deliverable, is the ultimate representation of the shared exhibition-idea and therefore, as well as a design product, it is also a record of the whole boundary crossing activity and the consents it produced.

We have proposed that IDDs should be understood as representations of the current state of development of a shared exhibition-idea which, at the same time, constitute a record of the processes of consent (negotiations, deliberations, agreements and resolutions) that shaped that shared idea through the collaborative navigation of the design space. This view suggests that museum teams engaging in digital exhibition projects should refocus their attention from appraising the design product – which is often considered to require specialist technical skills – to contributing to processes of consent in the design process and embracing boundary crossing, which involve activities within the museum team's domain of expertise. We hope that this paper will motivate further research on the role of IDDs and the processes for their production and use, as well as the role of other design representations in digital exhibition design.

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