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Published version

KOCSIS, Anita and BARNES, Carolyn (2009). Making Exhibitions, Brokering Meaning: Designing new connections across communities of practice. In: Undisciplined! Design Research Society Conference 2008, Sheffield Hallam University, Sheffield, UK, 16-19 July 2008.

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Making Exhibitions, Brokering Meaning:

Designing new connections across communities of practice.

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Abstract

New media museum exhibits often see designers representing the research of expert content providers. Despite perceptions that such exhibits provide museum visitors with a greater depth and range of experience, differences in knowledge and practice between designers and content providers can see content development become an unruly, competitive process in which audience experience, digital mediation, visualisation techniques and meaning become contested territory.

Drawing on Etienne Wenger's theory of "communities of practice", this paper argues that designers' advocacy for audiences and distance from exhibition content well positions them to broker interdisciplinary goal setting so that exhibitions observe the representational objectives of content providers and meet the needs and preferences of museum visitors. A wide range of design literature already discusses the pragmatic benefits and ethical importance of user-centered design, while the literature on co-design suggests that designed outcomes are more successful if the design process considers the interests of all stakeholders. These discussions can be compelling, but the inherent challenges in engaging others' perspectives and knowledge in the design process are less acknowledged, Wenger's ideas on the social dynamics of group enterprise offering designers valuable insights into the actuality of negotiating designed outcomes with non-designer stakeholders.

The paper has two main aspects. The first outlines the theory of communities of practice, focusing on the brokering of knowledge and practice between disciplines. This discussion frames an analysis of the design process for two museum exhibitions. Representing an original application of Wenger's ideas, the discussion recognises the unique role of the designed artifact in brokering information visualization processes, transcending the actions and intentions of individual stakeholders. While accepting there are successful examples of interdisciplinary exchange in various areas of design, the interpretation of examples via Wenger contributes useful principles to the theorisation of co-design with non-designer stakeholders.

Keywords

Information visualization; New media museum exhibits; Multidisciplinary projects; Communities of Practice; Brokering; User-centered design; Co-Design; Etienne Wenger.

Sources of information and opportunities for entertainment abound in the contemporary world, often merging into the one experience in a direct

challenge to the relevance of the museum. While people are still attracted to the museum as a principal repository of original artifacts of high cultural, historical, scientific or social value, the introduction of new technologies is a common response for museums seeking to provide innovative and engaging public programs. New media exhibits suggest dynamic new relations between audiences and museum content, but they also increase institutions' reliance on designers' skill in developing convincing visuals, compelling experiences and user-friendly information; expert content providers, especially those coming from outside the museum, potentially seeing the intellectual integrity of their scholarship as compromised by the designers' creative interpretation of information for a general audience. Drawing on Etienne Wenger's theory of "communities of practice", this paper discusses the designed artifact's critical brokering role in negotiating audience needs and expectations, the nature of digital media and the divergent perspectives of designers and content providers in information visualisation projects in the contemporary museum. The discussion is exemplified through an examination of two exhibitions at Museum Victoria, Melbourne. *The Universe in a Virtual Room* (2003) linked recent discoveries in astrophysics to Einstein's cosmological theories. *Sacred Angkor* (2004) presented new archeological findings about the grounds of Temple Angkor Wat, Cambodia. Both exhibitions were presented in The Virtual Room (VROOM), a ring of eight abutting, rear-projected screens, which supports interaction through the use of wands, motion tracking devices and spatial soundscapes (Figure 1).

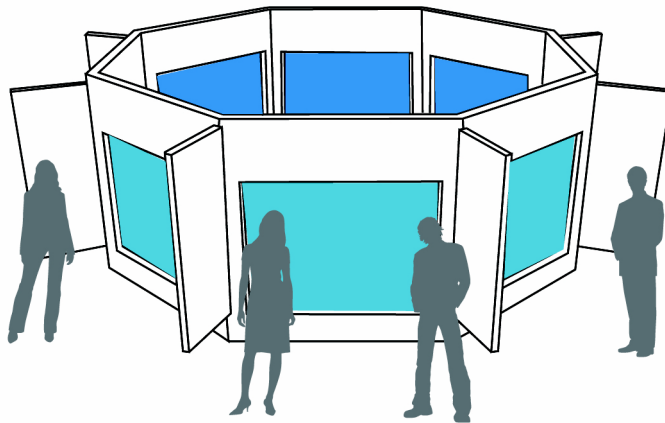


Figure. 1: Diagram of The Virtual Room

Museums, new media exhibitions and design

Museums turned broadly to designers to formulate their public presentations in the 1970s (Henning, 2006), when more egalitarian models of public programming emerged. Macdonald (2007) explains that initially designers were only required to supply "a more or less attractive medium for presenting content", where now design is an integral part of visitor experience with "potentially ... far-reaching implications for structuring the very nature of that experience (p.150)." New media attractions in museums range from hands-on exploratoriums to immersive digital installations such as multi-projections,

domes and panoramas, but there is some disagreement about their use. Hein (2000, p. 108) sees the trend for immersive, technologised experiences as educationally destabilising. For Miles (as cited in Witcomb, 2007, p. 35), multimedia exhibitions disrupt the museum's established role as a repository of important artifacts, reflecting the influence of a pluralistic society dominated by mass culture and electronic communications.

Alternatively, a broad literature claims that new technologies enhance human experience and perception, including in their application in museums. Smith (2001) argues technology has allowed museums to reinvent themselves, the synthesis of the real and the virtual revolutionising learning and meaning making. For Turner (2001), the capacity of digital exhibitions to convey differences, inverses and opposites of material permits plural, layered, recombinatory modes of representation, well-suited to an era of social diversity, and cultural and political complexity. Others, however, see significant unrealised potential in museums' use of digital media. Crampton Smith (as cited in McCullough, 2005, p. 14.) argues that those who supply content for digital platforms, "barely understand the consequences of this mediation in terms of their respective disciplines, much less the implications for any new synthesis in design." The examples in this paper explore the consequences of this lack of awareness for the development of new media exhibits, discussing the often challenging nature of co-designing in the context of real projects.

Designing across boundaries of knowledge and practice

Much has been written about the growing incidence of mixed project teams in contemporary workplaces and academia. Such teams are variously described as multidisciplinary, interdisciplinary and transdisciplinary. Choi and Pak (2006) suggest the nature of disciplinary relations can be partly distinguished by thinking of multidisciplinary as additive; interdisciplinary as interactive; and transdisciplinary as a holistic integration of disciplinary knowledge and methods. The design teams in the two projects discussed saw the sharing of knowledge and perspectives between those contributing to content development as an aim, struck on behalf of museum visitors, seeing design as having more than a service role in the presentation of information. It is a matter of conjecture whether this was achieved. Certainly, design work became contested territory, highlighting the highly situated nature of knowledge and meaning while revealing a complex circuitry to exist between audiences, content providers, designers and other project stakeholders.

Increasingly, advanced design thinking sees the designer as acting *for* audiences in the design process (Buchanan 2001, Forlizzi & Lebbon 2002, Hanington 2003, Redstrom 2006, de Stadler & van der Land 2007, Toker 2007). The capacity for distinct fields of knowledge—content providers' scholarly knowledge, designers' professional knowledge of communication and production, and museum visitors' everyday knowledge—to intersect as shared meaning *through* design is crucial to the success of information visualisation for new media exhibits in the contemporary museum, especially where their content is unavoidably abstruse. This holds for the main concepts driving exhibition development and the myriad of contingent issues concerning the nature of media literacy and reception as well as those factors of age,

gender, ethnicity, nationality, socioeconomic status and education that influence museum attendance. However, the way forward here is not necessarily clear.

Vredenburg, Mao, Smith & Carey (2002), Battarbee (2003) and Mao, Vredenburg, Smith & Carey (2005) show that although user-centered design practices are becoming more widely used in the areas of communications and information technology, their application and evaluation is lacking in many dimensions. Similarly, while the co-design literature describes a range of innovative tools and practices for facilitating design collaboration and user participation in dedicated projects, it has little to say to designers when project budgets and schedules preclude the participation of representative end-users or where other stakeholders see design as a straightforward process, not requiring, as Mattelmäki (2008, p.65) has elegantly described it, 'an iterative co-exploring of the design space'. This paper argues that Etienne Wenger's theory of communities of practice (1991, 1998), especially through its central principle of "brokering", makes a significant contribution to designers' understanding of the social and intellectual dynamics of multidisciplinary projects. The original dimension of the paper is its identification of the designed artifact as enacting the principal work of brokering. Our examples show that designs do this by revealing where differences of knowledge and intent exist between the different stakeholders to a project, especially where designers' take responsibility for the needs and perspectives of end-users. In fact, the paper proposes that by making conflicts between preconceived perspectives and knowledge systems visible, designing can succeed where verbal negotiation is insufficient.

Communities of practice

Wenger's theory of communities of practice addresses interrelated issues of identity, meaning and practice in the pursuit of a shared enterprise over time. Wenger developed the theory with the anthropologist Jean Lave while researching the social learning processes surrounding apprenticeships. For Wenger and Lave (Wenger, 2007), the exchange of knowledge was not limited to the apprentice, but rather revealed a dynamic process involving everyone in the workplace, hence the term "community of practice". Wenger (1998) describes communities of practice as informal, pervasive, often undetected, but nonetheless integral to daily life. An example is the productive coping and learning strategies families develop over time as a unique set of "practices, routines, rituals, artifacts, symbols, conventions, stories, and histories" (Wenger, 1998, p. 6).

Lave and Wengers' theory has been applied to various fields including education and learning, business and management, and virtual and distance communities. Cambridge, Kaplan and Suter (2005) report on the development of communities of practice in higher education in the aim of offering learning resources to the wider community. Trayner, Smith and Bettoni (2006) and Gannon-Leary and Fontainha (2007) discuss the application of Lave and Wengers' ideas to the conduct of international virtual learning communities. Lave and Wenger (1991), Kahan and Wenger (2004) and Wenger, McDermott, and Snyder (2002) describe efforts to establish learning communities in the management field as an alternative to formal business

associations. Wenger (1999), Wenger and Snyder (2000), Wenger et al. (2002) and Pemberton-Billing, Cooper, Wootton and North (2003) discuss the use of the theory as a model for the establishment of virtual learning communities among geographically dispersed groups and individuals in the European aerospace, construction and product design industries. Reitan (2006) uses the theory to discuss the transfer of design and sewing skills between generations of North Alaskan Inuit women. In these texts the theory of communities of practice is used to analyse the nature of existing groups or as a model for conducting self-directed group learning and negotiation. Both uses are relevant to design, conceptualising the social processes around design practice while offering a paradigm for the development of knowledge-in-practice in the conduct of multidisciplinary projects.

These texts also emphasise the widely differing circumstances in which communities of practice emerge. Despite such diversity, Wenger (1998) argues that communities of practice possess three basic attributes—mutual engagement, a joint enterprise and a shared repertoire—to the extent that individual contributions can no longer be seen as independent activities. Mutual engagement in an enterprise over time is the glue that holds a community of practice together, the complex relations that result defining it by what it does. Wenger stresses, however, that achieving mutual engagement is a subtle and delicate process involving a shared context and specific modes of communication, a group only qualifying as a community of practice when its members interact and learn together. Similarly, Wenger (1998, p. 77) rejects the positive connotations of the word community, arguing that harmony and homogeneity cannot be assumed in a community of practice since it is formed by what people do and not out of an idealized view of what a community should be like. In fact, Wenger sees diversity as important in making mutual engagement in practice “possible and productive” (1998, p. 75), engagement creating both collective and differential identities, roles and behaviour among participants.

The second element of a community of practice is the joint nature of the enterprise to the extent that participants feel it is fundamentally theirs, regardless of the presence of larger forces at the immediate organisational or broader social level (Wenger 1998, p. 80). A by-product of the perception of ownership is a sense of mutual accountability regardless of whether everybody agrees or believes the same thing (Wenger 1998, p. 77). Indeed, Wenger (1998, p. 81) argues that disagreement may reflect greater commitment to an enterprise than passive conformity. Mutual accountability in a community of practice is characterised by acknowledgement of each other’s differences and the balancing of divergent aspirations against the greater good of the enterprise (Wenger 1998, p. 77).

The third element of a community of practice is the development of a shared repertoire for doing things. For Wenger (1998, p. 125), a shared repertoire remains innate and unarticulated, especially to an outsider. It includes quick and effective communication, ready innovation, a capacity to slip into action or discussion, awareness of the skills and contributions of others, and the development of shared problem-solving methods, representational tools and tacit judgement regarding what is working and what needs adjustment.

Brokering between Communities of Practice:

When designers work together as a community of practice their common education, industry experience and shared practices mostly enable the successful coordination of perspectives. By contrast, the visualization of content for new media exhibits in the contemporary museum confronts the designer with unfamiliar bodies of knowledge and practice, requiring adept negotiation of directions and outcomes. While Wenger accepts that most people are brokers in their daily lives, he argues the task of brokering *between* communities of practice entails specific "processes of translation, coordination and alignment between perspectives" (1998, p. 109). Brokering can be conducted through human negotiation or artifacts such as documents, but its consistent aspect is the linking and integration of practices for the benefit of the joint enterprise (Wenger 1998, p. 109).

For Wenger, brokering happens on the boundary between communities of practice. It may arise as a single event, or as a pattern of activity that becomes integral to a shared enterprise. He represents boundaries between practices as worth scrutinising, depicting them as a location for productive conflicts that can unpack existing structures and facilitate connections, serving as a learning resource that advances understanding with the potential to produce radically new knowledge and practice (Wenger 1998, p. 254). Where designers step outside the fixed dynamics of artifact and client to invest in democratic and empathetic processes, boundary encounters are already important to design. Principles of user-centered design are built on an exchange of perspectives between designers and end-users in the aim of correlating the practices of design with the situation and practices of use. The related adaptation of research methods from anthropology, psychology or sociology to design also represents a boundary encounter, as does the participation of specialists from these fields in design teams.

Yet a productive merger of perspectives and practices cannot be guaranteed. Revealing the challenges of co-designing between communities of practice, Van Veggel (2005) reports that the conduct of ethnographic research in the context of new product development can result in an irrevocable collision of intellectual cultures. For van Veggel, anthropologists are trained to deeply consider the complexity of people's actions and motivations from a basis of detailed data collection. By contrast, designers' training and experience favours quick, decisive and intuitive problem solving. Anthropologists' involvement in product development challenges designers' assumptions about designed artifacts and their modes of use, but only if all parties embrace each other's ways of seeing and doing things. For van Veggel, designers need to appreciate the value of complexity and reflection, while anthropologists need to accept the requirement for prompt decisions in a process limited by real time and budget constraints. Ultimately, van Veggel argues that for designers and anthropologists to collaborate on product development requires "a totally new common language" (2005, p. 9), which is to say a shared repertoire. For a new community of practice to arise in such situations, mutual engagement and a sense of joint ownership also need to be present, being signalled by designers and social scientists sharing the roles of design and research with a measure of reciprocal understanding of each other's methodologies. The potential for disparate disciplines to collaborate to

this extent is explored in the discussion of the following exhibition examples, as are the challenges involved therein.

Design *is* the boundary object: The Universe in a Virtual Room

For Wenger, the catalyst for brokering knowledge and perspectives between communities of practice is the “boundary object”, an activity or artifact that reveals commonalities, conflicts or gaps of knowledge or practice among the contributors to a joint enterprise. For the scientists who provided the factual content, *The Universe in a Virtual Room* sought to popularise science through an innovative delivery platform. For the designers, the project provided a challenging context in which to explore co-design. The co-production of high-quality media content for a diverse museum audience suggested a prime motivation for mutual engagement and accountability among the project team. The commencement of designing, however, highlighted the need for significant boundary work to arrive at a shared perspective of what was needed in the delivery of media content.

The scientists—who had helped develop the VROOM platform—focused on the platform’s technical systems. The designers were more concerned with its support for creative approaches such as temporal and spatial asynchrony and multiple narratives on multiple screens, seeing communication principles as paramount if the exhibition were to inspire audience fascination in cosmological principles. Similarly, while the form of information was central to content delivery, early design work revealed the scientists and designers held divergent perspectives on the nature of information and visualisation, reflecting distinct cultural models. For the scientists, information was defined by the parameters of disciplinary knowledge and its justification according to the methodologies of the discipline, knowledge in astrophysics being primarily shared among experts. For the designers, characteristics of audience, media and context suggested the form of information, its visualisation for the exhibit being driven by a mix of pragmatic (organisational) and idealistic (user-focused and creative) objectives.

Where cultural models become routine for individual communities of practice they can be regarded as repertoires. Arguably, part of the scientists’ “empiricist repertoire” (Gilbert and Mulkey 1984, p.40) relied on an assumption that both designers and museum visitors would be unlikely to dispute science facts, framing the designers as “decorators of information” (Forlizzi and Lebbon, 2002, p. 4) and museum visitors as passive semiotic recipients. The designers saw a greater role for themselves in decision-making, while regarding everyday people in contemporary, image-based societies as having a sophisticated relationship to representations, exhibited in their daily practice as viewers through countless act of popular discrimination over which images to consume. For the designers, these divergent positions on information and visualisation suggested that the scientists, designers and future museum visitors would likely have different ways of conceiving and discussing the universe, underscoring design’s role in brokering a meaningful exchange of information between the scientists and museum visitors. Frascara (1997) highlights designers’ advocacy role in such circumstances, warning that when designers focus on design production to the exclusion of its inherent issues they weaken their position in the design process.

For Frascara, design is an intellectual, human-focused activity in which designers represent the interests of audiences, taking on the responsibility of “continual intervention” to lessen “the chance of weakness in ... communication delivery” (1997, p. 11). The design team for *The Universe in a Virtual Room* had hoped to conduct audience research—part of the designer’s repertoire of practice—to help themselves and the scientists understand what was needed for the project, but timelines intervened. In previous research, members of the design team had observed visitor responses to the VROOM over a two-month period, monitoring reactions to the task of tracking 3D stereo animation and audio effects across a series of screens in the semi-lit space in the presence of other museum visitors, while wearing Polaroid glasses. Following early meetings with the astrophysicists the designers felt compelled to adopt an interventionist approach to co-design, requesting the scientists visit the VROOM with them to observe visitors’ reactions as a basis for formulating content for the exhibition’s screen-based delivery system.

These visits were part of a pattern of activity, largely born of design methods, which prompted designers and scientists to confront each other’s perspectives on delivering astrophysics research to museum visitors with varying levels of science literacy and interest. These activities included a series of design workshops in which the designers’ struggle to understand basic astrophysics principles highlighted the position of the general museum visitor to the scientists, while stressing project members’ shared responsibility for the visualisation of information, obliging the designers to continue their efforts to understand the scientific principles underlying exhibition content and challenging the scientists to engage with principles of information design. Small exercises explored visualisation from scientific and design perspectives, revealing that the scientists saw digital images of galaxies, pulsars and black holes as transparent in character and meaning, exemplifying reasoned scientific principles and an explicable physical reality. For the designers, the images had undeniable aesthetic and emotional impact, particularly given the large scale on which they would be presented in the VROOM, but their meaning was open to broad interpretation.

To anchor meaning, the scientists thought to link imagery to Einstein’s theories through a monologue delivered by an animated image of the physicist. The designers saw this didactic approach as unlikely to hold the interest of museum visitors, while being inconsistent with contemporary museums’ principal teaching and learning philosophies, which promote visitors’ active construction of knowledge (Dean 1996, Hein 1998, Caulton 1998, Hooper-Greenhill 1999). Here the design team introduced what Cooper (1999, p. 124) has called “hypothetical archetypes of actual users” to help designers better conceive their target audience. The scientists were asked to imagine explaining their research to specific museum visitors of the age of 5, 16 and 50 as a way of conceiving the needs and perspectives of the diversity of museum visitors.

The investigation of differential positions was time consuming for all involved and could only be pursued as far as schedules and resources allowed, but was fundamental to the problem-solving repertoire of the mixed community of practice that developed around the visualisation project, enabling some

transfer of disciplinary knowledge and practice. For the designers, engaging with modes of visualisation in astrophysics provided some understanding of the simulated nature of cosmological images, which it was learned were not “real” but rather produced from mathematical data using a supercomputer. The designers’ emphasis on the mediating role of technology and struggle to understand exhibition content helped the scientists to understand something of the position of the museum visitor. However, it was principally the iterations of media content through the practice of design that revealed to the scientists that image, sound and typography are neither literal nor fixed vehicles of meaning. The embodiment of gaps in knowledge and practice through design was productive in developing various aspects of the exhibition, though it is arguable whether the interest of the design team in the interchange of knowledge and perspectives on behalf of the museum audience was shared or understood. A joint position was nevertheless achieved, it being agreed not to risk alienating the museum visitor with a flood of information or to discount their sophistication through the inclusion of naïve representations of science. Rather, aspects of imaginative visualisation were used to elicit audience interest without consciously compromising the scientific integrity of the information (e.g. Figure 2).

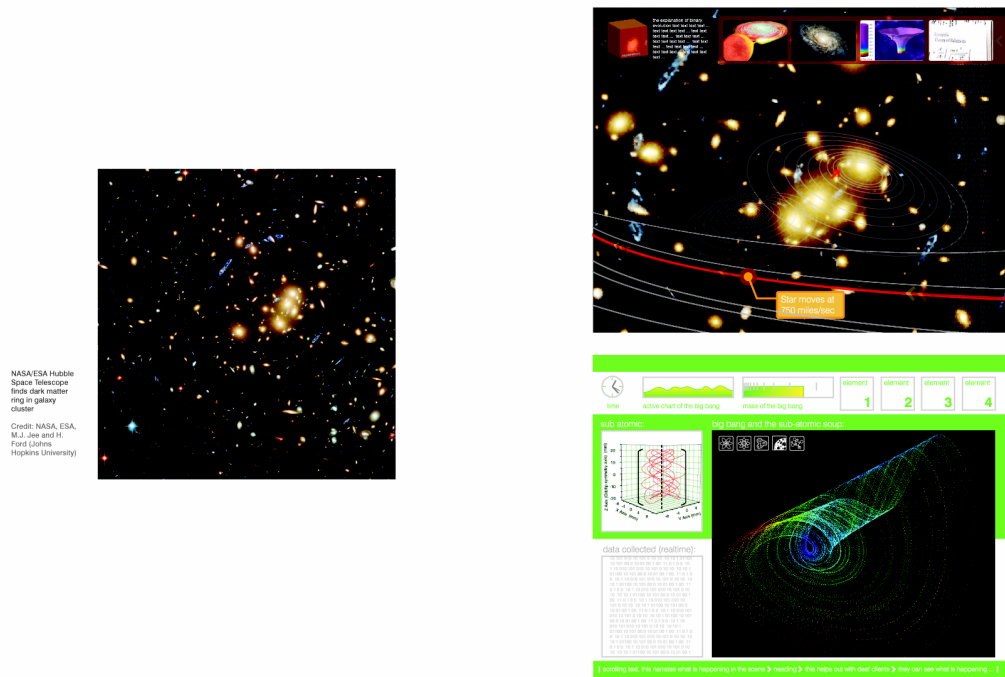


Figure 2: Left_dark matter in galaxy cluster, Credit: NASA, ESA, M.J Jee and H. Ford, Johns Hopkins University, Right-interface examples for VROOM, credit Anita Kocsis

Design as the boundary object at a distance: *Sacred Angkor*

The brokering between communities of practice in *The Universe in a Virtual Room* developed as a pattern of activity as a result of the insistence of the design team. In the case of *Sacred Angkor* the transfer and alignment of perspectives through design was brokered largely in a single event. *Sacred*

Angkor was a collaboration between its curator, Sarah Kenderdine, and a group of archaeologists, on whose research findings it was based. The curator directed the exhibition process, conferring with the archaeologists who did not attend production meetings. The production team comprised designers, photographers, audio technicians and programmers, this paper's first author serving as a design consultant to the curator.

Sacred Angkor's development raised various issues concerning the representation of archaeological data and the nature of the VROOM platform. The archaeologists were also researchers used to communicating their work to an audience of peers using established representational codes. They approached architectural diagrams, photographs, satellite maps and site plans from a scholarly perspective to establish knowledge about human history, the objective presentation of their data being of critical importance to them. However, the curator believed the demand for historical accuracy would impinge on visitor engagement, seeing the information as open to creative application through the curatorial practice of interpretation, enacted via digital augmentation. She sought to raise interest in the world heritage Angkor site by appealing to museum visitors' emotions, perceptions and imagination, creating possibilities for learning and understanding. This was also the archaeologists' goal, but not initially at the expense of the disciplinary protocols for the presentation of archeological data.

The prototype for *Sacred Angkor* was comprised of life-size panoramas of the temple grounds, augmented with animation, and audio, and diagrams, maps and plans, the latter representing the archaeologists' research findings. The use of the VROOM's stereo-visualization technology sought to create something of the presence of the site, encouraging museum visitors to slip between fact and fantasy (Kenderdine, 2004). It appealed directly to museum visitors' imagination through the inclusion of animated figures representing various "ghosts" connected with the site. The aim was to evoke Angkor Wat's intangible spiritual heritage, portraying the site as the living social and religious entity of former times not a collection of physical archaeology. When the archaeologists saw an early version of media content, previously unknown representational conflicts emerged. The prototype leveraged the type of immersive experience inherent to the platform, which the curator saw as supporting the museum experience as an active learning process arising from within the individual through deep engagement with rich content. The idea that museum visitors learn in a variety and combination of ways also influenced the diversity of information forms proposed for the exhibit. While accepting no exhibition can have universal appeal, the curator and design team were confident many visitors to *Sacred Angkor* would be accustomed and receptive to its experiential approach, the layering of information encouraging viewers to discover individual threads of interest and meaning.

In *Sacred Angkor's* development, design served an important brokering role in highlighting the divergent perspectives and viewing practices of expert content providers and museum visitors. Kenderdine (2007, p. 323) argues that contradiction is inherent to the application of virtual platforms to heritage material, a "provocative tension" existing between "the scientific requirement to reproduce rational material reality" and the qualities of immersion, sensory

experience and interaction that encourage museum visitors to visit virtual heritage presentations. The design work for *Sacred Angkor* was enmeshed in this tension, revealing the work of communication designers to be mediating meaning and experience in an age of ubiquitous information and media. The design team also contributed practical knowledge of the exhibition platform to the content development process, but it was the curator's and archaeologists' engagement with the designed prototype that allowed issues of content, communication strategy and visitor needs to be transacted, where previously there was polite discussion at cross purposes. Design thus precipitated mutual engagement with the point of the project, arguably leading to a more radical and successful exhibition.



Figure 3: Top Left: visualization of Angkor Wat in VROOM, Top Right: Angkor satellite image, Bottom: stereo photograph, Credits: Director-Sarah Kenderdine, Photography-Peter Murphy

In its final form, *Sacred Angkor* was built around single, long duration panoramas of the temple, placing museum visitors in a contemplative relationship to media content (e.g. Figure 3). The temporal shift, an invention of the design process, made something unique of the exhibit, which diverged from the pace and experience of viewing the temple in reality. Prototype designs were used in brokering outcomes on behalf of the project within the larger organisational framework of the museum and across a network of other stakeholders, resulting in the funding of the production team to travel to Cambodia to make high fidelity, stereographic photographs and spatialised soundscapes of the temple, thus ensuring a more atmospheric and faithful

representation of the site by comparison to the digital reconstructions that were initially proposed. Conversely, program managers outside the project insisted a didactic narration be added to *Sacred Angkor*. Concerned that the inclusion of the human voice would disrupt the immersive experience of the exhibit, the curator successfully negotiated for narration to be delivered through wireless headphones so listening was optional (Kenderdine, 2004, p. 21).

Discussion and Conclusions

Wenger's theory of communities of practice supports Frascara's view that co-designing "visual communication is more an interdiscipline than a discipline" (1997, p.3), identifying specific principles and methods to accommodate the hybrid disciplinary frameworks that enter design projects. Designers make a unique contribution to multidisciplinary projects through their knowledge of form and production, and commitment to user experience, but also, as we have argued, because design makes things material so the ideas invested in them can be recognised and negotiated. Others have discussed the wide applicability of design's distinctive capacities and knowledge. Rust (2008) sees design methods making a unique contribution to research in a range of academic fields if deep-seated barriers to such involvement can be overcome. For Rust, better understanding and respect for the knowledge and methods of researchers among designers, and access to open-minded academic collaborators could see designers' ability to quickly conceive and apply artifacts harnessed to varied research tasks, potentially expanding the boundaries of knowledge.

The scope for designers' ideation and visualisation skills to support research was acknowledged in reference to the *Sacred Angkor* project. In launching the exhibit, Roland Fletcher, Director of the Great Angkor Project, commented that the exhibition's combination of digital technology and creative interpretation enabled those committed to the temple's preservation and protection "to see what is not readily seeable" (Delivered 9 November 2004). Increasingly, interpretation practices developed in the museum and at heritage sites through the joint enterprise of curators and designers for the benefit of audiences are being applied in academic and theoretical archaeology for purposes of scholarly analysis and hypothesis framing. Brokering boundaries of knowledge and practice to discover the nexus of differences and connections in a project takes time and effort, but as Wenger stresses it is the only way to get to the heart of the matter. The examples in this paper saw prototype design work challenge contributors to engage with each other's ways of thinking, pushing information visualisation into new territory where differences in intentions and perspectives were initially too abstract and easy to ignore.

As the position of the museum visitor has changed from passive to active, the role of designers has shifted from waiting to receive instruction to a more active influence over the form *and* content of media exhibits. Wenger's theory of communities of practice reflects on the social dynamics of this new role. Our discussion has sought to show how design's brokering role can bring strategic focus to information visualisation if designers have the commitment and confidence to challenge barriers to knowledge and understanding. While

the design teams in the two examples were committed to co-design, the role of the designed artifact in catalyzing differences of perspective, knowledge and practice was more important in brokering outcomes than the individuals involved. This is especially demonstrated in the *Sacred Angkor* project, where the design team worked at arms length from the content providers, but successful brokering between communities of practice nevertheless occurred. Embracing Wenger's idea of brokering adds new levels of possibility to design, encouraging designers to engage with the range of knowledge and perspectives that converge in multidisciplinary projects as an alternative to denying their differences through premature aesthetic or conceptual resolutions.

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