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INSIDE: ARCHITECTURE AND DESIGN AS INTERPRETATION
PLUS: THE ROLE OF CREATIVITY IN WIDENING ACCESS TO STEM
EDUCATION AND MORE!

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BUILDING COMMUNITIES OF TRANSFORMATION: SENCER AND SENCER-ISE

By Marsha Semmel and David Ucko

INTRODUCTION

More than ever, our nation faces critical public policy issues related to the environment, health, applications of technology, and other key societal challenges. At the same time, informal science organizations increasingly seek to demonstrate their relevance as community learning resources and important sites of public engagement with civic issues. For these reasons, they can benefit from learning about the National Center for Science and Civic Engagement and its SENCER (Science Education for New Civic Engagement and Responsibilities) initiative.

The mission of the National Center is *“to empower citizens as responsible, lifelong learners who can apply the knowledge, values, and methods of science to the complex civic challenges facing our democracy.”* As their website (<http://ncsce.net>) notes, *“By putting content into context, what is inaccessible becomes accessible, what is uninteresting becomes interesting, and what is not meaningful becomes meaningful. We empower learners by showing them that their knowledge matters, and what they learn today can help solve some of the biggest problems of tomorrow.”*

Founded in 2004, and based since November 2015 in the Department of Technology and Society at Stony Brook University in New York, the National Center for Science and Civic Engagement supports a community of more than 6,000 educators, administrators, and students from more than 500 two- and four-year colleges, universities, and, increasingly, informal education venues like science centers, zoos, and wildlife centers.

The National Center’s signature initiative is SENCER. It was born in the wake of the HIV/AIDS epidemic of the 1980s and 1990s, when Rutgers University Professor Monica Devanas developed a course that taught basic biology through a focus on that disease. By teaching standard general education biology course content “through” a complex public health challenge of immediate relevance, enrollments surged from a typical 125 to over 450 (filling the largest available lecture hall). This use of a pressing public problem to engage students and help them learn and retain complex biological concepts became the foundational strategy of SENCER, and was extended to all STEM disciplines and course levels, from general education to majors. Since that time, hundreds of courses, course modules, teaching guides, and curricular programs have

been developed, evaluated, and shared within the SENCER community, all focused on both improving STEM learning and building civic awareness and agency. Currently, there are more than 50 exemplary SENCER field tested “model” courses contributed by faculty in a full range of STEM disciplines. The Center has also spawned nine regional hubs and boasts other successful initiatives, including GLISTEN (Great Lakes Innovative Stewardship Through Education Network) and Engaging Mathematics.

Since its establishment, the National Center and its respective initiatives have received significant support from the National Science Foundation, the Noyce Foundation, the Keck Foundation, the Institute of Museum and Library Services, the National Endowment for the Humanities, and other funders.

SENCER has also developed an online assessment instrument, SENCER-SALG (Student Assessment of Learning Gains), which is aligned with SENCER project goals. Analysis by Senior Research Fellow Stephen Carroll noted that SENCER faculty out-performed non-SENCER colleagues in several dimensions, including changing attitudes toward science and building habits of mind and behavior. Carroll’s report concluded: *“the data clearly show that SENCER is improving science education and civic engagement across the nation, supporting the NSF’s STEM education goals”* (Carroll 2012). Currently, the Center conducts participant evaluation for all SENCER programs, including educator professional development programs and resources. In addition, the Center has convened a research and evaluation task force to identify or develop assessment instruments that address SENCER-specific learning outcomes and their contribution to the organization’s future research agenda.

THE SENCER IDEALS

Critical to SENCER are its Ideals, which put forth its philosophy and frame its pedagogical approach and community values. While they focus principally on “students” and therefore connect most readily with formal education, several recent projects have tested these ideals successfully in informal learning settings. In fact, the focus on the scientific method and scientific ways of knowing align several of these ideals with the Strands of Science Learning put forward in the National Research Council’s Learning Science in Informal Environments (2009).

THE SENCER IDEALS ILLUSTRATE THE PRINCIPLES AND PHILOSOPHIES THAT GUIDE SENCER'S APPROACH TO EDUCATIONAL PRACTICE:

- SENCER robustly connects science and civic engagement by teaching **“through”** complex, contested, capacious, current, and unresolved public issues **“to”** basic science.
- SENCER invites students to put scientific knowledge and the scientific method **to immediate use** on matters **of immediate interest to students**.
- SENCER helps **reveal the limits of science** by identifying the elements of public issues where science does not offer a clear resolution.
- SENCER **shows the power of science** by identifying the dimensions of a public issue that can be better understood with certain mathematical and scientific ways of knowing.
- SENCER conceives the intellectual project as **practical and engaged from the start**, as opposed to science education models that view the mind as a kind of **“storage shed”** where abstract knowledge may be secreted for vague potential uses.
- SENCER seeks to **extract from the immediate issues the larger, common lessons** about scientific processes and methods.
- SENCER locates the **responsibilities** (the burdens and the pleasures) **of discovery as the work of the student**.
- SENCER, by focusing on contested issues, encourages student **engagement with “multidisciplinary trouble”** and with civic questions that require attention now. By doing so, SENCER hopes to help students **overcome both unfounded fears and unquestioning awe of science**.

A COMMUNITY OF TRANSFORMATION

With the informal learning sector increasingly engaging in Communities of Practice (CoP), the results of recent research by Dr. Adrianna Kezar and Dr. Sean Gehrke of the Pullias Center for Higher Education in the Rossier School of Education at the University of Southern California are of interest. Kezar and Gehrke examined four STEM-focused, higher education, communities focused on advancing the goals of scaling STEM reform: BioQuest, Project Kaleidoscope, the POGIL Project, and SENCER (Kezar & Gehrke 2015). Their NSF-funded study looked at design and structural features of the four programs, the perceived benefits

of participation for both members and leaders, and the goals of affecting and spreading undergraduate STEM pedagogical change. Kezar and Gehrke concluded that these groups had developed an approach to STEM educational reform that they dubbed “communities of transformation” with their defining feature being a philosophical focus on exploring “in deep and fundamental ways, how science is taught” (p. i). Moreover, these communities of transformation “address both individual faculty and broader systemic change” (p.i), with an innovation “that is lived, a distributed community, and a practice” (p.20).

Higher Ed Partner	ISE Partner	Project
Antioch College	Glen Helen Outdoor Education Center	Biodiversity, invasive species, forest restoration
Brooklyn College - CUNY	Gateway National Recreation Area	Seashore plastic debris survey
Cornell University	Sciencenter	Parent support for early cognitive development
Fordham University	Wildlife Conservation Society	Urban ecology field research
Hamilton, Hope, and Oberlin College	Green Science Policy Institute	Analytical toxicology & public policy
New Mexico EPSCoR	NM Museum of Natural History & Science	Current S&T research network
Paul Smith's College	The Wild Center	Climate change gatekeepers
Raritan Valley Community College	New Jersey Audubon Center	Forest health citizen science
St. Mary's College of California	Lindsay Wildlife Museum	Urban habitat mobile app
University of Connecticut	Connecticut Science Center	Genome ambassadors

SENCER-INFORMAL SCIENCE EDUCATION (SENCER-ISE)

The intersection of SENCER and ISE was first explored at an NSF-funded invitational conference in 2011 that brought together representatives of Higher Education (HE) and Informal Science Education (ISE) to discuss possible strategies for working together based on a shared interest in civic engagement. The groundwork for that event was laid two years earlier by presentations comparing informal with formal learning at SENCER's Fourth Annual Science Symposium by the late Alan Friedman (then director, New York Hall of Science) and David Ucko (then NSF deputy division director). Those talks revealed that SENCER courses are grounded in key attributes of informal learning (Ucko 2015). Emphasis on societal issues makes the STEM content more relevant, increasing intrinsic motivation. SENCER

courses focus on the learner rather than simply transmitting academic content. Like many informal learning exhibits and programs, SENCER courses tend to be interdisciplinary since they address real world concerns.

The interest generated by the conference led to proposals supported by NSF and the Noyce Foundation to fund a set of ten partnerships, which in turn received mini-grants to fund their local initiatives, as well as centralized support from SENCER staff. As indicated in the table below, many of the individual projects focused on aspects of the environment as the civic issue. Further details can be found at <http://sencer-ise.net/partnerships>. Figures 1 through 4 illustrate several of the partnership initiatives.



Figure 1: Students surveying plastics along Jamaica Bay as part of the Sentinels of Shoreline Change project, a partnership of the National Park Service's Gateway National Recreation Area and Brooklyn College.



Figure 2: A Family Workshop at Sciencenter, part of "Science from the Start: Engaging Researchers, Graduates, and a Science Museum to Reach Early Learners and Set the Stage for STEM Learning," in partnership with Cornell University's Early Childhood Cognition Lab.



Figure 3: In “Genome Ambassadors,” the Connecticut Science Center partnered with the University of Connecticut to conduct surveys and develop hands-on activities based on genetics and genomics.

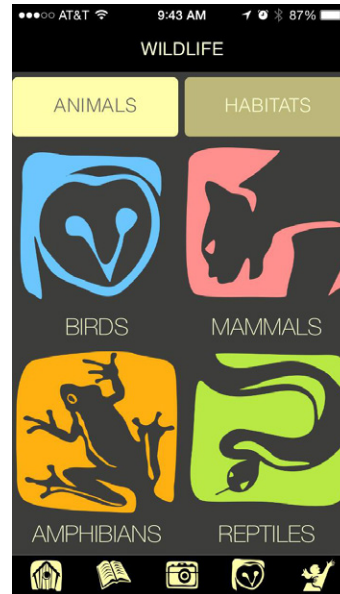


Figure 4: In “Facing the Future: Sharing Habitats with Wildlife,” students at Saint Mary’s College of California worked with Lindsay Wildlife Museum staff to develop and launch a free mobile app.

This pilot project demonstrated proof of concept. Eight of the ten partnerships completed their collaborative work around their selected issue of civic value, and most are continuing their relationships.

Based on a summative evaluation conducted by Randi Korn & Associates, the following factors were most important in creating durable HE-ISE partnerships:

- Sharing common goals and a “passion” for the project.
- Establishing clear and consistent communication.
- Connecting on a personal level to strengthen relationships beyond mutual respect.
- Planning at the outset to clearly define roles, responsibilities, and expectations.
- Reflective practice and openness to change that facilitate course correction as needed.
- Adequate resources that allow partners to contribute the necessary amount of time.

A National Leadership Grant from the Institute of Museum and Library Services (IMLS) supported five more partner-

ships in order to evaluate the impact of an additional element: experienced “eMentors,” mentors who would be in virtual communication with their designated partnership. The five eMentors, one assigned to each new partnership, were recruited from those who participated in the first SENCER-ISE partnership cohort.

Since this project is still underway, definitive conclusions cannot be provided. However, preliminary feedback indicates the importance of:

- Holding an in-person meeting of eMentors and partner mentees early in the project.
- Setting clear expectations and agreement on the role of the eMentor.
- Establishing a regular schedule for meetings via a chosen platform.
- Jointly creating an action plan and timeline for completion of project activities.
- Understanding and adapting to the respective organizational cultures and constraints of HE, ISE, and, in some cases, K-12.

Higher Ed Partner	ISE Partner	Project
Eastern Michigan University	Ann Arbor Hands-On Museum	Community needs assessment for collaborative programming
Lincoln Memorial University	Abraham Lincoln Library & Museum	Human geography & environmental history
Rider University	Stony Brook Millstone Watershed Assn	Water quality
Towson University	National Aquarium	Stewardship of aquatic environment
Wheelock College	Charles River Watershed Assn	Urban watershed quality

The potential for collective impact is being investigated in a related NSF-funded project based on possible cross-sector collaboration between SENCER and the National Informal STEM Education Network (NISE Net). In a March 2017 convening, representatives of both organizations, along with other key invited participants, explored the assets and structures of these two networks, along with the Portal to the Public Network (PoPNet), the Afterschool Alliance, the Hive Learning Network, and the Humanities Action Lab. It became clear that opportunities exist for SENCER to leverage its national resources and advance its strategy of linking STEM content to pressing civic challenges through strategic collaborations with other networks. It was also clear that doing so would not be easy and best accomplished in small but strategic steps. As a follow up, SENCER is conducting a national survey among network members to obtain feedback on possible next steps.

CONCLUSION

Collaboration between informal science organizations and higher education institutions based on civic engagement offers potential benefits for the partners, the students, and the public. ISE organizations gain access not only to faculty subject matter expertise but to undergraduates, a yet largely untapped STEM education resource and a potential audience. The colleges and universities gain access to public audiences and informal learning expertise. Those involved gain professional development, and both organizations benefit from greater involvement in their communities. For ISEs, these types of civic engagement partnerships provide a means to further their transition from “nice” to “necessary” by fostering public engagement with critical issues.

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INFORMAL LEARNING REVIEW SURVEY - PARTICIPATION REQUEST

In the hopes of serving you - our colleagues and Informal Learning Review readers - better, Informal Learning Experiences, in collaboration with Karen Wise of Wise Strategic Consulting, is seeking some feedback. Your responses to our survey will help us to shape the future of the Informal Learning Review. Our goal is to make it more relevant and interesting to you and your staff. The survey can be accessed at: <https://www.surveymonkey.com/r/CJYV8NS>.

We appreciate your taking the time to respond. We would also welcome any suggestions or requests. Please send them directly to us at ileinc@informallearning.com.

ARCHITECTURE AND DESIGN AS INTERPRETATION

By Lee H. Skolnick

Although the issue at hand has hovered in the air around the world of science centers and concept-based museums for a very long time, it came in for a landing not too long ago while a few of us were standing inside the amorphous blob of the Graz Kunsthalle in June of 2016, when we were attending that year's ECSITE Conference in Austria. We stood in wonderment: what a curious place to display art!...what did the outside of the building have to do with the inside?...with the purpose of the building?...with the functionality and operations of the institution? As we critically pondered these questions, I felt it was finally time to ask my colleagues an obvious question: why don't these conferences ever deal with the fundamental issue of the role of architecture and design in the pursuit of effective and meaningful interpretation? Why are there no focused sessions or papers on the subject? After all, there is without question a tremendous amount of informal discussion, most of it quite negative, regarding the impediment that most purpose-built museum buildings present to the proper functioning and educational mission of their respective organizations.

As I am often the lone architect at these conferences, or at least the only designer present for these complaint-filled discussions, I find myself absorbing the abuse born of years of the pent-up frustrations of many museum professionals. The architects of their buildings are routinely characterized as arrogant, stubborn, myopic, clueless, and worse. Of course, my dilemma in responding is that these multi-faceted complaints about their buildings and their authors are often largely correct.

So, who is to blame? Well, certainly the architects bear a great deal of responsibility for this unfortunate situation. But let's not forget about the people who hired them in the first place and proceeded to egg them on to their flights of hubristic and fantastical fancy. Board members and senior administrators can feel compelled for financial reasons (and a healthy dose of personal ambition?) to obtain a sellable architectural icon, frequently along with a brand-name architect, in order to cultivate the financial support they will need to realize their project. They believe they need that architectural rendering, often of a radical and aggressive design concept that will outshine and out-shout the other commodities on the grocery shelf of contemporary museum design, to attract the similarly ambitious sources of the big bucks. And the architects are only too happy to oblige. How could they not? Of course,

these designs can at times bear little sensitivity to the eventual operations of the organization. And because of this short-sightedness, or egregious omission, it will fall to others, down the food chain, to accommodate the angles, curves, idiosyncratic spaces, convoluted circulation, conservation challenges, uncontrolled natural light, poor acoustics, etc., that can frequently accompany the building as "statement."

ARCHITECTURE *IS* INTERPRETATION

It is a well-documented and widely held truth that the physical characteristics of the environments within which we dwell and engage in experience have a tremendous impact upon how we perceive and internalize those experiences. Context is both a filter and an integral component of making personal associations, and ultimately, meaning. As the original developers of the Reggio Emilia education philosophy and schools observed, "Environment is the third teacher."

How interesting then, and perhaps alarming, that so few designers and developers of museums and science centers take advantage of the rich and exciting opportunity to create exteriors and interiors that directly interpret the themes and concepts that they seek to communicate through the visitor experience. What we often see instead in the design of these buildings is an expression that is a symbolic, trendy, stylistic representation of the idea of "museum" or "science center," but not necessarily a true embodiment of the institution's communication goals and key messages nor an enhancement of the visitor's ability to gain deep understandings or find deep meaning.

We are all familiar with the museum or science center as an independent vessel into which we must then insert exhibitions and programs. At worst, these "containers" pose insurmountable obstacles to utilizing space effectively, whether through the imposition of idiosyncratic forms and shapes, or a disregard for the effects of too-specific circulation, the detrimental impacts of natural light, or the impossibility of adequate acoustic buffering or isolation. Consequent limitations abound, created by architectural features that are not attuned to the optimal functioning of the institution in delivering and offering to the public the highest quality interpretation and the most commodious experience. However, they do clearly illustrate the all too frequent situation wherein the design ambitions of the architect, as well as the leaders of the institutions them-

selves, overwhelm and ignore the more mundane, but critically important, issues that facilitate the best utilization of their buildings, including flexibility and the potential to evolve and adapt.

However, what is too often overlooked is the other, more positive side of the equation. This is the tremendous potential that design holds to powerfully contribute to the interpretation and communication of the content of the museum. All those same elements of design, and more – iconography, form, space, materiality, light, color, texture, pacing and movement, and even the smallest scale detail – can be harnessed and synthesized to support the creation of environments that provoke the most profound meaning making. It is toward the recognition of this powerful phenomenon, and the exploration of the tools and processes for achieving it, that our work must aim.

It must aim for what I call “design as interpretation.” Applicable to every medium of design (architecture, exhibits, graphics, media, etc.), it is an approach whereby content becomes embodied in every aspect of the designed environment, and we facilitate the greatest potential for learning and enlightenment on the part of the visitor.

Interpretation has many interesting definitions. I am particularly attracted to these two: “...to conceive the significance of” and “to present or conceptualize the meaning of by means of art.” It’s a profound form of “communication,” which itself has been defined as: “to make known; to reveal clearly; to manifest; to have an interchange – as of ideas.” I submit that “design as interpretation” consists of mining the individual situation to unearth the stories that constitute its essence and that it is the surest way of designing an experience that conveys meaning.

I have found interpretive design to manifest itself at two levels of depth and efficacy – one, minimally acceptable, and the other, sublime. I call the first mode “Representation,” and it’s certainly not terrible.

REPRESENTATION

Some very nice buildings use metaphor and symbol to great poetic effect. This is especially true in recent times, when formal architectural vocabulary has been freed from the formulaic constraints of strict stylistic convention, and as technological advances in both design tools and construction methods have allowed for greater freedom in imagining buildings and in building them (although in many cases the ways people actually use buildings may not have undergone the same revolutionary changes). I think the operative point for us is that often these exuberant expressions bear very little relation to the ostensible or real purpose of the building, and that they sometimes actually

impede rather than enhance their natural and proper function.

In Frank Gehry’s Guggenheim Museum, Bilbao, the light, curvilinear forms of walls and roofs have been said to evoke sailing ships on the water and are themselves sculpturally expressive. Further, they refer to Bilbao’s geographical position and historical role as a port city. This does not necessarily qualify them, or the interior spaces they enclose, as the most beneficial place to display art. Similarly, Santiago Calatrava’s boldly expressive Milwaukee Art Museum with its birdlike form and retractable roof, is a blockbuster in its own right but neither particularly expressive of nor supportive to the artwork stored inside. And while Renzo Piano’s New Metropolis Museum in Amsterdam may be photographed strategically in juxtaposition with the ships’ prows from which it takes its form, it is difficult to understand what relationship this is intended to have with the science activities which are at the heart of the museum’s program and *raison d’être*. We might compare these buildings to Jorn Utzon’s iconic Sydney Opera House, whose forms manage to refer to both the sails of the harbor and to the theme of music, while having the added advantages of clearly delineating the concert halls and offering them notably euphonic acoustics.

Of course, sometimes the “Representation” is quite literal. Throughout history, there have been buildings and structures which were, if not actually figurative, referential in their visual message to nothing so strongly as the function and/or subject for which they were created. And if they didn’t always work perfectly as integrated experiences or as beautiful objects, they nevertheless gave people a pretty good idea of what they were for. The Long Island Duck, of “Complexity and Contradiction” (Robert Venturi) fame, wears its function and subject on its sleeve (or wing). You bought ducks there. The forms of Frank Gehry’s Experience Music Project in Seattle are said to have been developed by smashing up electric guitars and then rearranging them until an optimal composition was found. (It is widely held that the usually masterful Gehry may have hit a “clinker” on this one. Herbert Muschamp, former architecture critic for the New York Times, likened it to “something that crawled out of the sea, rolled over, and died”.) Much of the music venerated at EMP was played on the electric guitar, and groups from “The Who” to the “Jimi Hendrix Experience” enjoyed smashing them. Unfortunately, the interior of the building gains little other than irrelevant, spatial bombast for all the trouble. It might get at the fracturing rebelliousness of rock music, but it doesn’t capture any of its other qualities. On the other hand, in that regard it beats I.M. Pei’s, Rock and Roll Hall of Fame in Cleveland, by “miles and miles.” Some can see the supposedly intentional reference to a record player there, but I’m not that

creative. It manages to freeze any of the heat of Rock and Roll, while sticking the exhibits in the basement and the mausoleum-like Hall of Fame way up in its darkened peak. And, Dominique Perrault's infamous Bibliotheque Nationale in Paris (the one that baked the books) is defined by the four glass towers at its corners (wherein books are stored behind large sheets of glass), each in the shape of an open book. Books within books, get it?

There have been more ingeniously sophisticated examples of "Representation" as well. Here, a modern sensibility has filtered and translated historical, cultural, or other subject matter information into an essentially contemporary design vocabulary. Still, in these buildings the references frequently appear to be somewhat applied, and as such have less influence on the depth and specificity of the experience in and around them. Two come to mind immediately.

Jean Nouvel's Institut du Monde Arabe in Paris, one of whose glass facades is fitted with a pattern of Islamic-inspired mechanical irises that open and close based on sensors which measure the sunlight hitting them. This late-twentieth century tour de force sends a message about Islam's traditional art, its marriage with a heritage of mathematics and science, and also serves as a forward-looking comment regarding the Islamic world's relevance and vibrancy in an age of technology. It has the added advantage of modulating the light entering spaces devoted to work and study.

James Ingo Freed's U.S. Holocaust Memorial and Museum, in Washington, DC, adapts a visual language referring to Hitler's World War II death camps for some of its interior and exterior forms and details (although far too slickly and exquisitely for my taste), and in an ironic twist for a building in our nation's capital, collides and juxtaposes it with an overtly hulking and conventional institutional building. Its almost covert insertion into its federal context provides a subtle but subversive commentary on the dangers of government-sanctioned atrocities. In this building, one must note that the staggering power of the total visitor experience is the result of a clear desire on the part of both the architect and the exhibit designer to imbue their separate parts with meaning and association. And, although the integration between architecture and exhibits could be both more intentional and more seamless, there is an undeniable emotional impact which owes to the largely successful attempt to let design help tell the story.

EMBODIMENT

When Louis Sullivan told the world that form should follow function he was interpreted by different people in different ways. On the most mundane level, the phrase is

understood to mean that a building should do no more nor less than be designed to facilitate its most pragmatic purpose. Storage facilities need big, open spaces. Prisons need lots of cells (perhaps), good lines of sight for security, and should be hard to get out of. Offices benefit from easy access to light and air and the provision of certain types of workspace and communication. It is easy to be reminded of Le Corbusier's "machines for living." However, Sullivan's declaration and edict is widely interpreted in architectural and academic circles as proposing something which is both more philosophical and more creatively challenging. It is understood to demand that the design of a building stems from an initial set of ideas which inform, to the greatest degree – and extent – possible, the creative problem solving which is embodied in the myriad of decisions regarding how it looks, functions, and is made. The idea is that by being clear regarding one's intent, and by carefully integrating each part of the building through adherence to rules and referents which support that intent, a unique harmony – an "organic rightness" – can be achieved. And it strongly suggests, I believe, that those guiding concepts be derived from the project's purpose, in a range of both general and specific terms. By following this path, we stand a decent chance of achieving the deeper and richer goal of "embodiment."

Thus, a church, while designed to comfortably seat its congregation, must also speak to themes of inspiration, and do so in ways which are evidenced in its materials, acoustics, and ventilation no less than in its space, light, and "decoration." (I use this term guardedly, for while Sullivan and his contemporaries felt comfortable in ascribing organic significance to decoration and ornamentation, subsequent history has gone through a sequence of banning it as impure and perverse, re-introducing it as symbolic pastiche, and, more recently – as seen in some of the previously cited examples – making it the guiding principle or image of the overall design. A big duck, a big bird, smashed guitars, boats of all sorts.)

The Penguin Pool at the London Zoo (1933), designed by Ove Arup and others, is a perfect poster child for "Embodiment." It is meant to enhance the viewing of penguins by offering them a place to congregate, to walk down a ramp, and to jump in the water. It affords the viewing public multiple unobstructed views of the proceedings and does so in a simple, elegant, and straightforward manner. It doesn't refer to anything else. Some may say that it doesn't refer in a strongly literal enough way to the penguins' natural habitat, but that is a matter of taste.

To return to our own subject of museums, it is fruitful to look at Daniel Libeskind's Jewish Museum in Berlin (2001). Widely revered, its jagged, slashing design is unquestion-

ably successful at evoking the wrenching, irrational, and disorienting chaos of the Holocaust on the most visceral and experiential level. Its highly architecturally specific spaces, are eloquently interpretive of the subject at hand rather than something completely unrelated. It is unfortunate that its physical design makes mounting exhibitions inside very challenging. And it is disappointing that many of his subsequent projects, having nothing to do with the Holocaust, employ the same aggressive and angular design vocabulary.

TOWARDS EMBODIMENT

For those of us who labor and dwell in the world of museums, who believe in their potential and are committed to making them better, the challenge is to take up the tools – of embodiment, of narrative, of the broadest interpretation of function – and to exploit their still untapped capabilities in order to enrich the museum experience for the broadest range of visitors.

At Lee H. Skolnick Architecture + Design Partnership, we have spent over twenty-five years pursuing this challenge. Our mission statement indicates our unique approach: “Through collaborative design we unearth the compelling story behind each project to enrich the lives of our clients and communities.” Through projects ranging from master planning and site design, through the architectural design of new buildings, renovations and additions, to exhibition design, graphics and educational programming we have explored and refined an interpretive design approach - new ways of creating seamlessly integrated experiences which embody the mission, goals, and objectives of each institution, combining an understanding of their specific target audiences with the unique stories these organizations seek to tell and the spaces that can enhance those experiences.

A key indication of our commitment to the values of interpretation and audience is the fact that I believe we were the first design firm – certainly the first architecture firm – to have a full-time museum services division, led and staffed by trained museum educators, as an integral part of our design team. One impact of this is that we are uniquely equipped to engage the interest, expertise, and perspectives of the full range of players necessary to ensure a project’s success: the museum board and administration, the curators and subject area specialists, the educators and programming personnel, the registrars and conservators, and the facilities and maintenance staff. And, most importantly, the visitor.

There are a few fundamental aspects to our approach to any project. First, we try and put ourselves in the position of the potential anticipated participant: What do they know about this subject? How interested might they

be? We try to learn as much as we can both about them and about the subject itself in order to find connections between the two. This involves research, close collaboration with curators and content experts, educators and interpreters, as well as the implementation of any range of interviews, focus groups, and other forms of front-end evaluation.

Secondly, we look at all the interpretive opportunities which the situation might offer – from its location within a larger architectural or geographic context, to the potential for interpretive expression in the building design, and finally to the marriage of site, building, and exhibitions into a cohesive visitor experience. These explorations eventually lead us to the development of a highly particularized, yet consistent visual and communicative vocabulary, including forms, space, materials, details, graphics, and media. Finally, through various evaluative means, we test our assumptions and refine them along the way in order to ensure that the story we are telling is as vivid, as compelling, and as understandable as we can make it. Throughout the process, we continually challenge ourselves, and our collaborators, to un-earth, identify, and exploit any aspect and/or component of the project which has interpretive potential and can contribute to the complete embodiment of the content.

CASE STUDIES

The Muhammad Ali Center

To honor and further the humanitarian achievements of “The Greatest,” the Muhammad Ali Center in Louisville, Kentucky had to embody the strength, power, lightness, speed, and grace that Ali brought to “the ring” and to the field of human empowerment, respect, and understanding. The form of the Center, referring to Ali’s famous dictate to “float like a butterfly, sting like a bee” juxtaposes a solid masonry base, firmly rooted to the ground, with a light and aerodynamic winged roof canopy. The narrative is further enhanced by the façade’s use of digitized photographic images of “the most recognized face on earth” to impart its distinctive identity. The man whose ascendancy paralleled the proliferation of mass media within our culture will forever be remembered through the medium that helped to immortalize him. On a substantive experiential level, the story of Ali’s evolution as a professional, as a world ambassador, and as a man is traced through a spatial organization that uses the timeline of his life as an armature. Along it are hung both the key moments in his development and the broader themes which they represent, and which tie his experiences to the lives of each visitor. In ascending along with Ali, we are all encouraged to be the greatest we can be.



Figure 1: The Muhammad Ali Center in Louisville, Kentucky.



Figure 2: Muzeiko – The America for Bulgaria Children’s Museum in Sofia, Bulgaria.

Muzeiko – The America for Bulgaria Children’s Museum

Muzeiko, the first children’s museum in Eastern Europe, was envisioned by its founders to introduce the joys of the American phenomenon of interactive informal education to the underserved Bulgarian populace. Our concept for this new, modern educational facility consciously expresses the nation’s cultural heritage while looking to the future and re-connecting Bulgaria with the global community.

Its architectural theme, “Little Mountains,” is an allusion to Sofia’s mountainous setting. The structure’s glass volume is intersected by three sculptural forms – “mountains” – each referencing through its color scheme and texture indigenous craft traditions. One “mountain” features abstracted patterns inspired by embroidered textiles, another by glazed ceramics, and the third by wood carving. These expressive, dynamic forms embody the sense of freedom, curiosity and discovery to be found within. Children travel into a unique, unfolding interior landscape that is organized conceptually as a journey through time and space, where they can explore “the past” in educational exhibits based on archaeology, geology, and paleontology; “the present,” represented by hands-on exhibits about the natural environment and contemporary cities; and “the future” with interactive exhibits featuring cutting-edge technologies and space travel.

Interactivity also pervades the site, which includes a science playground, green roof, rooftop climbing wall, rain garden, outdoor activity space, and an amphitheater. Muzeiko’s architecture, interiors, and exhibitions form a seamless journey moving from the ancient past to future exploration in a dynamic, fun, informal learning experience unknown to Bulgarians until now. All within a building which is literally and figuratively transparent, welcoming, and open.

International Technology Museum

When a major wireless technology company proposed to create a venue combining seamlessly interactive building and exhibits to demonstrate the powerful impact of its innovations on our lives, we mined the content to create a new kind of facility. This unique museum is defined by a light and luminous design that responds to the human presence. The structure and experience of the museum are characterized by a field of veil-like screens that diffuse into the landscape, displaying continuously changing content on surfaces ranging from semi-transparent (perforated metal) to translucent (channel glass) to opaque (solid wall). Day and night, the building’s veils are alive with intriguing, shifting patterns, text, and images. The displays morph in response to the movement of guests and other real-time and pre-programmed phenomena. Passing by the water-wall on the plaza leading to the entry, a dynamic pinwall sculpture behind the water responds by changing its profile, redirecting the cascade. This is the guest’s first experience with this responsive building – the first message that this experience is “all about you.” From its cutting-edge, visitor-activated responsive exhibit and architectural design to its engaging, personalized interactive experiences, this museum embodies the deep human need to connect, revealing for guests an inspiring vision for the future of communication technology that opens up new horizons, connects people and communities, and enhances lives.

The Queens Library – Children’s Library Discovery Center

While most libraries offer to help users to locate what they’re looking for by using conventional signage (and helpful librarians), the Queens Library enlisted our help to envision a community-centered Children’s Library Discovery Center that celebrates both its unique sense of place and the spirit of exploration and discovery.



Figure 3: The International Technology Museum in China.

A large floor map of Queens with illustrative icons leads visitors into the children’s library and orients them to both the borough at large as well as the various offerings within the CLDC. Wayfinding directories and graphics were developed to identify various features throughout the new building including “Dewey Lane,” a book stack area on the second level, and the “Cyber Center” computer area. Sculptural icons are used to identify special science “pla-

zas” that incorporate interactive exhibits, changing displays and reading material related to the natural and physical sciences.

ONWARDS, TOWARDS...

While the foregoing examples demonstrate our attempt to embody our projects’ identity, character, and purpose within the experiences they offer, “Design as Interpretation” is not about seeking a singular solution. There will always be as many alternative interpretations of a situation as there are interpreters. What is of critical importance is to understand, as the philosopher Hegel suggested, that no matter what its program or pragmatic function, a building can have the additional function of showing forth, or “darstellen,” of embodying its own notional and performative essence. And to remember, as the environmental psychologist, Rob Semper, observed that “...the individual in most instances is an aroused and active organism who defines, interprets and searches his physical environment for relevance.” It is in the service of these lofty but achievable objectives that interpretive design finds its justification and its promise.



Figure 4: The Children’s Library Discovery Center at the Queens Library in Queens, New York.

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A WHALE OF A CHANGE IN LONDON

By Robert Mac West



Figure 1: Dippy in the center of Hintze Hall.

In the summer of 2017 there was a very significant transition of iconic natural history specimens in one of the truly iconic spaces in the world's natural history museums – Hintze Hall of the Natural History Museum London. The plaster cast of *Diplodocus carnegiei*, a 150 million year old North American dinosaur, was replaced by the skeleton of a modern blue whale stranded in Ireland in 1891.

Diplodocus, know colloquially as Dippy, was donated to the Natural History Museum in 1905 by its namesake, Andrew Carnegie, founder of Pittsburgh's Carnegie Museum of Natural History (where the original still resides). After being in several Natural History Museum galleries, Dippy was placed in Hintze Hall (renamed in 2014) in 1979 and for the past 38 years has been the overwhelmingly popular welcoming agent into this architecturally stunning and memorable facility.

Several years ago the NHM staff started on a program of updating exhibitions and bringing the messages of the

museum to be current with the environmental and ecological concerns of the 21st century. Among the initiatives was to point out the contemporary biological resources and concerns of the UK; this meant a refocus on the modern natural world – while not ignoring billions of years of the biological past. The removal of Dippy and replacement of the iconic dinosaur with an iconic modern organism was a prime element in this transformation.

The modern organism that now is the attention-grabber in Hintze Hall is Hope, the 82-foot long, four ton skeleton of a blue whale that beached and died on the coast of Ireland in 1891. She was purchased by the museum (for £250) after she was stripped of meat and whale oil and was part of the mammal hall from 1938 to 2015. The skeleton was carefully positioned over a blue whale model but in a not particularly interesting pose. That definitely has changed.

And her name is part of the museum's strategy. It is a "symbol of humanity's power to shape a sustainable future."



Figure 2: Hope hanging in the active position.

The reinvigorated Hintze Hall has Hope suspended from the ceiling in a swimming/feeding position with her jaws wide open. Unlike when visitors encountered Dippy standing on the floor, they now gaze upward at Hope. At the lowest point, tip of the lower jaw, Hope is 13 feet above the gallery floor, and the highest point on the spine is about 44 feet up. Hopefully, visitors' gaze is drawn laterally from her to the Wonder Bays flanking the main floor as well as the diverse exhibits on either side of the upper levels of the museum. Further, visitors can quickly become aware that they are looking at a modern animal that only recently, with limitations placed on whaling, represents a species that has been moved out of the "endangered species" classification.

The process of reassembling the whale skeleton and suspending it from the ceiling of Hintze Hall was extraordinarily complex and time-consuming. The hall was closed to the public for six months in order for this to be done. The sequence of procedures was fully captured and is available online at <https://www.usatoday.com/videos/news/world/2017/07/13/timelapse-blue-whale-installed-u.k.-museum/103663478/>.

The greater purpose of the transition is expressed well by museum director Sir Michael Dixon: "to make a statement of intent about the relationship between humans and the natural world. Using our scientific resources, we want to challenge people to think about the future of the natu-

ral world, at a time when it faces threats that have never been greater." The story of Hope as a representative of blue whales in the eastern Atlantic Ocean clearly reinforces this. A few hundred years ago the global population of blue whales was estimated at about 250,000. By the time the 1966 international agreement banned hunting this species, the population was down to about 500 with extinction forecast. Now the population has increased to about 10,000 to 30,000. Thus Hope represents one of the few current success

stories of humans and their impact on the natural world and hopefully will engage museum visitors in this element of the museum's mission.

As I noticed immediately upon entering Hintze Hall, while my primary attention was drawn to the whale, I also was aware of the side exhibits both on the main floor and on the two upper levels. These weren't nearly as obvious or attractive when the dinosaur was the focal point.

The ten main floor Wonder Bays are very effectively refreshed alcoves that now have a conceptual importance. Natural History Museum Science Director Ian Owens explained the rationale for specimen selection and display: "Each bay had to pass three tests: as a work of art it must be beautiful or intriguing to look at; it should immediately inform visitors about the museum's work and purpose; and it must tell a great story." In doing so the museum has moved away from the chronological and systematic approach typical of 20th century natural history museums to a more relevant perspective. The bays look at the past and the present – but the present is in flux, and humans are part of the uncertainty about what is in front of us.

The bays on one side present geology and paleontology and the other side is biodiversity and modern environments. The geology side includes a 4.5 billion year old meteorite from northern Chile; a 2.5 ton, 2.6 billion years old banded iron formation from northwest Australia; fossil



Figure 3: Fossil trees, part of the geology and paleontology bays.

trees of various geological ages; a mounted dinosaur, *Mantellisaurus*, one of the most complete dinosaur fossils discovered in the United Kingdom; and an Ice Age American Mastodon from Missouri. In contrast, the biology side includes two giraffes, one a skeleton and one a taxidermied mount; an Atlantic blue marlin preserved in fluid; British coastal seaweeds; and a 120-year old massive bleached coral from West Australia. These specimens are very nicely presented and attract the visitors wandering beneath the whale skeleton.

The upper levels are a mélange of beautiful mounts of modern plants and animals, historic presentations of traditional museum materials, and wonderful views of Hope.

Three contemporary themes start here and carry through the museum – origins and evolution, sustainability (and its challenges), and biodiversity. Thus we can look forward to further modification of the museum’s exhibits and public spaces as well as additional ways of presenting what is happening in the natural world today, human impacts and solutions, and even more availability of the diverse specimens in the enormous collections of the Natural History Museum.

This report concludes with two further aspects of Dippy’s removal. First, when it was announced in 2015, there immediately was consternation and criticism of the museum for removing the specimen. An online campaign appears to have generated over 20,000 signatures demanding that the transition not take place. It has, and the outcome is a better awareness of the various elements of the natural world.

Second, where does Dippy go? A national tour is about to start, with the specimen to go to eight UK sites where it will promote the museum and hopefully inspire a new



Figure 4: Birds in the upper level of the museum.

array of scientists. The tour list includes the Dorset County Museum, Dorchester; the Birmingham Museum and Art Gallery, Birmingham; the Ulster Museum, Belfast; the Kelvingrove Art Gallery and Museum, Glasgow; the Great North Museum: Hancock, Newcastle upon Tyne; the National Assembly for Wales, Cardiff; Number One Riverside, Rochdale; and the Norwich Cathedral, Norwich. The specimen will return to London in 2020 and resume its role in the presentation of the wonders of the fossil record. Further, a bronze replica is planned to be placed in the garden in front of the museum.

And it’s not like this entry gallery hasn’t changed in the past – it started out with a sperm whale, an elephant was added in 1907, and it became a small herd of elephants in 1924, supplemented in the 60s, 70s, and 80s with hippos and other large mammals before Dippy arrived.

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Quotations: *Financial Times Magazine*, June 30, 2017, “The Natural History Museum’s New Hall of Wonders”: <https://www.ft.com/content/b5d17b84-5b89-11e7-b553-e2df-1b0c3220>.

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BUSINESS MODEL FIXES: CONVERT YOUR VALUABLE IMPACTS AND BENEFITS INTO REVENUE

By John W. Jacobsen

Business models are under heated discussion in recent museum magazines (*Museum* (#96.3), *Dimensions* (#19.3), *Attractions* (#21.4), to name a few), with many CEOs and other savants sharing ideas. The flurry of attention must reflect a need. Perhaps a panic... Perhaps it is time to re-think our value propositions.

The irony is that museums often struggle painfully with their business models when simple fixes can offer solutions by reframing challenges, changing attitudes, and adopting new perspectives. The seven business model fixes suggested in this article are inexpensive, but they can go deep. Why? Because these solutions are not about changing the product, the pricing, or the promotion, but about changing you and your museum. Simply put, these business model fixes are about letting your community change their museum.

1. Be intentional about multiple purposes, impacts and benefits.

Many museums silently recognize the range of their diverse impacts, but are stuck with old language and expectations, and so champion only their mission impacts.

Analysis of the database of 1,025 Museum Indicators of Impact and Performance (“MIIP 1.0”) in my recent book, *Measuring Museum Impact and Performance* (Jacobsen, J. W., 2016), reveals twelve broad areas of external impact and two of internal impact. These categories of potential museum contributions and benefits fall under four sectors: *Public impacts* benefit the public as a whole and tend to be funded by government and private philanthropy; *private impacts* tend to benefit businesses and corporations; *personal impacts* benefit individuals, families, and groups; and *institutional impacts* benefit the museum. Any one museum has its own unique mix that results in its unique business model.

Each of these categories can be looked at as the impacts desired by the museum and as the *benefits* perceived by the museum’s audiences and supporters. Comparing the alignment between these two perspectives may lead to increased efficiency.

Categories of potential impacts and benefits desired by museums

Public Impacts and Benefits

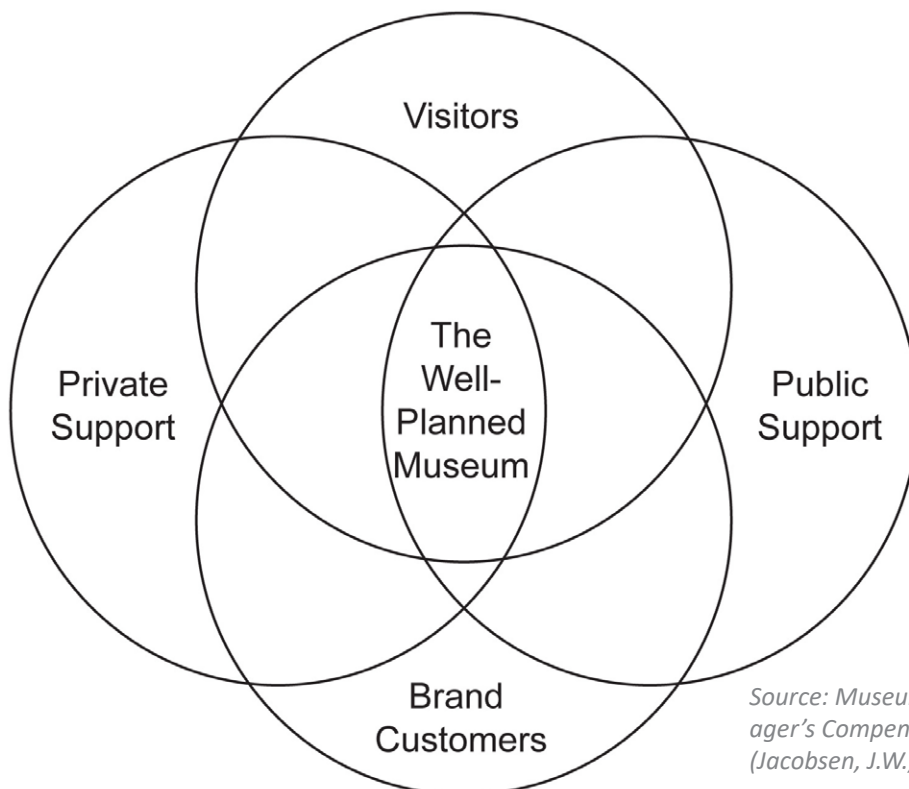
- Broadening participation
- Preserving heritage
- Strengthening social capital
- Enhancing public knowledge
- Serving the education system
- Advancing social change
- Communicating public identity & image

Private Impacts and Benefits

- Contributing to the economy
- Delivering corporate community services

Personal Impacts and Benefits

- Enabling personal growth
- Offering personal respite
- Welcoming personal leisure



Source: *Museum Manager's Compendium* (Jacobsen, J.W., 2017)

Institutional Impacts and Benefits

- Helping museum operations
- Building museum capital

Source: *Measuring Museum Impact and Performance* (Jacobsen, J.W., 2017)

Your museum is likely to be providing some, if not all, of these benefits to some degree. Which ones are most valued by your community? Which ones are explicit in your mission statement? How well do they align? If the community is coming to you for benefits that are outside your mission, perhaps you can offer your community more value by pluralizing or expanding your mission rather than by closing down or subjugating your non-mission services.

The business model fix is to establish a limited number (3 – 5) of prioritized *intentional purposes*. Your current mission is likely to be IP #1 among your several avowed purposes, but it will no longer stand alone. Both the museum and its publics benefit once the museum becomes intentional about more than one mission and set of impacts and benefits.

2. Listen to your key service markets.

The four categories that make up the museum's audiences and supporters – visitors, program participants (aka brand customers), public supporters, and private supporters – are also the museum's sources of potential revenue. A museum with regular revenues from all four service market sectors must be a servant of four masters, as illustrated on page 17.

In the Servant of Four Masters diagram, the horizontal axis is support revenue, and the vertical axis is earned revenue. This diagram illustrates the need to find the sweet spot: a museum plan that provides enough benefits efficiently to enough sectors to sustain operations.

The museum's annual operating revenues and attendance breakdowns are a good place to start research for long-range planning. A museum's financial statements show who is paying for the museum's operation, and visit and program counts show the number of efforts people make to engage with the museum. The main customers that provide most of your annual revenues are your museum's *key service markets*, such as paying visitors, grant-making foundations, corporate members, etc. Quantify changes among the sources of revenues. Which sectors are growing or declining? Why? Assess who is getting what perceived benefits from the museum. What do they think they are getting that is valuable to them? Use both qualitative and quantitative surveys to ask what perceived benefits each key service sector thinks it gets from its museum engage-

ments. Is the cost sufficiently worth it to them that they want to keep doing it?

The business model fix is to think anew about your museum's operating revenue and attendance sources, aka, your *key service markets* and your museum's lifeblood. Look strategically at each revenue and attendance stream as an expression of some audience or supporter's interests. Ask: What individual or societal benefits do we provide to each key service market? Are those benefits we wish to continue providing? If so, how can we be more purposeful, effective, and efficient at providing them?

“Strive for diversity income...Sciencenter's six sources of revenue are somewhat independent, allowing for readjustment if any one source comes under pressure: Admission and Membership; Programs, Store and Other Earned; Endowment; Traveling Exhibitions; Donations; and Grants” (Trautmann, 2017).

3. Align desired impacts to perceived benefits.

A museum's business model is the mix of benefits and impacts it delivers annually to its audiences and supporters in return for their money/revenues. Some museums have a close alignment between “What we want to change” (desired impacts) and “What they are paying us for” (perceived benefits).

Impact and benefit are both words for the outcomes of a museum's activities. They may describe the same outcome but from different perspectives: impacts are what the museum wants to accomplish; benefits are what the community, audiences, and supporters want from the museum.

Art museums and children's museums enjoy a close alignment. Their desired impacts – art appreciation and child development – align closely with what their visitors are buying – experiencing art and developing their children.

Science centers, history museums, aquariums, natural history museums, and zoos are not as well aligned. These museums desire educational impacts on their audiences such as communicating messages, changing attitudes, and guiding behaviors. Their audiences, however, are not buying lectures; audiences pay admission for quality time with friends and family and new experiences.

Multi-purpose museums, such as mid-city science centers, are not wrong or inefficient but rather clever like a fox. They work hard to deliver quality visitor experiences and STEM learning outcomes, plus more from other revenue sources, sometimes selling the same activity to multiple buyers, like a sponsored exhibition.

The business model fix is to add to your prioritized list of intentional purposes and desired impacts the other benefits you are already delivering. For instance, if people want to host their events at your museum, and these function rentals bring in the community, then add “community gathering and bridging” to your purposes with the desired impact of “the community uses our facility to gather their own friends, colleagues, and co-workers.” This attention from management will lead to more and better equipped event facilities and services, and thus to more community value.

4. Live by your guiding principles and core values.

The traditional business model advice of “focus, focus, focus” and “stick to your core business” is less applicable to museums that depend on multiple revenue sources and service markets.

Yet, what do we cling to instead? If our once-honored mission becomes a number of separate purposes, and if we intentionally serve several sectors with different needs, and keep changing what we do as our community evolves, where is our museum’s eternal soul?

Our soul is in our guiding principles (aka core values). A museum’s character, culture, and brand identity determine what it stands for – the long-term how it does what it does. This is where the museum’s reputation has always lived – in its standards and in the museum’s unique definition of museum quality.

The business model fix is to transfer the reverence traditionally paid to mission statements to your guiding principles. The U.S. Coast Guard has multiple missions but unifies all its services instead under a value statement – *Semper Paratus*, always prepared. Once you make that shift from a mission culture to a quality culture, you will liberate the kinds of activities your museum can run while strengthening your staff’s resolve to do those activities within your quality standards, values and principles, resulting in a wider range of museum quality community benefits.

5. Look at your value exchanges as evidence of benefits delivered.

If you follow museum guru Stephen E. Weil’s approach as I do, that a museum’s value lies in what outcomes it delivers, then one way to evaluate a museum is to look at how others value the museum’s activities through their exchanges of time, effort, and money.

The implication of operating in a free-choice market is that all transactions are evidence of value on both sides. Visitors pay admission, donors give, and foundations grant

year after year only if the exchange is also of value to them.

Hence, an operating museum has evidence of its value in its operating numbers. If a museum receives \$3 million from its audiences and supporters yearly, then that museum can claim that it delivers at least \$3 million worth of value back to its audiences and supporters. If that museum hosts 100,000 visits yearly, then it has evidence that visiting is worth at least that much time and effort.

The business model fix is to think of your operating numbers as an expression of the changing interests of your audiences and supporters and to use that data to inform decisions. When those expressions are by experts – teachers, grant officers, researchers, philanthropists, etc., then their cumulative choices over time might indicate changes in the museum’s outcomes as well as its outputs.

6. Count all museum engagements.

The umbrella term museum engagements collects attendance at all the museum’s activities – gallery attendance, lecture series attendance, volunteer shifts, board meetings, interactions with partners, outreach participations, etc. – into one number. A physical museum engagement is defined as one person-trip to a museum site or to a museum-sponsored program off-site by a person not employed or contracted by the museum to be there. The person-trip is a measure of effort spent by the person (time and often money are also spent). Virtual museum engagements involve much less effort but still require time.

The business model fix is to be inclusive about what engagements you count but rigorous in defining each sub-category. Once you add in school auditorium attendance, function rental guests, committee meetings, press tours, and other previously uncounted physical encounters on- and off-site, your annual engagement number will rise. At the same time, each sub-category needs to be precisely defined, actionable, and transparent – the number of “paid adult walk-ups” is likely to be a small fraction of the new, larger annual museum engagement number, but you will be able to target more precise interventions.

7. Evidence your value and show your impacts and benefits.

Of course museums have value and impact, but how do we, as museum professionals, measure the impacts and other benefits that museums provide our communities? Museums are valued for a wealth of beneficial results beyond their focused missions.

I believe we have indicators of impact and performance if we a) adjust our thinking about museums to evaluate them

as multiple-purpose, community service institutions rather than solely as mission-focused institutions; b) recognize that in addition to public impact, museums also create private, personal, and institutional impacts; c) admit that for museums some key performance indicators (KPIs) may also be evidence of impact, and d) accept that there is no one standard to measure all museums, but that each museum will need to declare its own intentional purposes, theories of action, and evaluation indicators.

The business model fix is to select metrics that measure your value – all your values, and consistently report those metrics, testing periodically whether they do, in fact, indicate that you are achieving your intentional purposes. Because your museum is delivering multiple benefits to multiple sectors, this can be a deep planning and analysis process – the second half and all the attached worksheets in my *Measuring Museum Impact and Performance* book describe it step-by-step. However, once you are measuring and reporting on all your values and providing evidence of your impacts, your community leadership will build trust and increase support. Internally, you will be better able to prove your value, anticipate the trends, address the issues, and ride the opportunities.

CONCLUSION

Becoming intentional about providing our audiences and supporters the benefits that meet their needs may improve impact and performance in those areas, and it may

give the museum greater opportunities to further its intentions. Counting all of a museum’s impacts and benefits totals a more complete picture of the museum’s contributions. We need equally rational ways to measure learning outcomes as well as societal and economic impacts, even though some may feel that one is more worthy than the others. To conserve the prestige and value long enjoyed by museums, but now facing stiff competition, we need to deliver value to our community, audiences and supporters, and count every benefit we provide.

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THE ROLE OF CREATIVITY IN WIDENING ACCESS TO STEM EDUCATION

By Peter Trevitt

Widening access to STEM engagement is a major concern for all involved in informal learning, and funders and governments are increasingly recognizing its importance. While there is much innovative work to celebrate and learn from, there is also much more to do.

Engaging with science continues to be off putting to many people. Phrases such as “it’s not for me” or “preaching to the converted” still lurk behind much of what we do, and challenge us to do more. A specialist in branding of visitor attractions recently said he would “run a mile” from anything with science in the title. For those who are passionate about science like myself, it is sometimes not easy to acknowledge this all too common viewpoint.

Some science centers rename themselves to avoid the word “science” and some outreach programs are branded differently from the host organization for the same reason. While it may not be possible or desirable to rename institutions, it may be helpful to look again at these organizations and their activities through the lens of creativity, looking more deeply at their creative qualities to help identify where improvements could be made, both back and front-of-house.

This article also makes the case for those involved in informal education to do more to focus their engagement at a

more creative and emotional level: observing, questioning, making choices, problem solving, finding patterns, seeking out short cuts or easier ways to do things. Relating science to these tasks and drives may be more likely to be engaging and accessible to a wider audience because they are familiar and relevant, while also remaining true to the real activity of scientists, and, for that matter, artists, designers, and other creative jobs. From another perspective, this is about challenging cultural norms and breaking down some of the stereotypical views of arts and sciences.

Using the basic ingredients of creativity as a guide, a creative audit may also help to map the creative skills of the institution’s staff, showing how team work could be improved, or even where new income could be generated. As a former Head of Creative Services at the Science Museum, London, I used this approach not only to generate substantial unrestricted income for the institution but also to reach wider audiences through new partners and innovative external projects. Examples include creating specially designed science exhibits in bookshops; outdoor interactive installations in school playgrounds; a major sports science experience at the home of Chelsea Football Club; and even a \$12m editorially balanced exhibition about nuclear power and energy issues sited at a nuclear reprocessing facility.



Figures 1, 2, 3, and 4: Many science centers have removed or excluded the word “science” from their names. Others downplay the word “science” by going by an acronym (e.g. OMSI) or including it as part of the name’s subtitle.

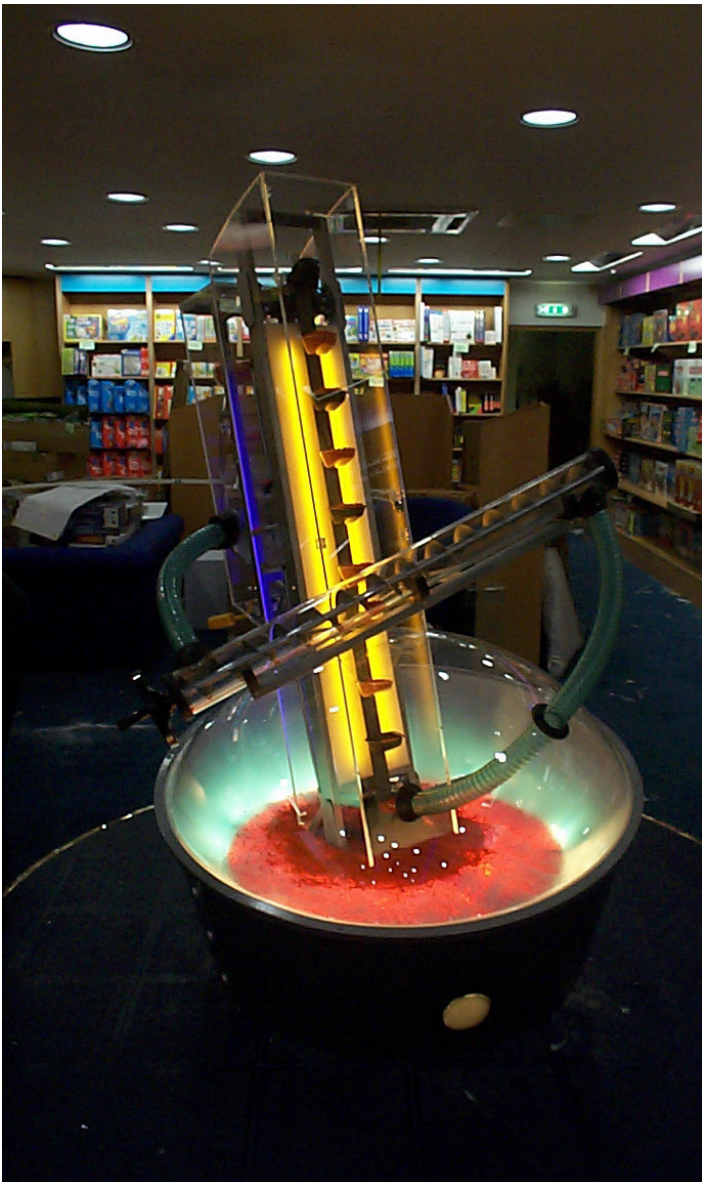


Figure 5, 6, and 7: Creative approaches to engagement at a nuclear reprocessing site, in school playgrounds, and in bookstores.

These ideas apply to outreach as well as to workshops, shows, programs, and exhibitions taking place within an institution. Whether you value outreach activity as a means of attracting new visitors to your center, or as an end in itself (I prefer the latter, but boards don't always agree), outreach is a great way to find new audiences and start engaging with them (i.e. "go to where the people are"). Large-scale schools' programs can reach a wide cross-section of society by supporting and enriching formal education and combining high quality with exceptionally low cost. Important strategies used to establish Techniquet's successful country-wide schools outreach service during my period as Chief Executive included involving operational staff in creative tasks and that ensuring all staff had a stake in shaping both on-site and outreach activity.

There are examples of excellent practice that target other ILR September/October 2017 - 24

audiences for "live" outreach: co-developed participatory programs that draw together diverse communities such as the excellent work by Nina Simon at the Santa Cruz Museum of Art & History,¹ or programs that target large crowds at malls, sports events, or festivals, such as Einstein's Garden.² Digital media is also offering exciting channels to reach new audiences via social media, video channels, online citizen science, code clubs, hacker events, and more, with those that lack the impact and memorability of live experiences often offering opportunities that could not be provided live. Some of the most innovative and interesting initiatives are now combining these approaches in a coordinated way.

Cultural stereotypes are major barriers to many communities engaging with science. Work on tackling gender bias and on getting more girls into STEM has highlighted the



Figures 8 and 9: Einstein's Garden is a nature and science area at the U.K. Green Man festival. Its mission is to "make and curate playful experiences inspired by science and nature, within Green Man and in other unexpected places."

importance of role models in tackling gender stereotypes in science, but often we are seeing more, not less, stereotyping between girls and boys, for example in toy design. The influential ASPIRES research³ and the notion of science capital has highlighted how strongly our aspirations can be shaped by those around us. A parent or friend who says they are no good at math is a powerful negative model for their children. If this is prevalent within the community, that child will struggle to engage with math, and even the positive impact of a great science center math program risks being eroded by these attitudes.

The stereotypical view of scientists and engineers is that they produce useful things, but what they do is mechanical, nerdy, unemotional, difficult. In contrast, artists are seen as – almost by definition – creative people, in touch with their emotions, good communicators, entertaining even, although often society fails to see the benefit of what they produce. These are broad generalizations, but for those who believe the stereotypes the distortions are divisive and alienating.

However, if we consider what creativity is in terms of the skills and activities needed, it becomes clear that not only can science be seen as highly creative, but even more importantly that most people can readily relate to them as part of their daily lives. The table on the next page shows an assessment framework for tracking the development of young people's creativity in schools commissioned by The International Foundation for Creative Learning,⁴ and widely used by Arts Council Wales.⁵

Of course, for those with a science background it is no surprise that the process of science is creative and that

professional scientists use these skills all the time. Arguably, in science the ability to frame the right question is the greatest challenge and is at the heart of the science process, often drawing heavily on intuition and making connections. Once it has been defined, the question then frames and focuses the experimentation, with the other skills such as crafting, collaborating, and reflecting being frequently used. Indeed, huge amounts of persistence are often needed and with luck, eventually sharing the product comes to the fore. These are the same activities that children and adults use without thinking of them as being closely related to the activity of science or art, and as such they represent shared experience around which greater relevance may be developed.

For those who deal with lobbying and funding of science centers and museums, this approach happily coincides with key public policy priorities and corporate strategies. The widely referenced chart⁶ from the World Economic Forum on page 27 shows how creativity is expected to grow in importance in the workplace, moving from tenth place in 2015 up to third in 2020. The trend within formal education in developed countries is toward a more skills-based learning model. The Programme for International Student Assessment (PISA)⁷ test for 15 year olds, which focuses on creative and problem solving skills, does not take place in the U.S., but for the 72 countries that do participate it is an important factor in competition for global investment. In the EU, fostering innovation is seen as vital for industrial competitiveness.⁸ Corporate interest in working with and supporting informal learning institutions can be stronger when arts and science are intertwined.

For several years I have been helping Arts Council Wales to

AN ASSESSMENT FRAMEWORK FOR CREATIVITY⁹

Inquisitive	Wondering and questioning Exploring and investigating Challenging assumptions
Persistent	Managing uncertainty Sticking with difficulty Daring to be different Managing risk
Imaginative	Playing with possibilities Making connections Using intuition
Disciplined	Crafting and improving Developing techniques Reflecting critically
Collaborative	Cooperating appropriately Giving and receiving feedback Sharing the “product”

facilitate creative learning projects¹⁰ in schools across the country. The projects are a collaboration between teachers, external facilitators, external “creative” people, and of course pupils. Indeed, “pupil voice” is central to the work, and pupils are consulted, listened to, and as far as possible, their direction followed throughout. Each project has two elements at its heart: a learning focus, which can be any part of the curriculum, and a creative focus, which is defined by the assessment framework referred to above. The project is regarded as a journey, during which pupils are stretched and inspired, and the increases in attendance we have seen, even in the most disadvantaged schools, show

how motivational this approach can be.

Another example is the superb Room 13 initiative¹¹ which is setting up a network of creative studios where young people are in control of their creativity, developing their ideas, and turning them into events and products that are neither art nor science but a blend of both. Of course, the various community workshop movements embody these ideas, too, helping and encouraging those already interested in technology and crafts to be creative and enticing people who don’t see themselves as “handy” or “techie” to have a go. Excellent work is also being done by organizations in Europe such as Science Gallery¹² and Ars Electronica,¹³ which bring artists and scientists together to engage wider audiences and to foster innovation and creativity.



Figure 10: A Room 13 creative studio in South Africa.

Conducting an audit of creativity within an organization and across its audience-facing activities could be a helpful first step to assessing where cultural stereotypes persist and may be acting as barriers in informal learning organizations. Creating programs with “story,” and bringing out the human side is not new, but identifying and fine-tuning the “creative” elements and attributes could help strengthen many onsite and outreach programs and increase their relevance and appeal to a wider audience. The findings of such an assessment would help guide an action plan to make improvements, whether this creates more income, better team working and partnership building, or increased relevance and accessibility of exhibitions and programs, the benefits could be profound.

FUTURE OF JOBS REPORT: WORLD ECONOMIC FORUM - TOP 10 SKILLS

In 2015	In 2020
1. Complex Problem Solving	1. Complex Problem Solving
2. Coordination with others	2. Critical Thinking
3. People Management	3. Creativity
4. Critical Thinking	4. People Management
5. Negotiation	5. Coordination with others
6. Quality Control	6. Emotional Intelligence
7. Service Orientation	7. Judgement and Decision Making
8. Judgement and Decision Making	8. Service Orientation
9. Active Listening	9. Negotiation
10. Creativity	10. Cognitive Flexibility

END NOTES

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[3] King's College London website, accessed September 30, 2017 from: <https://www.kcl.ac.uk/sspp/departments/education/research/ASPIRES/Index.aspx>.

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[5] Lead Creative Schools Handbook, pg. 61, accessed September 30, 2017 from: <http://www.arts.wales/94715.file.dld>.

[6] "The 10 skills you need to thrive in the Fourth Industrial Revolution" from the World Economic Forum website, accessed September 30, 2017 from: <https://www.weforum.org/agenda/2016/01/the-10-skills-you-need-to-thrive-in-the-fourth-industrial-revolution/>.

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[12] Science Gallery website, accessed September 30, 2017 from: <https://dublin.sciencegallery.com/>.

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THE INFORMAL LEARNING REVIEW

1776 KRAMERIA STREET, DENVER, COLORADO 80220

ON THE COVER:

The International Technology Museum in China is the first “responsive” building. Designed by a major tech company, this unique museum is defined by a light and luminous design that responds to human presence. From its cutting-edge, visitor-activated responsive exhibit and architectural design to its engaging, personalized interactive experiences, this museum embodies the deep human need to connect, revealing for guests an inspiring vision for the future of communication technology that opens up new horizons, connects people and communities, and enhances lives.

Full story on page 8.

