

The Golden Gate Bridge As An Informal Science Education Resource

Summative Evaluation Report

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Consortium of Universities for
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DAVID HEIL & ASSOCIATES, INC.

Innovations in Science Learning

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EXECUTIVE SUMMARY

Since its completion in 1937, the Golden Gate Bridge has become one of the world's most recognized landmarks as both an iconic public works accomplishment and a popular tourist destination. In 2008, the National Science Foundation (NSF) awarded a \$3 million grant to the Golden Gate Bridge Highway & Transportation District to leverage this status in developing informal education resources to interpret the science, engineering and history of the bridge. Through this initiative the Golden Gate Bridge would become a model for other public works venues for providing informal science education and outreach as a part of their public service.

This report summarizes front end and summative evaluation research conducted by David Heil & Associates, Inc. (DHA) to guide early project planning and designs as well as measure impacts of the effort on both professional and public audiences. The report also documents important strategic impacts and lessons learned that will inform and advance the field, as well as recommendations for the project team going forward. DHA used a mixed methods approach to this evaluation, combining both quantitative and qualitative data sources and analysis.

Key Findings

The project team assembled for this innovative informal science education initiative was both experienced and motivated to impact the target audiences as well as advance the field. A comprehensive Master Plan was developed for the south end of the Golden Gate Bridge and served as a catalyst for significant partner investment in improved facilities and experiences for visitors to the site. A collection of interactive outdoor exhibits were designed and installed on the site to foster interest in, and increase public understanding of, the science, engineering and history that defines the iconic bridge. The project team also hosted an international conference, *Public Works for Public Learning*, created web-based resources, a scholarly publication, and numerous journal articles and conference presentations to disseminate their experience with individuals who could scale the project model for their own community.

In the end, circumstances surrounding jurisdictional authority and competing visions for development of the Golden Gate Bridge site resulted in challenges to the original plan, eventual compromises in exhibit design and installation, and at least temporarily, elimination of the signature exhibit, a large-scale model of the Golden Gate Bridge. While these unanticipated challenges led to additional lessons learned, they also altered the overall impact of the exhibition. That said, both professional and public audiences see value in the project's products. Visitor feedback is both positive and consistent—the exhibits have definitely enhanced the visitor experience on-site, boosting both their interest in, and understanding of the science, engineering and history behind the Golden Gate Bridge. Stakeholders interviewed by DHA for this study acknowledge the challenges were significant, but that the overall outcomes are also significant and demonstrate that public works venues can, indeed, serve as effective vehicles for public engagement and education. For the field at large, ten strategic lessons emerged from the project.

Lessons Learned

1. Projects like the Golden Gate Bridge Outdoor Exhibition project can serve as catalysts for collaboration and advancing public works for public learning as long as all interested and vested partners are on board early and stay engaged.
2. Relationship building and transparency are essential components of a strong and sustainable collaboration.
3. A unified vision and plan are necessary to actively engage partners and successfully execute on the plan.

4. Sites with historical significance and/or designation require additional research and due diligence.
5. Outdoors exhibits installed in locations with 24/7 accessibility must be extra sturdy and durable to withstand the damages that come with exposure to the natural elements as well as vandals.
6. The project plan should be scaled to match available finances, personnel, and time.
7. Project teams should retain a degree of flexibility in their plan, as well as an attitude that promotes solution finding when unanticipated situations arise midway through the project.
8. When multiple agencies and other organizations are involved, sort out jurisdictions, authorities, and ownership issues in advance of project initiation.
9. If hands-on exhibits are a project focus, budget for both short-term modifications based on formative evaluation feedback, as well as long-term maintenance and replacements as needed.
10. Be sure that individuals tasked with facilitating public engagement at a public works venue have all the training, tools and resources needed to succeed at that task.

Drawing on the data summarized in this report, DHA has identified five recommendations for the project team to further optimize their investments and maximize their impact. These appear abbreviated below, and again in the final section of the report with more elaboration.

Recommendations

- I. The Golden Gate Bridge Highway & Transportation District should strengthen their interagency collaboration with the National Park Service and the Golden Gate National Parks Conservancy in order to ensure a greater impact from their investment in the outdoor exhibition.
- II. Tour operators offering tours at the Golden Gate Bridge should be convened to identify ways in which they can contribute to improving the on-site visitor experience for their customers.
- III. The Golden Gate Bridge Highway & Transportation District, in collaboration with the NPS and Conservancy, should create and disseminate marketing messages and materials that inform prospective visitors to the Golden Gate Bridge of the expanded visitor engagement opportunities and services available on site.
- IV. The Golden Gate Bridge Highway & Transportation District should work with CUREE and other project partners to complete all deliverables and resolve all outstanding project issues by the end of March 2016.
- V. The Golden Gate Bridge Highway & Transportation District should work with CUREE and other project partners and contractors to further disseminate lessons learned from the Golden Gate Bridge Outdoor Exhibition project over the next two years in order to maximize project impact on the field.

INTRODUCTION & PROJECT HISTORY

The Golden Gate Bridge opened for traffic in 1937 and instantly became San Francisco's most famous landmark. Once called "the bridge that couldn't be built," after enduring its four-year engineering and construction struggles with relentless winds, fog, and treacherous tides, the iconic public works structure and much beloved bridge has now withstood the test of time and today is considered one of the seven wonders of the modern world.

As San Francisco ferry congestion grew in the early 1900's, so did the call for a bridge spanning the Golden Gate strait and linking the city of San Francisco to Marin County. Engineer Joseph Strauss initially conceived the design for the bridge in 1922, and although city authorities readily accepted his plans, years of legal action led by ferry companies who opposed the construction of the bridge (and transportation competition) followed. Construction of the Golden Gate Bridge finally began in January 1933, and its final design and aesthetic attributes came from various collaborators, including Charles Ellis, the engineer responsible for the structural design of the bridge and who, along with engineer Leon Moiseiff, reimagined Strauss's original design into a graceful suspension bridge; and Irving Morrow, who contributed the bridge's distinctive Art Deco lines, the iconic burnt orange color, and its dramatic lighting. Construction of the bridge required great feats of planning and engineering, as well as heroic efforts on the part of the construction teams dealing with the many challenges associated with its construction. At 1.7 miles long and 6 lanes wide, today the workhorse bridge carries 39 million vehicles a year. Besides being a valuable transportation span, the Golden Gate Bridge is also one of the most iconic public works accomplishments in America, an internationally recognized symbol of San Francisco and the United States, and one of the top tourist attractions in the U.S., seeing more than 10 million visitors annually. The bridge's status as an iconic public works venue, coupled with a high visitor attraction, inspired the Golden Gate Bridge Outdoor Exhibition Project. Leveraging the bridge status and popularity, the outdoor exhibition would demonstrate how public works agencies, in collaboration with local partners, could provide a platform for public education in science, engineering, and history.



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In 2009, the National Science Foundation awarded the Golden Gate Bridge Highway and Transportation District (GGBHTD) \$3 million in funding to create an outdoor exhibition interpreting the science, engineering, and history of the Golden Gate Bridge. The project's title was, "The Golden Gate Bridge As An Informal Science Education Resource" (Award #0840185) but is referenced hereafter as the Golden Gate Bridge Outdoor Exhibition Project. At the time of the

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award, despite the extremely heavy tourist traffic to this area, infrastructure of the south end of the bridge was very limited—some dirt paths, a bathroom, and a closed café. Visitors had few opportunities for engagement besides a photo with the bridge in the background (weather allowing!) and a long wait for the restroom. The premise of the project was that visitors would come to the bridge as sightseers but then be surprised with enjoyable opportunities to learn about how the bridge was engineered, how it withstands earthquakes, resists the forces of wind, and the aesthetic design qualities of the bridge that contribute to its iconic image. As Denis Mulligan, General Manager and CEO of the GGBHTD and Principal Investigator for this project described in the original proposal, "They are going to come here as tourists and be surprised by education."

Components of the Golden Gate Bridge Outdoor Exhibition were first installed in June 2012 in time to commemorate the 75th anniversary of the bridge's completion. The exhibits showcase science, engineering, and historical factors that influenced the Golden Gate Bridge's design and construction. Through photographs, text panels, interactive components, and Quick Response (QR) codes linked to additional content and language translations posted on the District's website, the exhibits explore the history of the Golden Gate Bridge's site, construction challenges, implications of natural forces on engineering design (wind, fog, salinity and moisture induced corrosion along with seismic activity), and fundamental engineering principals that make its design successful (deck torsional resistance, relationship between tower height and cable tension, and modes of bridge vibration to name a few).

To date, twelve new exhibit components have been installed at the south end of the Golden Gate Bridge. In the course of designing, developing, and installing the Golden Gate Bridge Outdoor Exhibition, project managers have navigated a multiple-agency collaborative project model for leveraging informal science education opportunities within the context of an iconic public works venue. The GGBHTD partnered with an array of diverse and talented experts, including the Consortium of Universities for Research in Earthquake Engineering (CUREE) for project management; EHDD Architecture for master planning; the American Public Works Association (APWA) for helping reach public works professionals across the nation, and the Exploratorium, West Wind Laboratory, Princeton University and others to design various exhibit components.

In addition to the exhibition, to inform both public works and informal education professionals about the project, gain insights from the field, and disseminate lessons learned, project staff organized a small international conference, featuring pioneers of informal, site-based engineering education from around the globe. The two-day *Public Works for Public Learning* conference was held in San Francisco, CA, in June of 2012 and included 25 speakers. During the proceedings, representatives from around the world shared how their sites approached the development of public education and outreach activities by showcasing the unique science, engineering, and contextual history of their sites for public audiences.

The Golden Gate Bridge Outdoor Exhibition project engaged two teams of evaluation specialists to provide front-end, formative, and summative evaluation over the course of the project. Inverness Research of Inverness, CA provided some front end as well as the formative evaluation. David Heil & Associates, Inc. (DHA) of Portland, OR provided some additional front-end research and conducted the summative evaluation, which is summarized in this report.

SUMMATIVE EVALUATION METHODOLOGY

David Heil & Associates, Inc. (DHA) employed a number of evaluation methodologies to compile this Summative Evaluation Report. DHA values an approach to evaluation that focuses on utility. That is, the evaluation approach responds to the needs of the project using rigorous methods to aid the project leadership in making data-driven decisions and/or measuring impact from their investments. Patton (2008) argued that evaluation findings are more likely to be considered and applied when intended users have input and ownership through active involvement in evaluation planning and implementation. With this need in mind, DHA applied a utilization-focused evaluation approach (Patton, 2001) to ensure that the study was aligned with the project's various activities and needs, working collaboratively with the project leadership over the duration of the project to plan and implement a range of studies that employed various evaluative instruments and procedures outlined in this section of the report.

PROJECT LOGIC MODEL

As part of the original evaluation proposal, DHA developed a logic model to illustrate the proposed theory of action and guide summative evaluation over the duration of the project. As often happens in complex, multi-year projects, some of the original outputs did not evolve as originally planned, and a few additional outputs were provided during the project that were not anticipated in the proposal phase. The logic model presented in Figure 1 outlines how the final project outputs, including but not limited to exhibit installation and associated resources and supports, should result in short-term outcomes for both professional and public audiences as well as longer-term strategic impacts on the field.

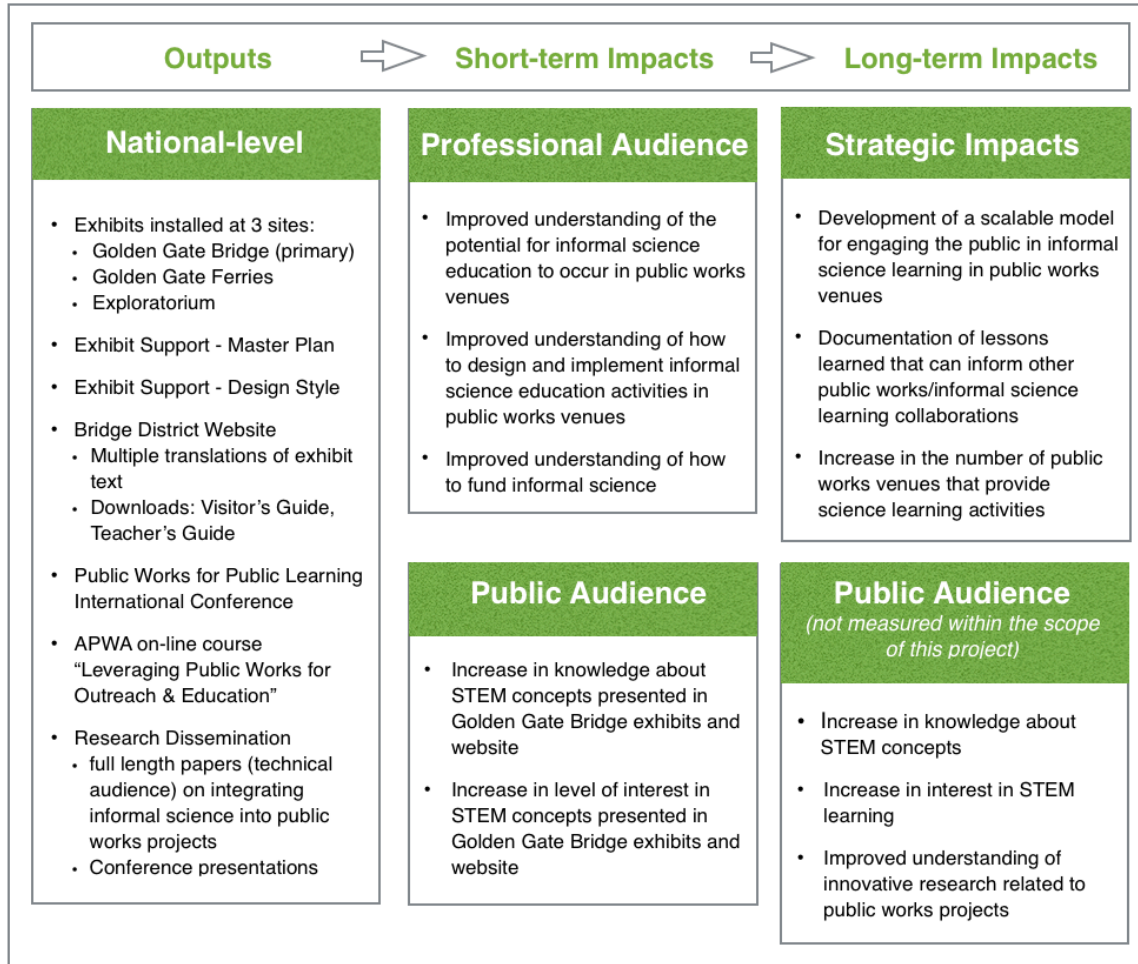


Figure 1 Logic Model

MAJOR SUMMATIVE EVALUATION QUESTIONS

This report details DHA's summative evaluation efforts to document short-term audience outcomes and strategic impacts that resulted from the Golden Gate Bridge Outdoor Exhibition project. The study was driven by the following evaluation questions:

- 1) To what extent did interaction with public works, engineering, and informal science education professionals result in increased interest in and an improved understanding of the potential for informal science education to occur in public works venues?

- 2) To what extent did interaction with public works, engineering, and informal science education professionals result in increased interest in and improved understanding of how to fund, design, and implement informal science education activities in public works venues?
- 3) To what extent did visitor interaction with the exhibits result in increased knowledge about the STEM concepts presented in the exhibit?
- 4) To what extent did visitor interaction with the exhibits result in increased interest in the STEM concepts presented in the exhibits?
- 5) To what extent did visitor interaction with the exhibits result in enhancing the visitor experience at the Golden Gate Bridge?
- 6) To what extent did the Golden Gate Bridge website generate user traffic drawn to the posted resources and multiple language translations of exhibit text?

SPECIFIC METHODOLOGIES

This section outlines the data sources, sampling techniques, data collection instruments and data analysis processes used for the summative evaluation study. In order to document the effectiveness of the Golden Gate Bridge Outdoor Exhibition, DHA used a mixed methods study design, drawing on both quantitative and qualitative sources of data. The two methods were strategically combined to draw on the strengths of each paradigm; quantitative data provided a broad overview while the qualitative data allowed for a nuanced, in-depth understanding of the project and related outcomes. Further, using a complementary approach provided DHA with breadth and depth of information from a number of perspectives that enhanced the reliability and validity of the findings.

In particular, DHA used the following complementary data collection strategies:

- APWA Member Survey
- Public Works for Public Learning Conference Attendee Survey
- General visitor surveys;
- Exhibit component visitor surveys;
- Timing and tracking of visitor interaction with the exhibits;
- Observations of visitor interaction with the exhibits;
- Web analytics;
- Interviews with key project staff and stakeholders.

Each of these data collection strategies is further described in the next section.

Surveys

APWA Member Survey

As a component of the Front-End evaluation, DHA designed and implemented an online survey to be completed by active members of the American Public Works Association (APWA). This survey was designed to establish a baseline for how much public works were currently incorporating informal learning at their venues and the interests and needs of public works professionals related to this type of activity. The survey also served as a vehicle to inform public works professionals about the Golden Gate Bridge Outdoor Exhibition project overall, and in particular the Public Works for Public Learning conference and APWA online course to be offered as project activities later. An email was sent by APWA to their active members with a link to the online survey. The survey was posted for two weeks and resulted in 659 respondents.

Public Works for Public Learning Conference Attendee Survey

Attendees at the Public Works for Public Learning conference, held June 20-22, 2012 in San Francisco, were asked to complete a survey following their participation in the conference. This survey focused on participant satisfaction with the overall conference as well as specific sessions offered at the conference. It also assessed participant interests and needs related to the conference topics and project goals going forward. A total of 35 conference participants completed the survey.

Visitor Intercept Surveys

DHA implemented two types of visitor intercept surveys—a general visitor survey and a more specific exhibit component survey—to collect feedback from visitors to the Golden Gate Bridge who had the opportunity to interact with the project’s exhibits during their visit. Intercept surveys are a strategy whereby respondents are recruited on site, in the study context, and asked to respond to a survey instrument facilitated by a live data collector. Earlier front-end and formative evaluation work conducted by Inverness Research noted limitations on bridge site data collection related to language barriers for visitors from other countries or with limited English language skills, including a large population of tourists from Asian countries. In response to these concerns, for site-based visitor data collection, DHA recruited multilingual undergraduate students from Bay Area universities, including the University of San Francisco and San Francisco State, to participate in the visitor data collection activities at the bridge. Collectively, the students were proficient in a variety of languages including Mandarin, Japanese, Spanish, and French. Members of the DHA evaluation team held a full-day training session in San Francisco to prepare the participating students for appropriately implementing the visitor data collection activities (see photo.)

The general visitor survey aimed to collect visitors’ overall reactions and feedback after experiencing the Golden Gate Bridge exhibits. Items on the survey were intended to collect general demographic information (e.g., gender, group composition, age), visitors’ general use of the exhibit (e.g., time spent at the Golden Gate Bridge, use of QR codes, use of language translations), as well as to measure potential outcomes of engaging with the exhibits such as increased understanding of science and engineering concepts. Visitors were intercepted at random nearby exhibit installations at the south end of the bridge.



The student volunteers collecting the data were instructed to position themselves near the exhibits and to intercept every third visitor who entered the area. Visitors under the age of 18 were excluded from the study. Using the random process of approaching every third person insured that the sampling process was reflective of the visiting population. In total, 495 visitors completed the general visitor survey during two multi-day windows in the summer of 2015.

To better understand visitors’ perceptions of specific Golden Gate Bridge exhibit components, DHA also administered component-specific surveys at the following exhibits:

1. Braille Model
2. LIFETILES
3. Entrance Panels
4. Suspension Cable Size vs. Tower Height
5. History Banner
6. Battery Lancaster
7. Foghorns
8. How the Bridge Vibrates
9. Isolator Seismic Retrofit
10. Lattice Strut Retrofit
11. Bridge Deck Aerodynamics
12. Resisting the Twisting

These surveys sought to gather insight into the ways in which visitors engaged with each specific exhibit component. For instance, visitors were prompted to indicate their level of interest in the exhibit content and to identify the ways that they interacted with the exhibit (e.g., read the exhibit text, discussed an idea or concept with others).

In a similar fashion to the general visitor survey, DHA used an intercept process by randomly approaching visitors and inviting them to complete the exhibit component survey. Volunteers were instructed to envision an imaginary circle encompassing the exhibit space and to ask every third adult visitor who entered the circle to complete the survey for that particular exhibit component. Over the two multi-day evaluation windows, DHA collected 294 responses to exhibit component surveys.

Timed Observations

Through a “timing and tracking” study, DHA conducted unobtrusive observations to examine how visitors engaged with various Golden Gate Bridge Outdoor Exhibition components and understand the nature of interactions between group/family members in context with the exhibits. This timed observational data complemented the self-reported data from the general and specific exhibit component visitor surveys, with the exception that timed observations were also conducted on a stand-alone bridge model located at the Exploratorium on the San Francisco pier. This additional site was included to see if there were notable differences in the types of interactions based on the overall context surrounding the exhibit unit—one at a science center, and the rest at the bridge.

Using an observation protocol developed by the evaluation team, volunteers documented visitors’ length of stay at each exhibit and systematically recorded details about interactions at the specific exhibits such as engaging with the interactive component if there was one, discussing the exhibit with someone else nearby, taking a photo, reading text panels, etc. The volunteers tracked the length of interactions from the moment a visitor entered the exhibit space until the time that they departed. Over the course of the two multi-day study periods, DHA representatives conducted over 1000 timed observations.

Web Analytics

DHA pulled a web analytics report for the period of June 1-30, 2015 as a sample window of time to measure page views of the Golden Gate Bridge website, where Outdoor Exhibition content and language translations were posted.

Stakeholder Interviews

In addition to the targeted surveys and observational studies described above, DHA also conducted in-person interviews with key project staff and stakeholders. Staff and stakeholders were engaged in the summative evaluation to learn more about the project’s progress and to gain an understanding of lessons learned throughout the exhibit development and implementation process. The lead evaluator from DHA conducted semi-structured interviews in person using a protocol containing open-ended questions. The evaluation team ensured that a range of key stakeholders were included in the interviews such as the project’s principal investigator, the project manager, National Park Services staff, members of the San Francisco tourism industry, and engineering professionals involved with the project. Interviews lasted between 60-120 minutes and a total of 17 interviews were conducted.

Data Analysis

The data collected for the summative evaluation were analyzed using both quantitative and qualitative methods. For the quantitative data, basic summary statistics were calculated and compared using the analysis tools in SurveyMonkey (e.g., filter and compare tools). Quantitative data were also entered in

to the statistics software, SPSS, to generate descriptive statistics and to calculate inferential statistics as appropriate. The timed observation data were analyzed by calculating the mean overall engagement time in the general exhibits area as well as the mean engagement time at each of the specific exhibit components.

Open narrative responses from the target audience surveys, observation data from the timing and tracking study, and input collected from the stakeholder interviews were analyzed applying the rigors of qualitative research. The DHA evaluation team used an iterative cycle, drawing on both deductive and inductive methods at various points throughout the analysis process.

EVALUATION FINDINGS

PROFESSIONAL AUDIENCES

For the purposes of this project, the targeted professional audiences included, but were not limited to, public works employees, practicing engineers and engineering educators, and informal science educators. As a reminder, the two key questions explored through this evaluation were as follows:

- 1) To what extent did interaction with public works, engineering, and informal science education professionals result in increased interest in and an improved understanding of the potential for informal science education to occur in public works venues?
- 2) To what extent did interaction with public works, engineering, and informal science education professionals result in increased interest in and improved understanding of how to fund, design, and implement informal science education activities in public works venues?

APWA Survey

The American Public Works Association (APWA) was an invited partner on the Golden Gate Bridge Outdoor Exhibition project from the beginning. Larry Lux, a longtime APWA member and association consultant was an active member of the project’s advisory board and helped facilitate engaging the APWA membership through the online member survey and the online course delivered through the association’s signature “Click, Listen, and Learn” professional development program. As mentioned earlier in this report, the APWA member survey, posted in June of 2012, served to establish an important baseline for the project by measuring current levels of interest and engagement in informal science and engineering education activities related to public works venues by the professionals who work in those settings.

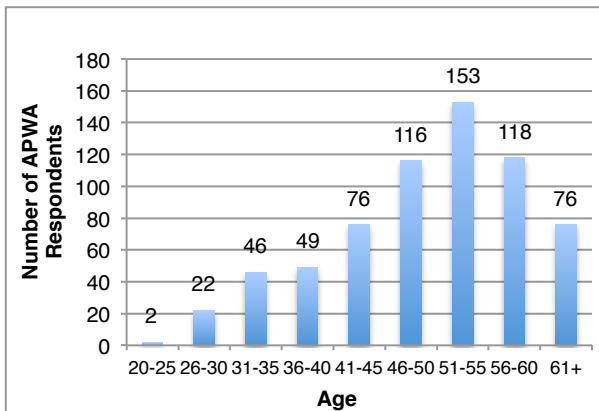


Figure 2 Age of APWA Survey Respondents (n=659)

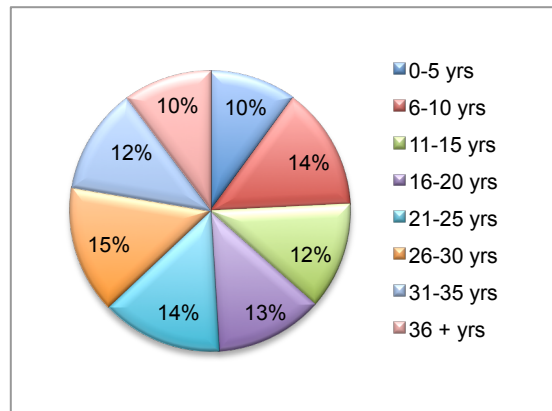


Figure 3 Public Works Experience of APWA Survey Respondents (n=632)

The survey prompted feedback from a diverse set of APWA professionals who represented a broad range of ages and public works professional experience. Seventy percent (70%) of the 659 APWA respondents were between the ages of 40 and 60 (Figure 2). The APWA respondents also represented professionals engaged at, literally, every career tenure (Figure 3).

Every profession has their own vernacular when it comes to labeling or describing regular functions or activities. Since professional collaborations between public works agencies and Informal Science Institutions have been historically rare, DHA was interested to find out which terms APWA members most often used to describe education and outreach activities. Respondents were asked to rate their familiarity with the following five terms commonly used to describe public education:

- 1) Public Education;
- 2) Public Outreach;
- 3) Educational Outreach;
- 4) Public Interpretation; and
- 5) Informal Science Education (ISE).

Not surprisingly, APWA respondents were most familiar with terms often used in public agency education and outreach circles – *Public Outreach* and *Public Education*, followed by another common label that combines the two, *Educational Outreach*. They were least familiar with the two labels more often used by professionals in the informal education arena, *Public Interpretation* and *Informal Science Education*, terms used in the description of this Golden Gate Bridge Outdoor Exhibition project. In order to better understand the APWA membership’s current utilization of different public education and outreach strategies, survey respondents were asked to select from a provided list of education and outreach activities their organization had previously used to interact with public audiences. The survey presented 16 different possible strategies for APWA respondents to select from.

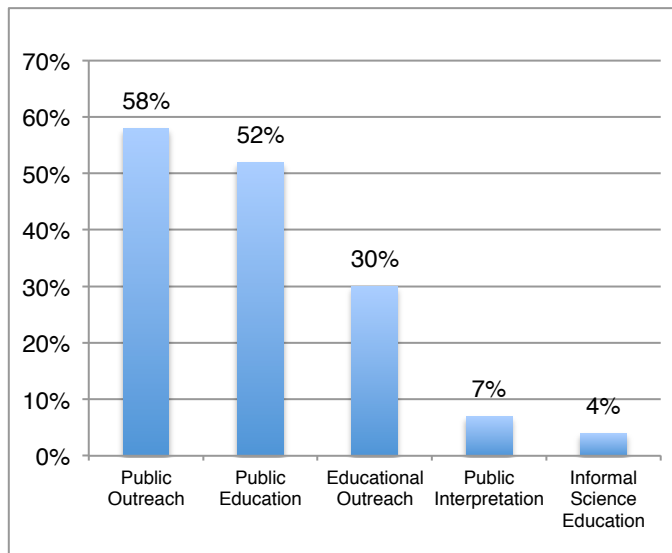


Figure 2 Educational Labels of APWA Survey Respondents Had Frequently Heard (n=659)

The most common education and outreach strategies used by APWA respondents were websites (86%), public hearings (70%), public newsletters (65%) and interpretive exhibits and displays (see Figure 5). The least commonly used strategies were National Public Works Week open houses (28%), collaborations with local museums and/or science centers (14%), and afterschool programs (8%). The fact that interpretive exhibits and displays have been used by 54% of the responding APWA members was a promising indicator relative to the goals of this Golden Gate Bridge Outdoor Exhibition project.

APWA respondents were also asked how they had previously learned about public education and outreach methods, selecting from a list of common resources. Figure 6 summarizes their responses. *Professional Development/Training* was selected by the largest percentage of APWA respondents (69%) with Professional Journals (60%), Internet (60%), Coworker (51%), and Attending a Conference Session on the Topic (44%) rounding out the top five responses. Anticipated from earlier data, learning about public education and

outreach from an Informal Educator (11%) was the lowest rated vehicle for learning about education and outreach methods.

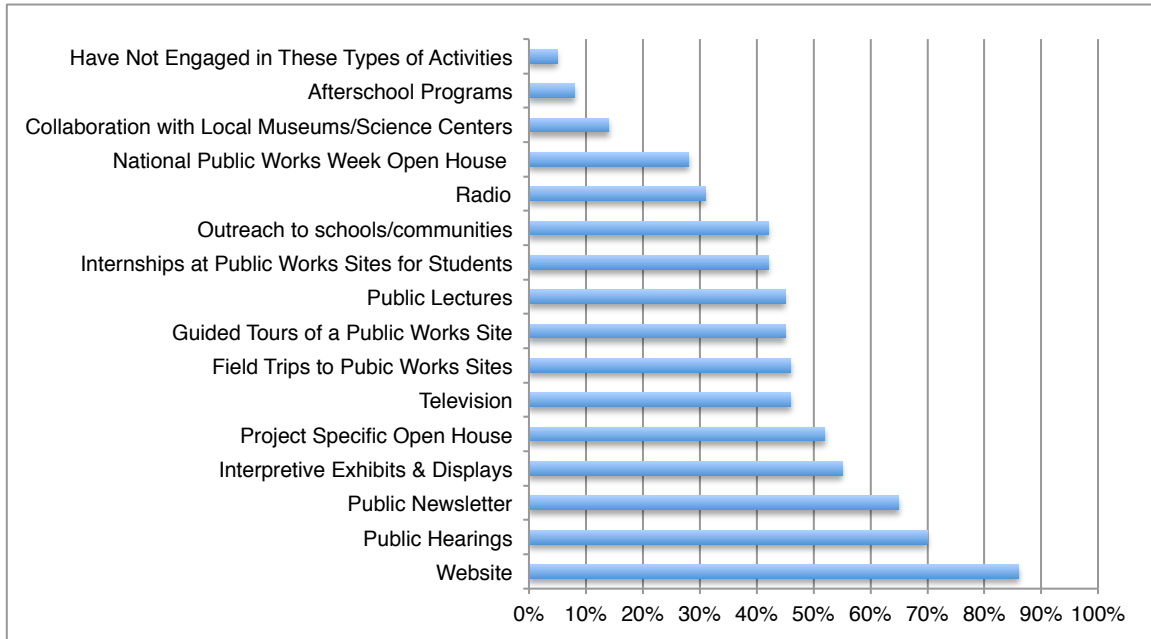


Figure 3 Public Education and Outreach Strategies Currently Used by APWA Members (n=659)

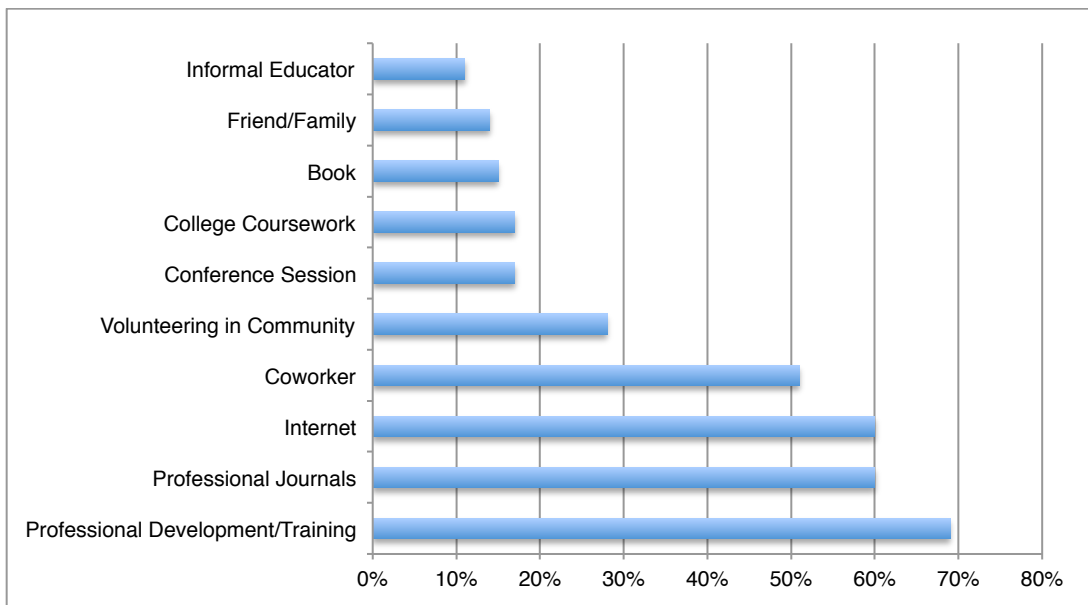


Figure 4 Percentage of APWA Respondents Who Have Learned About Education and Outreach Methods from Various Sources (n=565)

Even though many public works apply science and engineering principles in their construction and/or function, only 15% of APWA respondents reported that their local agencies either *Always* (2%) or *Usually* (12%) included science and engineering in their public education and outreach activities. Remarkably, nearly 40% reported that they *Rarely* (34%) or *Never* (6%) share the science and engineering involved in their work.

Another important element of public education and outreach is how agencies fund such work if they choose to pursue it. APWA survey respondents reported that their *Original Project Budgets* most often fund these efforts (59%), with *Additional Allocations From Their Agency Funds* next at 31%, *Special Grants* at 19%, and *Corporate Donation* and *Public Arts Funding* both at 7%. Over 28% of the respondents did not know how their agencies funded these types of activities.

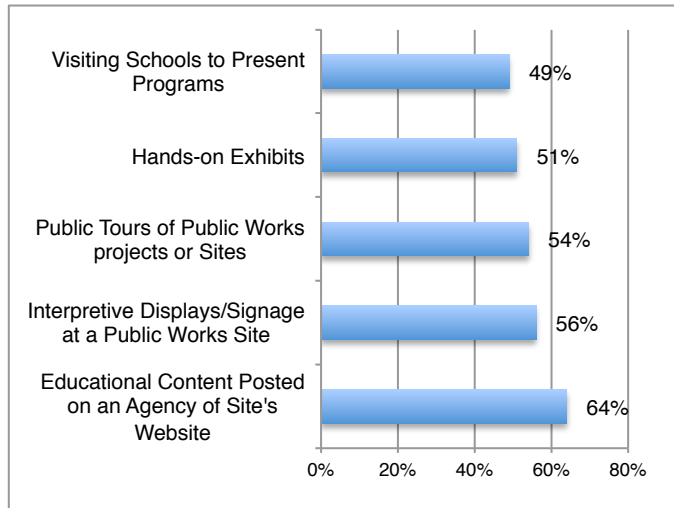


Figure 5 Percentage APWA Survey Respondents Interested or Very Interested in Five Common Public Education/Outreach Strategies

Finally, the APWA respondents were asked to rate their interest in five education and outreach strategies used to teach public audiences about public works projects (Figure 7). APWA respondents were most interested in utilizing *Educational content posted on an agency or site's website* (64%), which is likely also the lowest cost option in the list. It is worth noting that the lowest rated option was still of high interest with 49% of the respondents, indicating that this subset of public works professionals see relatively high potential for incorporating some elements of public education and/or outreach into their public works endeavors.

asking respondents if they were planning to attend the *Public Works for Public Learning* (PWPL) conference sponsored by the Golden Gate Bridge Outdoor Exhibition project and promoted through the APWA journal, *APWA Reporter*, and a series of mass mailings and email blasts to members over a couple of months in the Spring of 2012. Despite these efforts, only one APWA professional who responded to the survey indicated they were planning on attending the conference, while an additional 35 APWA respondents (5% of the survey sample) were undecided. At the time this survey was administered it was already apparent that registrations for the conference were running lower than anticipated.

The APWA member survey closed by asking respondents if they were planning to attend the *Public Works for Public Learning* (PWPL) conference sponsored by the Golden Gate Bridge Outdoor Exhibition project and promoted through the APWA journal, *APWA Reporter*, and a series of mass mailings and email blasts to members over a couple of months in the Spring of 2012. Despite these efforts, only one APWA professional who responded to the survey indicated they were planning on attending the conference, while an additional 35 APWA respondents (5% of the survey sample) were undecided. At the time this survey was administered it was already apparent that registrations for the conference were running lower than anticipated.

In order to gain a better understanding of why registration numbers were lower than anticipated, especially among APWA members, the survey asked respondents to rank order a list of eight choices for reasons they were *not* planning to attend the conference. Figure 8 shows respondents primary reason.

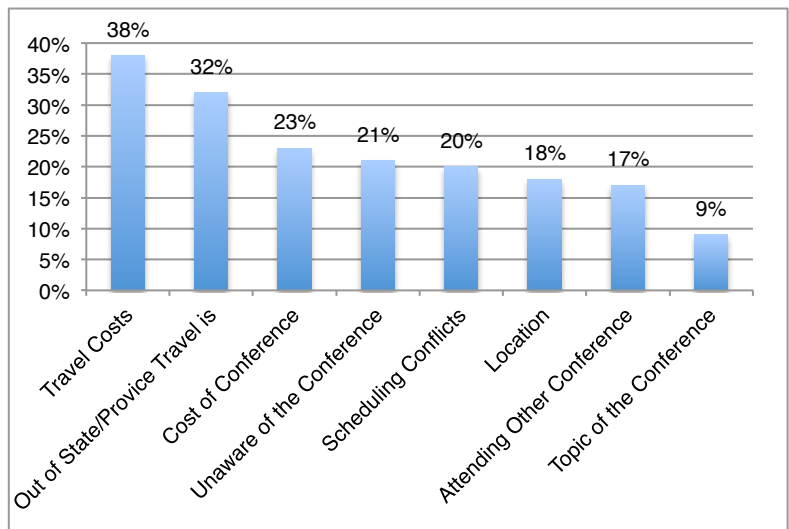


Figure 6 Respondents Primary Reason for Planning to NOT Attend the PWPL Conference

Public Works for Public Learning Conference

By design, the Golden Gate Bridge Outdoor Exhibition project coincided with the 75th anniversary of the Golden Gate Bridge with this momentous date, May 27, 2012, landing mid-way through the project timeline. Project developers felt that there would be no better time than this notable anniversary to host an international conference to explore the connections between public works endeavors and public education. As the APWA member data illustrates above, promoting the conference became a challenge in and of itself. Barriers to attend the conference expressed by the public works community were identified in the APWA survey. Efforts to reach out to the informal science and education communities were less directed, and resulted in low awareness of the conference and ultimately low participation from these sectors. In the end, about 50 individuals participated in the conference, with about half of that number contributing as presenters on the program.



Figure 7 PWPL Conference Poster

The two-day *Public Works for Public Learning* conference was held at the end of June 2012, in San Francisco. Project staff invited 25 representatives from sites of various sizes from the US and around the globe, to speak at the conference and share insights into how they developed and administer public education and outreach opportunities that convey the unique history, engineering, and context of their sites. The conference began with Golden Gate Bridge Outdoor Exhibition project partners presenting the experiences, challenges, and rewards of participating in their collaborative endeavor at the Golden Gate Bridge. Through this first round of speakers, and touring the actual outdoor exhibits at the base of the bridge, conference attendees were introduced to how the project was developed and funded, the goals and deliverables of the project, and how the outdoor exhibits were collaboratively researched, fabricated, and pilot tested on-site.

Following these initial sessions focused on the Golden Gate Bridge Outdoor Exhibition project, representatives of the Eiffel Tower, the Sydney Harbour Bridge Climb experience, the Panama Canal, and the Hoover Dam provided additional examples of how other large-scale, iconic public works sites can engage visitors through public education and outreach. While these programs and projects represented a diverse set of sites, services, funding sources, and content delivery mechanisms (e.g.

“There are big and small projects, but there are no easy projects.”

exhibits, tours, programs, etc.), each site shared the common goal of encouraging visitors to personally explore, experience, and learn. John Bowe, Project Director at the Sydney Harbor Bridge Climb, succinctly expressed the overarching lesson of these presentations by explaining that successful outreach initiatives consistently provide value to visitors’ experiences. These outreach activities enhance the story of a site in a way that invites people to feel inspired by the remarkable science and engineering achievements in the unique context of a public works venue.

The internationally recognized, large-scale projects were then balanced by examples of smaller public works sites that provide public education and outreach. Although the scale of these projects was smaller, the creativity, vision, and utilization of local partnerships mirrored their larger counterparts. Collectively, the presenters offered a robust picture of the challenges and rewards associated with on-site interpretation and programming around a public works venue. As one presenter commented, “There are big and small projects, but there are no easy projects.”

In order to support conference attendees’ operational understanding of public outreach and education projects both large and small, advice from informal educational professionals was also

incorporated into the conference’s proceedings. These presentations ranged from the iterative process of exhibit design, the benefits provided by audience feedback and project evaluation, examples of potential funding sources, an introduction to opportunities provided by local museum collaborations, and strategies to increase site accessibility and interpretation for audiences with physical, visual, or auditory impairments.

In spite of the relatively small participation, the *Public Works for Public Learning* conference provided an excellent opportunity for advancing the field in regard to shared insights and lessons learned and its holistic representation of projects, challenges, and practical considerations by experienced professionals in the field produced a highly effective event as demonstrated by participant feedback.

Two weeks after the conference, presenters and attendees were asked to complete an online post-conference survey. Thirty-five participants, representing an assortment of professional backgrounds (see Figure 10), responded to the survey. The relatively large student component was a result of another intended impact of the project, involving university students, primarily engineering students, in the research and development of some of the exhibits. The project partner team at Princeton University and CUREE each hosted a number of students at the conference to expand their experiences with public education and outreach as it relates to public works engineering and design.

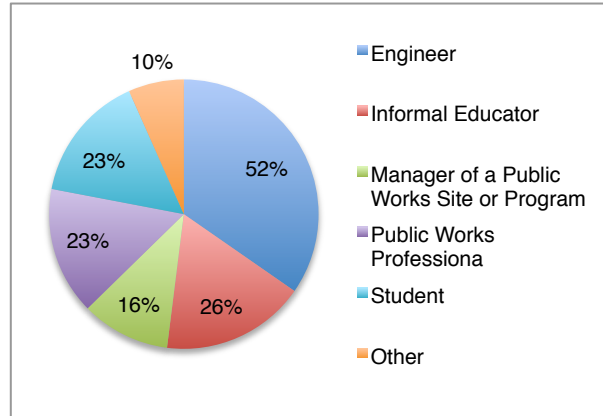


Figure 8 PWPL Survey Respondents by Profession

Conference Element	Valuable	Extremely Valuable
Professional Diversity of Presenters	24%	65%
Range of Project Size/Scale	29%	59%
Variety of Project Examples	38%	56%
Variety of Session Topics	41%	47%
Experiencing the GGB Outdoor Exhibits	52%	45%

Table 1 Percentage of Respondents Rating Conference Elements as "Valuable" or "Extremely Valuable" (n=35)

Conference attendees were first asked to rate how valuable they perceived some of the general elements of the conference program and format. Table 1 summarizes the percentages of respondents who rated each item as either “valuable” or “extremely valuable” from a five-point scale.

The survey then asked respondents to rate their satisfaction with individual presenters/presentations. Table 2 summarizes this data by presenter and presentation title and lists the percentage of respondents who were “extremely satisfied” or “satisfied” by the offering. Overall high satisfaction ratings for the sessions suggest that conference attendees were generally pleased with the program and saw value in the topics presented.

Session Presenter/Title	% Satisfied or Extremely Satisfied
Wayne Clough; <i>If You Build It, They Will Come</i>	100%
Steve Ressler; <i>West Pointe Bridge Design Contest</i>	100%
Jim Duncan; <i>Waterworks at Arizona Falls, A Venue for Education</i>	100%
John Bowe; <i>BRIDGECLIMB: Exploring and Experiencing the Sydney Harbour Bridge</i>	97%
Denis Mulligan; <i>Project Overview</i>	97%
Sarah Billington; <i>Engineering the Golden Gate: The Interplay of Design and Experiences</i>	94%
Chris Gallagher; <i>San Francisco Bay/Delta Model Renovation</i>	94%
Ari Epstein; <i>Creative Energy and Innovation: Undergraduates as Informal Educators</i>	93%
Shawn Lani; <i>Exhibit Design Process</i>	90%
Sylvester Black; <i>Designing the Large Scale Golden Gate Bridge Model</i>	90%
Bob Reitherman; <i>Overview of Golden Gate Bridge Exhibits</i>	88%
William Schermerhorn; <i>Achieving a Balance: Determining What the Public Wants to Know</i>	88%
Javier Pinzón Pascal; <i>The Panama Canal: Expansion Program and Visitor Centers</i>	87%
Nicholas Lefebvre; <i>Learning While Visiting the Eiffel Tower</i>	84%
Maria Garlock; <i>The Pedagogy of Designing Exhibits</i>	84%
Cora Jackson-Fosset, Panel Discussion; <i>Public Works Concerns</i>	84%
David Lawry, Panel Discussion; <i>Public Works Concerns</i>	78%
Becky Caroll & Shannon Weiss; <i>Engaging Visitors – Evolution/Summation</i>	77%
David Heil; <i>Public Education Takes Resources, How Do I Get Them?</i>	77%
Charles Trautmann; <i>Science Centers and Public Works: Energizing Partners in Education</i>	72%
Beth Ziebarth; <i>On Striving for Accessible Exhibition Design</i>	71%
Larry Lux; <i>Developing Effective Public Works Exhibits</i>	69%

Table 2 Percentage of Respondents Who Were "Satisfied" or "Extremely Satisfied" With Each Conference Presenter/Session (n=33)

Interesting to note from this summary is that conference attendees, while overall relatively satisfied with the program sessions and presenters, were less satisfied by sessions that dealt with the more practical aspects of interpreting public works through exhibits with sessions on evaluation, funding, accessibility, and design rating lower than other sessions that were more descriptive of certain projects across the globe. Some of this variation may be due to the nature of the presentation, or the visuals used. But, in other cases, the project specific sessions told some very interesting stories about their particular development process and the challenges they faced along the way. This is one arena where the conference was quite successful, assembling a collection of experienced professionals from the field willing to candidly share their stories and strategies as well as their challenges and lessons learned. This became more evident when respondents provided narrative responses to the next survey question that asked them to list the three most important things they gained from participation in the conference. While the responses cover a wide range of perspectives, the emerging themes cluster around the key objectives of the conference and of the overall Golden Gate Bridge Outdoor Exhibition project – increasing interest and understanding as well as capacity for leveraging public works venues for informal education. Frequently mentioned important things gained from attending the conference:

1. Networking with highly experienced professional from numerous fields
2. Exposure to diverse projects and outreach activities
3. Better understanding of the potential for public works as educational resources

4. Appreciation for some of the challenges around funding, collaboration, serving public audiences
5. Ideas and relationships that could lead to future projects
6. Realization that every project has a story to tell

In the spirit of advancing the field, conference attendees were asked “What next steps do you think would be most appropriate for disseminating the content of the Public Works for Public Learning conference to broader audiences?” Respondents provided narrative answers to this question as well, but the majority of responses focused on four vehicles for dissemination:

1. Offer a small subset of the topics/presentations at larger conferences where target audiences convene—e.g. APWA, Association of Science Technology Centers (ASTC), and others
2. Compile the sessions and post them online
3. Distribute a print summary of the conference proceedings
4. Offer an online course that covers the conference topics

Finally, the post-conference survey asked participants to provide a written response to the open-ended question, “As a result of the Public Works for Public Learning conference, what opportunities/outcomes would you most like to see developed to advance this field of work?” Participants’ answers were diverse and reflected the conference’s broad professional audience. The most common responses though mirrored the number one response theme above which was a request for increased dissemination via related project presentations at other professional conferences for engineering, public works, and informal science education practitioners. Also mentioned was the need for more information and materials on how to do this type of work, especially on the smaller scales experienced in most communities. Providing materials on funding, content development strategies, cost/benefit analyses of existing projects, evaluation techniques, and hints on successful collaborations were all referenced as valuable resources for advancing this work in their respective fields.

APWA Course

In response to the feedback from APWA members and the participants at the Public Works for Public Learning conference, the APWA made arrangements for offering an online course titled *Leveraging Public Works for Outreach & Education* through their “Click, Listen, and Learn” portal. This course was advertised through the association’s usual member professional development outlets and scheduled for January 2013. David Heil, President of David Heil & Associates, Inc. (DHA) and Shannon Weiss, Research Associate at DHA were invited by CUREE to design and deliver the course. Content presented during the two-hour session covered many of the topics requested by members and conference participants, including:

1. Identifying suitable public works projects and strategies for public education and outreach
2. The difference between “formal” and “informal” learning environments
3. Potential sources of funding and potential collaborators
4. Practical aspects about project planning, development, and implementation
5. Strategies for evaluation and measuring impact

The Click, Listen, and Learn online platform is designed to accommodate individual members on a single computer screen as well as a room of public works employees connected through a single computer portal and large format screen. Given this format, it was not possible to know the exact head count for the course, but there were more than 20 sites registered, many with more than one participant, and following the course 28 individuals completed the follow-up survey prepared by DHA.

The first question asked in the survey was “Why did you choose to attend this session?” Table 3 below summarizes the responses, which speak directly to the goals of the course, and the goals of the overall Golden Gate Bridge Outdoor Exhibition project, expanding knowledge about leveraging public works for public education and outreach.

Reason for Attending Course	Number Selecting This Reason
I wanted to expand my current knowledge	17
I had no previous knowledge of the topic and wanted to learn something about it	6
I needed to know what other agencies are doing in this area	5
My employer requested that I bring information back	1

Table 3 Online Course Participants' Reason for Attending Course (n=28)

Participants were asked to classify their roles in the public works sector by selecting from a menu of options. The largest professional group represented was Engineer in a Public Agency (52%), followed by Director/Commissioner/Superintendent (17%), Public Works Supervisor (17%), Consulting Engineer/Manager (13%), and “other” which included 4 individuals ranging from Public Information Officers to Administrative Assistants.

Size of Agency Jurisdiction	% Affiliated with this Size
0 – 24,999	11%
25,000 – 49,999	7%
50,000 – 99,999	15%
100,000 – 249,999	30%
250,000 – 1,000,000	15%
More than 1,000,000	22%

In order to get a sense of the group’s diversity in terms of small to large municipalities, the participants were also asked to report on the population size of the jurisdiction that their agency serves. Table 4 summarizes this data.

Table 4 Population Served By Online Course Participants' Home Agency (n=28)

some might assume only the larger agencies can afford such investments, the attendees in this course represented the full spectrum from small to large jurisdictions, with the largest contingent coming from agencies serving mid-size communities with populations between 100,000-250,000.

This level of diversity is a sign that the idea of leveraging public works for public education is somewhat universal in its appeal. Even though

To gauge to what degree participants in the course advanced their knowledge and/or capacity for leveraging public works for public education, survey respondents were asked to rate their level of agreement with each of the statements shown in Table 5.

This data demonstrates that properly packaged and delivered professional development for public works professionals can clearly increase interest in, and understanding of, the potential for leveraging public works for public learning and what it takes to do so successfully. While the course facilitators provided a range of examples for this type of work, their main illustrative example was the Golden Gate Bridge Outdoor Exhibition project with its various partners and collaborative process for exhibit development, implementation, and evaluation. Due to the iconic nature and scale of the Golden Gate Bridge it serves more as an aspirational model for these types of endeavors

“After viewing this program I am now better able to...”	% “Agree” or “Strongly Agree”
Identify suitable projects and strategies for education and outreach	89%
Identify potential sources of funding and support	89%
Inventory suitable collaborators and assemble the right team	89%
Conduct basic evaluation of a project’s development, impact and success	85%

Table 5 Percentage Online Course Participants Who "Agreed" or "Strongly Agreed" With Each Statement (n=28)

and a “proof of concept” for the idea of using public works venues for staging public education and outreach activities than a directly reproducible model for most public works sites. That said, the principles applied to the design and execution of the project and the lessons learned are quite universal. This was brought forth in comments from many of the stakeholders interviewed by DHA in the summer of 2015. Project advisors, staff, and partners all felt that the Golden Gate Bridge project did increase the potential for public works venues to provide more education and outreach to complement and interpret the science and engineering evident in their sites. These stakeholders also agreed that to accomplish this there needs to be more dissemination of the lessons learned by the project, and greater awareness of this, and other examples of public works sites engaging in public education and outreach activities in order for significant investment in these types of projects to be actualized. Finally, as the above data suggests, they felt that to be sustainable and successful over time, staff and volunteers engaged with public audiences at public works sites need to be adequately trained on the specific resources available at each site and the best practices of informal education and interpretation.

Professional Articles & Presentations

In addition to the project deliverables described above, the project staff and consultant teams on the Golden Gate Bridge Outdoor Exhibition project have prepared a number of journal articles and conference presentations that used this project to illustrate the potential for public works sites to offer informal science and engineering educational opportunities for public audiences. The goal is to further increase interest in, and understanding of these types of efforts and the specific strategies and approaches that lead to project success. A partial list of these publications and presentations follows.

Milligan, D., Reitherman, R., *The Golden Gate Bridge Outdoor Exhibition: Public Works for Public Learning*, Proceedings of the American Society of Civil Engineers Architectural Engineering Institute, Oakland, CA., 2011.

Anagnos, T., Carroll, B., Weiss, S., Heil, D., *Public Works for Public Learning: A Case Study*, Proceedings of the American Society for Engineering Education Annual Conference, Atlanta, GA, 2013.

Anagnos, T. Weiss, S., Heil, D., *Public Works As Vehicles for Engineering Education and Outreach*, Proceedings of the American Society for Engineering Education Annual Conference, Atlanta, GA, 2013.

Reitherman, R., *Using Exhibits To Educate The Public About Earthquake Engineering*, Proceedings of the Tenth U.S. National Conference on Earthquake Engineering, Anchorage, AK, 2014.

Reitherman, R. *A Historical Perspective and Some Speculations About The Future*, Presentation at the Cleveland Section of the American Society of Civil Engineers Centennial Gala, 2015.

Carroll, B., St. John, M., Heil, D., Weiss, S., *Public Works for Public Learning: The Golden Gate Bridge Outdoor Exhibition Project In Context*, In Progress.

PUBLIC AUDIENCES

Impacting professional audiences and advancing the field of informal science learning were clearly stated goals of the Golden Gate Bridge Outdoor Exhibition project. The primary driver for the project, though, was the potential to engage public audiences in STEM learning by leveraging the bridge’s iconic public works stature, history, and remarkable engineering story as a hook for increasing interest in, and understanding of, basic concepts in science and engineering. To accomplish this, the project designed and installed a dozen interactive exhibits for the southern

terminus of the bridge, a location that sees over 10 million visitors a year. As vehicles to reach and engage public audiences, these exhibits are the signature hallmark of the project, but according to many of the stakeholders interviewed by DHA, they also served as a catalyst for changing the overall visitor experience at this site. Prior to this project being initiated, the south end of the bridge was a landscape of well-worn footpaths and historic perches for photo opportunities, but there was really no unifying design or storyline to guide the visitor experience. Tour buses dropped off thousands of visitors daily to use the on-site restroom, take a quick photo of the bridge (if the fog was not too dense), and if time allowed, run up for a second photo from mid-span on the deck of the bridge. Most visitors stayed less than 20 minutes. And while they left with visual memories of their visit, they did not have the opportunity to engage more deeply in the rich history of the bridge, understand the context within which this amazing public works icon was designed and constructed, or appreciate the remarkable science and engineering that made it's construction and long-standing service possible.

The process with which these exhibits were designed and installed is a complex story of its own. This section of the report will focus on the public audience dimensions of the exhibits, how the public interacts with the specific units, their collective impact, and some of the challenges identified by project staff and stakeholders that affect their overall durability and effectiveness. In a later section of the report DHA will focus more on strategic lessons learned from the project, and exhibit development and placement will play an important role in that story as well.

As a reminder, the four key questions guiding this part of the summative evaluation are:

- 1) To what extent did visitor interaction with the exhibits result in increased knowledge about the STEM concepts presented in the exhibit?
- 2) To what extent did visitor interaction with the exhibits result in increased interest in the STEM concepts presented in the exhibits?
- 3) To what extent did visitor interaction with the exhibits result in enhancing the visitor experience at the Golden Gate Bridge?
- 4) To what extent did the Golden Gate Bridge website generate user traffic drawn to the posted resources and multiple language translations of exhibit text?

First, it is important to have a visual context for the exhibits and how they are placed on the landscape. Figure 11 is a schematic map showing the relative locations of each of 12 exhibits installed at the south end of the Golden Gate Bridge. As was described in the Methodology section of this report, DHA's evaluators conducted a series of surveys and observations from various locations throughout this layout, capturing visitor impressions and experiences in real-time as individuals and families roamed the site.

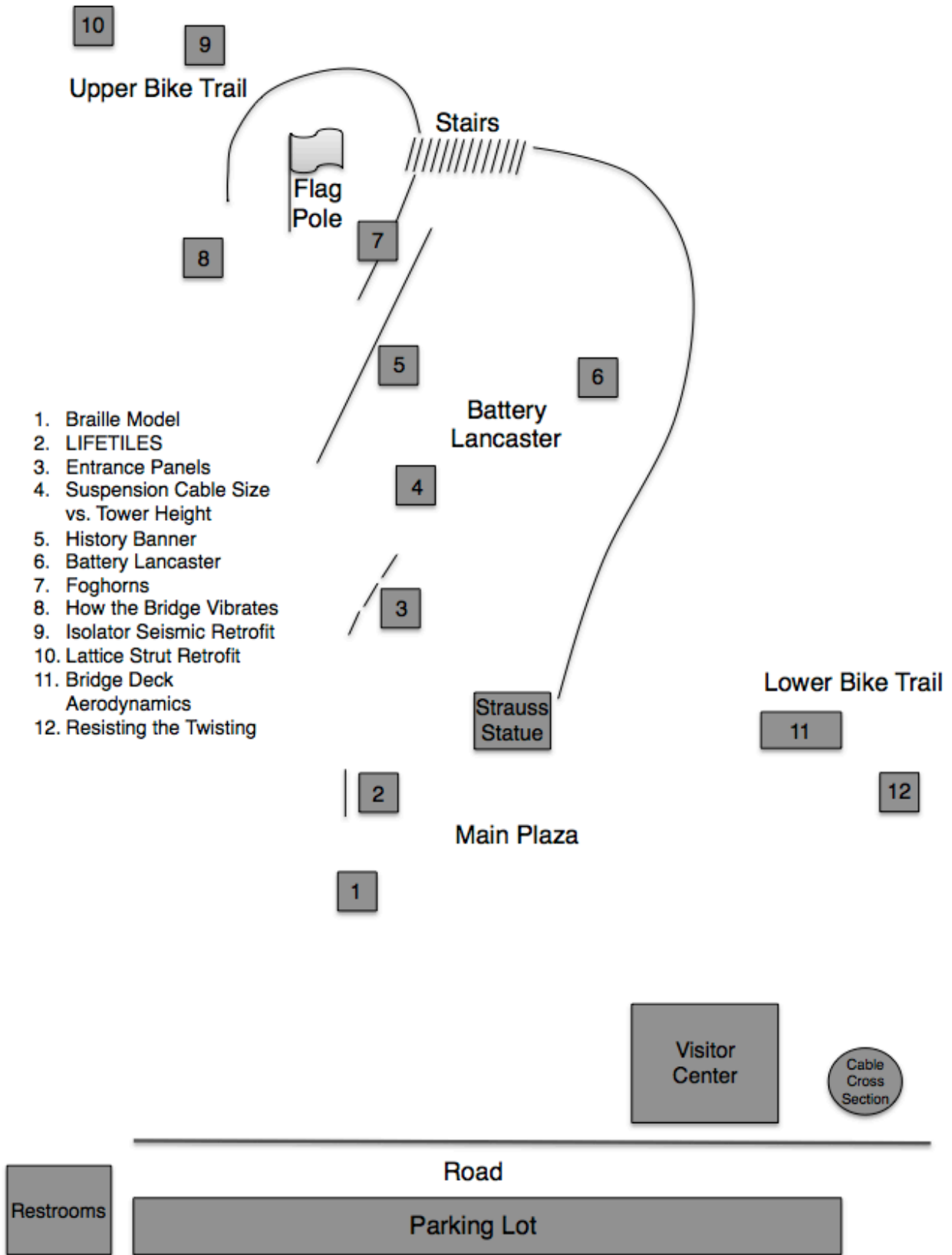


Figure 9 Schematic Map of Exhibits

General Survey

General surveys were administered from two primary locations: in the center of the Battery Lancaster (233 respondents), and near the flagpole (244 respondents). From these numbers, 51% were male, and 49% were female. As Figure 12 illustrates, the bulk of those surveyed were between the ages of 21 and 50, with the largest percentage being age 21-30.

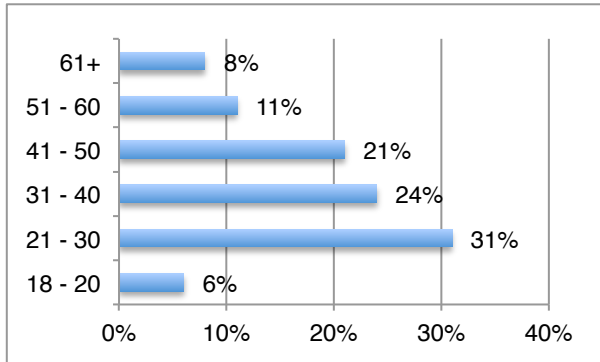


Figure 12 Age Ranges of Individuals Completing the General Visitor Survey (n=467)

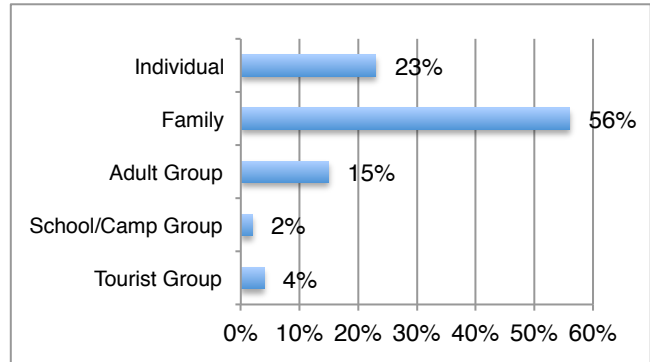


Figure 13 Group Composition for Individuals Completing the General Visitor Survey (n=463)

The majority of individuals surveyed were visiting the site with their family (56%), whether they came as part of a tour group or by way of their own transportation (Figure 13). Most individuals who were visiting as part of a tour group declined to take the survey due to their limited time on site.

Most individuals surveyed were visiting the Golden Gate Bridge for their first time (67%), which is a typical representation of visitors on any given day. Table 6 summarizes how each respondent characterized their visit at the time of their evaluation interview.

How would you characterize your visit to the Golden Gate Bridge?	
This is my first visit	67%
I visit every few years	18%
I visit once a year	3%
I come here a few times a year	8%
I come here monthly	2%
I come here weekly	1%

Table 6 Frequency of Visitation by Individuals Completing the General Visitor Survey (n=467)

As was mentioned earlier, historically the length of time that any one person would spend at the South end of the bridge was between 20-30 minutes, driven primarily by the tour bus schedules and inclement weather conditions. With the 2012 completion of a new visitor center, re-designed entrance pavilion and trail system, and the installation of the outdoor exhibits, the length of visit seems to be increasing as

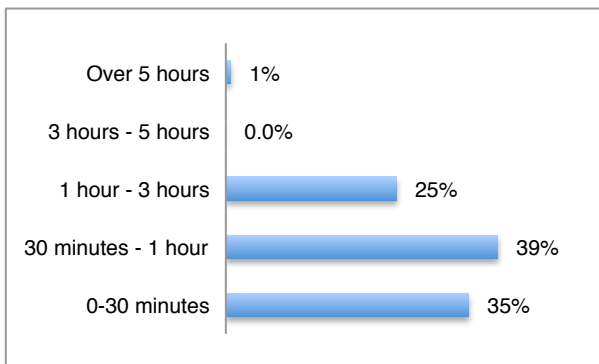


Figure 14 Length of Visit Reported by General Visitor Survey Respondents (n=457)

documented in Figure 14. Clearly a significant number of visitors are still on site for less than 30 minutes (35%), but a relatively high number reported staying for 30-60 minutes (39%) and 25% of those surveyed reported being on-site for 1-3 hours! This trend reinforces comments made by a number of key partners and stakeholders in the project who called attention to the fact that there is now a lot more to do at the site and visitors who have the flexibility to do so may choose to stay longer to enjoy the exhibits and new visitor center.

Each survey respondent was asked which of the exhibit components they had previously experienced, presumably during their current visit, or if returning, on a previous visit. Figure 15 summarizes their responses to this question. It is important to note that whether a particular exhibit had been experienced or not may be a factor of when during an individual’s visit the survey was administered. In other words, if they completed the survey early in their visit, they may not have had time yet to roam the site and find all of the exhibits. Or, if they focused their visit on only one area of the site (such as the flagpole location), they may miss those exhibits located in other areas of the site. That said, it is worth noting in this data that exhibit components located on the bike trail (#9, 10, 11, and 12 on the map) were experienced the least, most likely due to their more remote locations. The Braille model was experienced by only 16% of those surveyed but since it is designed to meet the needs of a specific population, the visually impaired, this number may be reflective of its unique focus. In general, the three exhibits experienced the most are the most visual and/or the most interactive components in the collection. They are also installed in the most prominent locations at the site – either in the Battery Lancaster or above the battery near the flagpole where nearly every visitor to the Golden Gate Bridge takes a photo. This data also affirms a concern shared by project staff and many of the partners and stakeholders interviewed – having the exhibits spread out over the site results in some visitors never experiencing the full collection during their visit, with the four bike path components being the ones most isolated in the layout. The reasons for this configuration will be discussed in more detail in the next section of this report when strategic impact and lessons learned are explored.

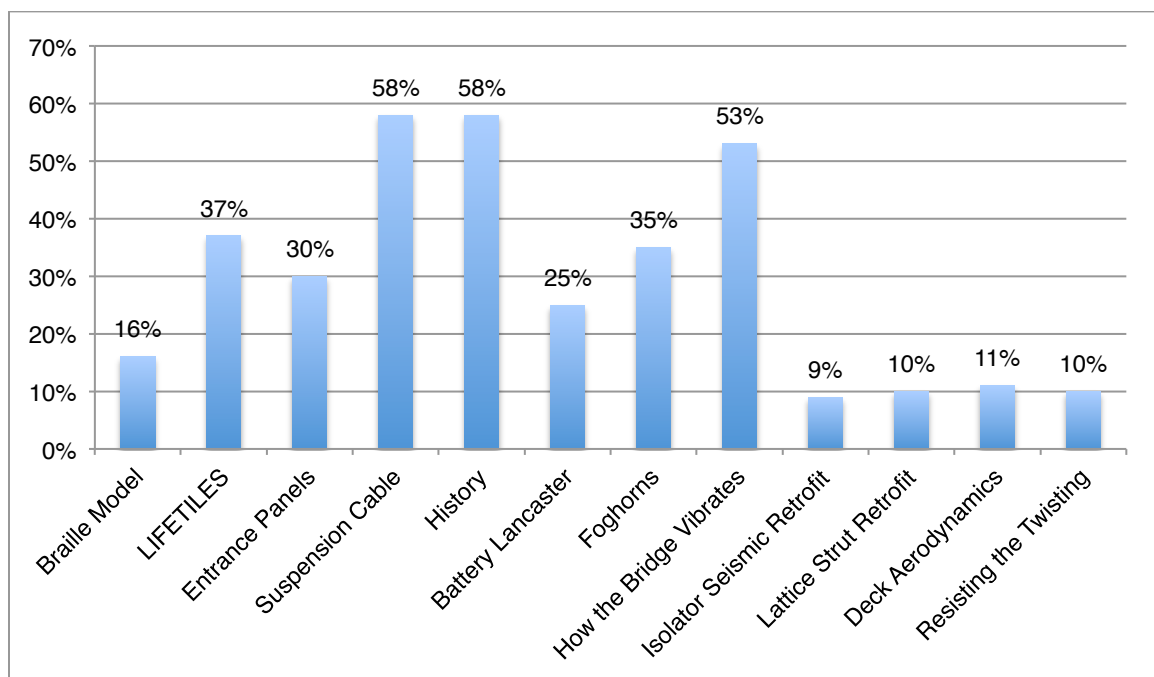


Figure 15 Exhibits Experience by Individuals Completing General Visitor Survey (n=401)

Another challenge mentioned earlier in this report is that many of the visitors to the Golden Gate Bridge do not speak English as their native language. To accommodate this, the project team chose to place QR code stickers on the exhibit text panels that, when activated using a cell phone or other mobile device, would direct a visitor to the Golden Gate Bridge Highway and Transportation District website where the text for that particular exhibit component was available in 10 different languages. The QR code also accesses additional web-based information on each exhibit component for those interested in learning more. Even though the ten languages provided on the website are heard among visitors at the bridge, very few are actually accessing translations on the website using the QR code.

Only three respondents out of 455 reported using the QR code to access translated text. And, only seven reported using the QR code to access additional information. While it is important to acknowledge the potential need for language translations, and to provide additional information for those particularly interested in the history, science and engineering associated with the bridge, very few visitors are accessing these resources while on-site. While on location, DHA team members noticed that the code stickers on some of the exhibits are incomplete, having been worn off due to weather and/or scratched from vandalism, which may contribute to low usage.

The main focus of the General Visitor Survey was to measure visitor impacts in the domains of general attitudes and behaviors that may have changed as a result of their interactions with the exhibits, or increased interest in or understanding of the history, science, or engineering associated with the bridge. In addition, the study sought to measure whether visitors were interested in seeing hands-on exhibits at public works venues in their home communities. Table 7 summarizes visitor responses to a number of questions that get at these potential impacts.

This self-reported data suggests a high degree of impact relative to visitors' attitudes, interests, and understandings as a result of interactions with the Golden Gate Bridge Outdoor Exhibition. This clearly matches stated goals of the project, especially pertaining to history and STEM related topics of science and engineering. The fact that 84% reported that the exhibits contributed to making their visit "more enjoyable" quantifies an observation shared by a number of the project staff and partners

Statements Rated By Survey Respondents	% Agree or Strongly Agree
Because of the outdoor exhibits, my visit to the Golden Gate Bridge today was more enjoyable.	84%
Because of the outdoor exhibits, I have a better understanding of the history of the Golden Gate Bridge.	83%
Because of the outdoor exhibits, I have a better understanding of the engineering behind building/maintaining the Golden Gate Bridge.	83%
Because of the outdoor exhibits, I have a better understanding of the science behind building/maintaining the Golden Gate Bridge.	80%
I would be interested in seeing more hands-on exhibits or panels about the Golden Gate Bridge added to the visitor area.	69%
I would be interested in seeing hands-on exhibits and/or panels at a public works site near where I live.	60%
I was able to locate all twelve of the outdoor exhibits while visiting the Golden Gate Bridge today.	26%

who commented that one of the project's major successes is that people seem to appreciate the exhibits and have a good time interacting with them. It is also worth noting that 69% of surveyed visitors to the Golden Gate Bridge would be interested in seeing more hands-on exhibits about the bridge added to the area, and 60% reported being interested in seeing hands-on exhibits at a public works site near their home town. These are all positive outcomes of this outdoor exhibition and speak to both a strong individual impact as well as the potential for more public works venues to develop informal education resources and experiences for public audiences.

Table 7 Percentage of Survey Respondents That "Agreed" or "Strongly Agreed" With Each Statement (n=400)

The fact that a relatively low percentage of visitors were able to locate the full

complement of exhibits while visiting the Golden Gate Bridge site is indicative of the challenges associated with this particular site, having exhibits spread over a relatively large area, and many of them not visible from a single location. Again, the reasons behind their current location will be discussed more in a later section of the report, but it is important to note that even though the full

set may not have been located by every visitor to the site, visitors are still reporting an enhanced experience and increased interest and understanding having interacted with even a few of the exhibit components.

Exhibit Component Survey

During the same windows of time that the general visitor surveys were being conducted on-site, DHA evaluators also conducted visitor surveys at each of the individual exhibit components. The questions for this second survey focused on the visitors’ personal engagement or interaction with the exhibit, and to what degree they valued that interaction. Table 8 summarizes a number of particular engagements as reported by visitors surveyed after they had spent time interacting with a particular exhibit unit. Following this summary, there will be additional data for each unit.

Engagement Activity	Rarely/ Never	Sometimes	Frequently/ Often
Read exhibit text	10%	17%	73%
Touched exhibit or interacted with hands-on elements of exhibit	30%	18%	52%
Discussed with others how exhibit functions	36%	24%	40%
Compared information presented by exhibit with real Golden Gate Bridge	37%	25%	38%
Discussed with others an idea or concept presented by exhibit	38%	23%	37%
Used exhibit to explain an idea or concept to others	49%	18%	33%
Recalled an idea or concept previously learned in school or another setting that related to exhibit	52%	22%	26%

Table 8 Summary of Visitor Engagement With Golden Gate Bridge Exhibit Components (n=293)

The significant insight from this data is that while visitors appreciate the exhibits and value having them on-site, the degree to which they are interacting with the exhibits is comparatively low. Reading the exhibit text clearly is the most frequently reported form of interaction, with 73% of the visitors surveyed saying they did this “frequently or often” and 17% doing so “sometimes.” For those reporting touching the exhibit the numbers decline considerably, to 52% for “frequently or often,” 18% “sometimes,” and 30% saying they “rarely or never” touched or interacted with the hands-on elements. The exhibits did prompt some discussions among visitors and yet 40-50% of those surveyed reported “rarely or never” having such discussions. Some of this lack of engagement is due to the relatively short time that visitors spend on any one exhibit or location while visiting the South end of the bridge. But, it may also have to do with language barriers (even though most survey respondents were able to complete the survey in English), comfort with interactive exhibits in general, or the fact that for many visitors, simply reading the exhibit information panels was enough.

Visitors that were surveyed at particular exhibit components were also asked about the value of having the particular exhibit on-site, and their responses mirror the general visitor surveys in that they tend to agree or strongly agree with statements like “the exhibit component was interesting” or “the exhibit taught me something I did not previously know about the Golden Gate Bridge.” Table 9 summarizes the survey responses collected at all of the individual exhibit components. Tables following are specific to individual exhibits.

Value Statement	Disagree/ Strongly Disagree	Neutral	Agree/ Strongly Agree
The exhibits were interesting	0%	5%	95%
The exhibits taught me something I did not previously know about the GGB	3%	12%	85%
The exhibits made my visit to the GGB a richer experience	0%	20%	80%
The exhibits were relevant to my visit	2%	23%	75%

Table 9 Visitor Perceptions of Exhibits When Surveyed at a Particular Exhibit - Totals for All Exhibits (n=293)

Individual Exhibit Components

Summarized below are survey responses for each of the 12 installed exhibits. There is also a photo of each exhibit and brief description of the content or interaction provided to the visitor through the exhibit. The goal of this data collection was not to identify the most popular exhibits, though this can be inferred by some of the responses, but more importantly to test the consistency of exhibit value to visitors across the set of exhibits, measuring visitor satisfaction and interest for each individual component and whether the exhibit component was seen as relevant to their visit and/or made their visit to the Golden Gate Bridge a richer experience.

Braille Model



Located at the east entrance to the pavilion, this is the first exhibit component that most visitors encounter. It is a bronze tactile-readable tabletop model of the Golden Gate Bridge with Braille captions and an 18” high replica of one of the bridge towers.

Public Value Statement	%Disagree/ Strongly Disagree	% Neutral	% Agree/ Strongly Agree
This exhibit component was interesting	0%	4%	96%
This exhibit component was relevant to my visit	0%	17%	83%
This exhibit component taught me something I did not previously know about the Golden Gate Bridge	4%	25%	71%
This exhibit component made my visit to the Golden Gate Bridge a richer experience	0%	13%	87%

Table 10 Visitor Perceptions of Braille Model Exhibit (n=24)

LIFETILES



Using artistic technology developed by Rufus Butler Seder, this innovative glass tile mural animates historic photos documenting various phases of the bridge’s construction as a visitor walks past the exhibit.

Public Value Statement	%Disagree/ Strongly Disagree	% Neutral	%Agree/ Strongly Agree
This exhibit component was interesting	0%	0%	100%
This exhibit component was relevant to my visit	0%	4%	96%
This exhibit component taught me something I did not previously know about the Golden Gate Bridge	4%	4%	92%
This exhibit component made my visit to the Golden Gate Bridge a richer experience	0%	8%	92%

Table 11 Visitor Perceptions of LIFETILES Exhibit (n=24)

Entrance Panels



This series of four text panels introduces the visitor to some of the more fascinating facts about the Golden Gate Bridge. First is a description of how the bridge spans the Golden Gate by using connecting cables and high towers to distribute the loads necessary to support the roadbed across such a long distance. Next is recognition of the various Art Deco design elements that help define the Golden Gate Bridge. The third panel explains further the role played by the tall towers in carrying the weight of the bridge down to their foundations. The panel also explains how rivets are used to hold the bridge

steel together. Finally, how the bridge was constructed and continues to be maintained to withstand the inclement elements of rain, fog, and sea salt is introduced to the visitor, comparing an unpainted steel surface with one painted with the Golden Gate Bridge’s iconic International Orange paint.

Public Value Statement	%Disagree/ Strongly Disagree	% Neutral	%Agree/ Strongly Agree
This exhibit component was interesting	0%	5%	95%
This exhibit component was relevant to my visit	0%	11%	89%
This exhibit component taught me something I did not previously know about the Golden Gate Bridge	0%	21%	79%
This exhibit component made my visit to the Golden Gate Bridge a richer experience	0%	16%	84%

Table 12 Visitor Perceptions of Entrance Panels (n=19)

Suspension Cable Size. Vs. Tower Height



This exhibit provides visitors with a hands-on, experiential explanation of how the height of the bridge’s towers, the slope of the cables, and the tension of those cables all had to be taken into account in order to arrive at the final design of the bridge, which at the time it was built had the tallest towers of any bridge in the world. This is a classic example of how engineers often wrestle with numerous tradeoffs in order to optimize performance from their designs.

Public Value Statement	%Disagree/ Strongly Disagree	% Neutral	%Agree/ Strongly Agree
This exhibit component was interesting	0%	7%	93%
This exhibit component was relevant to my visit	0%	27%	73%
This exhibit component taught me something I did not previously know about the Golden Gate Bridge	2%	11%	87%
This exhibit component made my visit to the Golden Gate Bridge a richer experience	0%	18%	82%

Table 13 Visitor Perceptions of Suspension Cable/Tower Height Model Exhibit (n=45)

History: Design and Construction of the Bridge



This series of nine floor-mounted panels located beneath a large fabric banner inside the Battery Lancaster tells the story of the many financial, political, and structural challenges that had to be taken into consideration when designing and building the Golden Gate Bridge. So, while the bridge was clearly a world-renowned engineering feat, visitors are introduced to the complexities involved in orchestrating such an historic accomplishment.

Public Value Statement	%Disagree/ Strongly Disagree	% Neutral	%Agree/ Strongly Agree
This exhibit component was interesting	0%	3%	97%
This exhibit component was relevant to my visit	0%	22%	78%
This exhibit component taught me something I did not previously know about the Golden Gate Bridge	6%	6%	88%
This exhibit component made my visit to the Golden Gate Bridge a richer experience	0%	17%	83%

Table 14 Visitor Perceptions of History Exhibit (n=36)

Battery Lancaster

The Golden Gate Bridge Outdoor Exhibition is installed in and around a historic military defense construct at the south end of the Golden Gate Bridge called the “Battery Lancaster.” On the inside walls of the battery are huge metal “doorknocker” like rings that perplex (and amuse) visitors of all ages. This exhibit, provided by the National Park Service, stewards of the site, explains the historic function of these rings, which was to help maneuver the large military cannons housed inside the battery. It is designed to match the other exhibit panels in the collection and adds to the topical mix of history, science, and engineering.



Public Value Statement	%Disagree/ Strongly Disagree	% Neutral	%Agree/ Strongly Agree
This exhibit component was interesting	0%	6%	94%
This exhibit component was relevant to my visit	0%	35%	65%
This exhibit component taught me something I did not previously know about the Golden Gate Bridge	0%	6%	94%
This exhibit component made my visit to the Golden Gate Bridge a richer experience	0%	12%	88%

Table 15 Visitor Perceptions of Battery Lancaster Exhibit (n=17)

Foghorns



When the weather is foggy, visitors to the Golden Gate Bridge often are unable to actually see the bridge, yet they can hear the foghorns booming from the bridge's towers. This exhibit explores the speed of sound by allowing visitors to compare arrival time of the foghorn sound via a cell phone connection (instantly) or naturally through the open air (delayed). It is located along a railing near the flagpole, the most popular area for visitors to stage their photos of the bridge.

Public Value Statement	%Disagree/ Strongly Disagree	% Neutral	%Agree/ Strongly Agree
This exhibit component was interesting	6%	11%	83%
This exhibit component was relevant to my visit	6%	22%	72%
This exhibit component taught me something I did not previously know about the Golden Gate Bridge	11%	22%	67%
This exhibit component made my visit to the Golden Gate Bridge a richer experience	6%	28%	66%

Table 16 Visitor Perceptions of Foghorn Exhibit (n=18)

How the Bridge Vibrates



Also located near the flagpole, this exhibit is probably the most frequently noticed and touched of all the outdoor exhibits, partly because of its location and partly because of its enticing design. The mechanical, hands-on exhibit allows visitors to explore how the Golden Gate Bridge vibrates, from swaying side to side in the wind to vertical and horizontal rippling between the towers. This motion is both a daily occurrence and a structural allowance for less frequent, yet anticipated, motion caused by an earthquake.

Public Value Statement	%Disagree/ Strongly Disagree	% Neutral	%Agree/ Strongly Agree
This exhibit component was interesting	0%	7%	93%
This exhibit component was relevant to my visit	14%	28%	58%
This exhibit component taught me something I did not previously know about the Golden Gate Bridge	0%	7%	93%
This exhibit component made my visit to the Golden Gate Bridge a richer experience	0%	28%	72%

Table 17 Visitor Perceptions of How the Bridge Vibrates Model Exhibit (n=29)

Located on the west side of the bridge, along the bike trail as it passes under the bridge, are two exhibits dealing with how engineers continue to study and strengthen the bridge through retrofitting the original design and materials. The location underneath the bridge infrastructure allows visitors to immediately locate and compare the exhibit elements with the actual structural elements on the bridge.

Seismic Isolator Retrofit

Seismic isolators have been installed on the approach spans close to shore. In the event of an earthquake, these isolators will deform similar to a shock absorber resulting in the platform above the isolators experiencing less violent shaking than the underlying earth beneath the platform. This exhibit includes a sample isolator and a text panel explaining the science and engineering involved.



Public Value Statement	%Disagree/ Strongly Disagree	% Neutral	%Agree/ Strongly Agree
This exhibit component was interesting	0%	11%	89%
This exhibit component was relevant to my visit	0%	42%	58%
This exhibit component taught me something I did not previously know about the Golden Gate Bridge	5%	0%	95%
This exhibit component made my visit to the Golden Gate Bridge a richer experience	0%	21%	79%

Table 18 Visitor Perceptions of Isolator Seismic Retrofit (n=19)

Lattice Strut Retrofit



One of the iconic design features of the Golden Gate Bridge was its intricate lattice of hundreds of crisscrossing metal pieces riveted together to create the support braces (struts) in the arch and spans. A seismic retrofit has replaced many of these struts with one-piece metal tubes but with laser cutouts to match the original design. The exhibit explains how a team at the University of California, Berkeley tested a replica strut in their laboratory to measure its strength and a sample of a tested strut is standing next to the text panel.

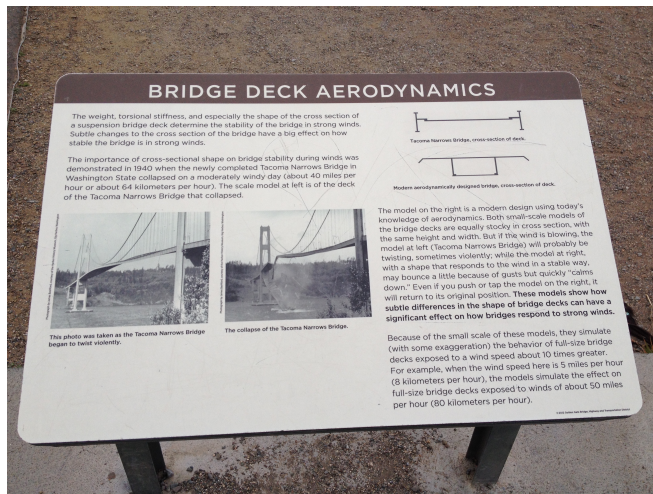
Public Value Statement	%Disagree/ Strongly Disagree	% Neutral	%Agree/ Strongly Agree
This exhibit component was interesting	0%	0%	100%
This exhibit component was relevant to my visit	0%	29%	71%
This exhibit component taught me something I did not previously know about the Golden Gate Bridge	0%	14%	86%
This exhibit component made my visit to the Golden Gate Bridge a richer experience	0%	14%	86%

Table 19 Visitor Perceptions of Lattice Strut Retrofit Exhibit (n=7)

Located along the bike trail just below the visitor center and to the East of the bridge are two additional exhibits. This location, while not part of the original layout plan, allows a more distant but contextual view of the bridge and attracts bikers and hikers taking a quick break after climbing the trail from Crissy Field. Unfortunately, these exhibits have also attracted vandals who have taken advantage of their isolated location to deface or damage the exhibits on multiple occasions. At the time of this evaluation, Bridge District maintenance staff were re-installing the Resisting the Twisting exhibit daily to avoid damage at night.

Both of these exhibits address impacts of bridge movement caused by wind, a signature feature of weather conditions at the Golden Gate. When the Golden Gate Bridge was first designed in 1937 the engineers did not have the benefit of the lessons learned from the dramatic collapse of the Tacoma Narrows Bridge in 1940, highlighted in photos on the Bridge Deck Aerodynamics exhibit panel.

Bridge Deck Aerodynamics



This exhibit calls attention to the Tacoma Narrows bridge collapse and how engineers continue to test the Golden Gate Bridge to evaluate its performance in windy conditions. The hands-on component allows visitors to compare two side-by-side model bridge decks, one more aerodynamically stable than the other.

Public Value Statement	%Disagree/ Strongly Disagree	% Neutral	%Agree/ Strongly Agree
This exhibit component was interesting	0%	5%	95%
This exhibit component was relevant to my visit	5%	19%	76%
This exhibit component taught me something I did not previously know about the Golden Gate Bridge	0%	10%	90%
This exhibit component made my visit to the Golden Gate Bridge a richer experience	0%	29%	71%

Table 20 Visitor Perceptions of Bridge Deck Aerodynamics Exhibit (n=21)

Resisting the Twisting

This hands-on exhibit explains a 1954 retrofit of the Golden Gate Bridge’s vertical deck trusses to reduce twisting in the wind. Visitors are allowed to compare two side-by-side models of bridge deck, one without the retrofit and the other with the additional horizontal diagonal bracing added to the bottom edges of the deck trusses.



Public Value Statement	%Disagree/ Strongly Disagree	% Neutral	%Agree/ Strongly Agree
This exhibit component was interesting	0%	0%	100%
This exhibit component was relevant to my visit	3%	22%	75%
This exhibit component taught me something I did not previously know about the Golden Gate Bridge	0%	22%	78%
This exhibit component made my visit to the Golden Gate Bridge a richer experience	0%	31%	69%

Table 21 Visitor Perceptions of Resisting the Twisting Exhibit (n=36)

Timed Observations

Another measure of visitor engagement employed timed observations of visitors in and around individual exhibit components. Sixteen different factors were observed and recorded, including total time observed. Table 22 summarizes the timed observation data collected over two multi-day observational windows. At the bottom of the table the average time a subject remained at the exhibit and was observed and the total number of individuals observed at each exhibit appear. This data tells a story about visitor behavior at the outdoor exhibits and which exhibit components promote certain behaviors over others.

	Braille	LIFE TILES	Entrance Panels	Suspension Cable	History	Battery Lancaster	Foghorns	How Bridge Vibrates	Isolator Seismic Retrofit	Lattice Strut Retrofit	Deck Aero- dynamics	Resisting the Twisting	Exploratorium Bridge Model
Stops for more than 3 seconds	94%	99%	97%	99%	100%	97%	100%	96%	97%	100%	100%	98%	96%
Reads text panel (no interactive)	30%	3%	56%	3%	56%	63%	63%	4%	53%	50%	41%	14%	0%
Reads text panel before touching interactive	17%	1%	14%	15%	3%	0%	2%	7%	30%	23%	26%	49%	15%
Touches interactive	37%	15%	34%	80%	11%	3%	4%	77%	53%	40%	40%	77%	81%
Reads text panel after touching interactive	10%	1%	10%	20%	3%		4%	29%	20%	17%	22%	37%	28%
Correctly uses interactive	20%	67%	25%	52%	47%	21%	7%	51%	33%	50%	19%	42%	49%
References real Golden Gate Bridge	9%	6%	1%	2%	2%	0%	11%	25%	57%	50%	21%	9%	N/A
Activates Sound	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	49%
Uses interactive to engage w/ member(s) of their group	18%	43%	28%	53%	38%	39%	12%	34%	27%	30%	34%	49%	47%
Takes a photo of the interactive or text panel	18%	28%	16%	9%	23%	3%	14%	22%	3%	10%	3%	0%	9%
Gets their photo taken w/ the interactive or text panel	8%	11%	2%	15%	3%	0%	11%	19%	0%	3%	5%	2%	6%
Photographs someone else w/ the interactive or text panel	5%	7%	1%	7%	1%	0%	12%	11%	0%	7%	3%	0%	8%
Appears confused or frustrated by text panel	2%	1%	0%	1%	5%	3%	5%	1%	0%	0%	3%	5%	4%
Appears confused or frustrated by interactive	0%	6%	0%	16%	1%	0%	4%	4%	0%	0%	2%	7%	2%
Acknowledges (touches, points at, etc.) exhibit damage or dysfunction	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average time	00:41	00:33	01:13	01:19	02:38	00:24	00:46	01:25	00:51	01:06	00:50	00:56	01:18
n=	105	165	100	100	100	50	60	101	30	32	60	43	59

Table 22 Exhibit Component Timed Observation Summary (n=950)

The first thing to notice in this data is that for visitors attracted to these exhibits, a very high percentage will stop for more than three seconds to satisfy their curiosity. Overall, the exhibit components that held visitors for the longest period of time include the four history panels in the Battery Lancaster area (2:38 average), How the Bridge Vibrates (1:25 average) located near the popular flagpole area, the Suspension Cable Vs. Tower Height component also in the Battery Lancaster area (1:19 average) and the Entrance Panels (1:13 average) near the lower entrance to the Battery. In the case of the entrance panels and the history panels, the multiple panels themselves require a longer time commitment to read and process the information. The two hands-on exhibits with longer engagement times (Bridge Vibration and Suspension Cable/Tower Height) are also the two most elaborate exhibit designs with shiny metal materials and multiple ways of interacting. These two components also show the highest percentages of “Touches Interactive” behaviors, along with the Resisting the Twisting component, which requires hands-on comparisons of bridge deck models. The Exploratorium Bridge model, located outside at the popular new Exploratorium science center on a San Francisco waterfront pier is based on the How the Bridge Vibrates exhibit with the addition of an audio element, also had a relatively high average engagement time (1:18 average) and a high percentage of recorded hands-on interactivity, something to be expected in an environment designed specifically for hands-on engagement. Visitor surveys were not conducted at the Exploratorium.

Interestingly, the two exhibits touched by the highest number of visitors mentioned above had some of the lowest percentages of visitors who observers reported “Reads text panel.” This was recognizable behavior to the evaluators since highly attractive interactive exhibits often entice visitors to “touch” before “reading” how to touch the components or what the exhibit is actually demonstrating. Notice that 20-30% of visitors did actually “Read text panel after touching interactive” for these two components, suggesting that they were more interested in the content of the exhibit or how it worked after their initial contact. The LIFETILES exhibit does not require a text panel for effective engagement, and therefore also shows a low percentage of visitors reading the text panel (3%).



Correctly using an exhibit can be a reflection of both the exhibit design and the patience of the visitor approaching and interacting with the exhibit. In this set of exhibits, the LIFETILES component has the highest rating for “correctly uses interactive” at 67%. This is likely due to the nature of the exhibit itself, whereby a visitor walking by and discovering the tiles will often walk back and forth a few times in order to get the full benefit of the changing images. This behavior would trigger a record for “correctly using interactive” for this study. Only about half

of the visitors observed at the Suspension Cable/Tower exhibit and the How The Bridge Vibrates used the interactive correctly, which is a reflection of their tendency to manipulate the interactive before reading the text instructions, and some confusion around how to manipulate it. Visitors that stick with either of these two exhibits for a while will often try out various manipulations during that time. The Foghorns exhibit requires a visitor to dial a number on their cell phone in order to hear the horn instantaneously and very few visitors take that step.

Exhibit components that have the higher percentages of visitors referencing the real bridge are located with a clear view of the real bridge. In the case of the two seismic retrofit exhibits located

underneath the bridge, the exhibit actually prompts a visitor to look at the related structures on the real bridge, resulting in recordings of 50% for the Lattice Strut Seismic Retrofit and 57% for the Isolator Seismic Retrofit.

Using the interactive to engage with another individual is a measure of how the exhibit facilitates conversations, sharing of ideas, and/or collaboration. The Suspension Cable/Tower Height prompted the highest percentage of visitor-to-visitor interaction (53%) followed by the Resisting the Twisting exhibit (49%), the Exploratorium exhibit (47%) and the LIFETILES (43%).

As mentioned earlier, taking photos of the Golden Gate Bridge is a major element of most people's visit to the south end of the bridge. Now with the exhibits in place, visitors are taking photos of themselves or others *with* an exhibit component as an intentional part of the shot. At 28% of visitors, the LIFETILES exhibit attracted the most photos of the exhibit itself. How the Bridge Vibrates garnered the most overall photo taking in all three categories recorded—photo of the interactive or text panel (22%), photo of self with interactive or text panel (19%), and photo of someone else with interactive or text (11%).



Confusion with an interactive or an exhibit's text panels is not uncommon in science center settings. It is noteworthy that this particular set of exhibits did not result in a very high percentage of visitors being confused. The exception is that evaluation observers at the Suspension Cable/Tower Height exhibit recorded 16% of visitors being confused or frustrated at some point during their time at the exhibit. This is a positive reflection on the quality of the exhibits themselves, the ingenuity of the interactives and the care taken to write clear, understandable text for the panels. Prototyping of both the interactive and the text panels in some cases helped reduce the level of confusion or frustration experienced by visitors.

While a part of the timed observational study, there were no recorded cases of visitors acknowledging exhibit damage or dysfunction. This is a credit to the robustness of the original designs, and the dedication of the Bridge District's staff in maintaining the exhibits and/or removing one for repairs if it becomes damaged or dysfunctional. It is worth noting that at other times on site the evaluation team did notice some damage or dysfunction on some of the components but even when this was observable by the evaluators, visitors appeared to be less distracted by the condition.

Web-Based Resources

As part of this Golden Gate Bridge Outdoor Exhibition project, web-based materials were developed and posted on the Golden Gate Bridge Highway & Transportation District website. To locate the resources one must access the District's website, select "Visitors" from the left hand menu, then select item #6 in the list of things to do "Before your trip to the Golden Gate Bridge," which is titled "Virtual Golden Gate Bridge Exhibition." Currently, the posted material is limited to photos of each of the exhibits and a transcription of the text panels accompanying each exhibit component. This information is available in nine languages in addition to English, including the following: Chinese, Japanese, Korean, Vietnamese, French, German, Italian, Portuguese, and Spanish. As the title of the section implies, a visitor to the District website could get a "virtual tour" of the outdoor exhibition, or visitors to the south end of the bridge can access the website via the QR code on an exhibit panel and access the translated text if needed, even in real time while actively perusing the exhibits. A considerable amount of additional material has been developed for the website, including but not limited to additional historic and scientific content relative to the Golden Gate Bridge and/or the

science and engineering concepts introduced by the exhibits, and classroom resources for educators and students. While the evaluators have seen drafts of some of these additional resources, since they had not yet been posted at the time this report needed to be written, there was no analysis or user data collected on these materials.

Exhibit Welcome Page in All Languages	Page Views (June 1 –June 30, 2015)
English	1,064
Chinese	177
French	332
German	153
Italian	100
Japanese	105
Korean	54
Portuguese	317
Spanish	481
Vietnamese	36

Table 23 Golden Gate Bridge Outdoor Exhibition Page Views by Language for June 2015

views (177), German page views (153) and Japanese page views (105). It is not known whether access to these pages was prompted by an on-site visit of the exhibits or through a simple browser search for information about the Golden Gate Bridge. Based on earlier data gathered during the general visitor surveys, the percentage of on-site visitors using the QR codes to access the while engaging with the exhibits website was relatively small.

DHA did request some analytics on the site in order to gauge overall access and usage. Table 23 summarizes page views for the month of June 2015 a period of time that would have seen both general public and school group visitation at the exhibition itself, and open access to the website by all audiences.

Table 23 illustrates the importance of having translated content available for non-English speaking visitors to either the exhibition site or the website. In terms of frequency of page views, the top five languages accessed following English language page views (1,064) were Spanish language page views (481), French language page views (332), Portuguese page views (317), Chinese page

Table 24 summarizes more detailed page views by exhibit component for four of the top five languages—English, Spanish, Chinese, and Japanese. In this data one can see which exhibit descriptions were being accessed the most and the least by language. For ease of reference, exhibits are listed in the same order as previously described in this report.

Exhibit Component	English Page Views	Spanish Page Views	Chinese Page Views	Japanese Page Views
Welcome Page	1,064	481	177	105
Braille Model	100	148	5	8
LIFETILES	285	205	12	32
Entrance Panels				
<i>How Bridge Span Golden Gate</i>	762	655	56	57
<i>Art Deco Bridge Aesthetics</i>	460	406	16	59
<i>Tower Height/Strength</i>	426	341	20	35
<i>Maintenance</i>	1,906	488	18	54
Suspension Cable/Tower Height	847	329	13	21
History: Design & Construction	880	9,930	71	44
Battery Lancaster	156	159	29	30
Foghorns	276	223	84	45
How the Bridge Vibrates	937	575	31	45
Isolator Seismic Retrofit	161	296	9	12
Lattice Strut Retrofit	196	195	11	44
Bridge Deck Aerodynamics	279	384	11	58
Resisting the Twisting	322	216	6	72

Table 24 Golden Gate Bridge Outdoor Exhibition Page Views by Language & Exhibit Component for June 2015

For English language users, the most frequently visited pages after the welcome page were the Entrance Panels (3,554 for the collection of four, with bridge maintenance attracting 1,906 views), How the Bridge Vibrates (937 views), History of Bridge Design & Construction (880 views), and Suspension Cable/Tower Height (847 views). For Spanish language users the most viewed page was affiliated with the History of Design and Construction with a very high 9,930 page views. Following this the entrance panels (1,890 total page views for all four), How the Bridge Vibrates (575 views), Bridge Deck Aerodynamics (384 views), and Suspension Cable/Tower Height (329 views). Chinese and Japanese language users of the website pages showed a similar spread of frequently viewed pages, with Foghorns being added to the higher viewed page count. In general, exhibit components with a high degree of printed text on the panels or more complex interactive elements requiring operating instructions attracted the most page views for all languages, including English, suggesting that these exhibits may have required some additional content interpretation or translation in order to be fully understood by visitors. The high number of Spanish language page views for the History of Design & Construction page may be an error without explanation since DHA did not have access to any additional data to explain the anomaly.

It should be noted that the CUREE website contains some of the same resource materials as what is posted on the District's website, and in some cases additional content background and interpretation. These materials, while available to anyone seeking them out, were not evaluated as a separate project deliverable since they are by and large a duplication of the other materials.

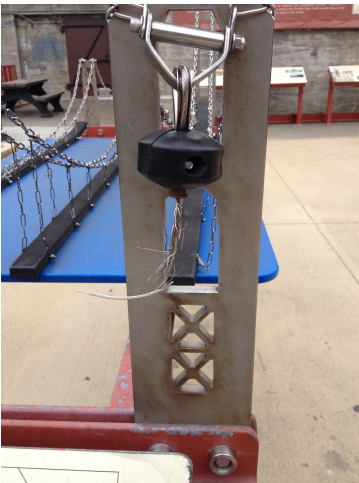
Stakeholder Perspectives on the Exhibits

As part of the stakeholder interviews, the lead DHA evaluator asked individuals familiar with the project to describe what they thought were the project's key strengths. In almost all cases, the stakeholders felt that the exhibits themselves were one of the main successes of the project. These were new resources to enhance the visitor experience and most stakeholders felt that they have been successful in doing that. Mentioned specifically by a number of stakeholders were the LIFETILES, History Panels, and the How The Bridge Vibrates model near the flagpole. Specific exhibit components identified as weaknesses by stakeholders included the fabric banner (tends to blow in the wind and is hard for some to read) and the Foghorns exhibit (cell reception necessary to compare foghorn sounds). Other weaknesses mentioned by stakeholders were that some of the exhibit panels were too text heavy and not easy to read, and that some of the exhibits have fostered inappropriate use by visitors—standing on them for instance—or simply require more maintenance than will likely be sustainable over time (Resisting the Twisting). In general, stakeholders felt that the exhibit collection has done a great deal to enhance the visitor experience, providing props for tour guides if they want them, and interesting resources for learning about the bridge for all visitors to the site. Conservancy staff mentioned that they often recommend the exhibits to visitors inquiring about what to do while on site, and in particular suggest that individuals unable to walk out on the bridge itself explore the exhibits as an alternative experience.

There are a few additional elements of the Golden Gate Bridge Outdoor Exhibition that garnered stakeholder comments and/or evaluative observations during the course of the project. A few of these have strategic significance as well, and will be discussed further in the final findings section of this report.

Improper Use, Vandalism, and Maintenance Of Exhibits

As early as the prototype phase of this project the evaluation teams of Inverness Research and DHA both noticed occasional improper use of the exhibits by visitors to the site. This ranged from energized youth testing the sturdiness of an exhibit by climbing on it in jungle gym fashion, to individuals operating an exhibit mechanism with unreasonable force. Because of the outdoor nature of this exhibition, and its installation at a highly accessible public site, a certain amount of this misbehavior will likely always occur. When interviewing stakeholders about the project, a number of them referenced their concern about exhibits not holding up to this type of treatment or abuse. District staff tasked with maintaining the exhibits report that components located along the bike trail seem to receive the most abuse and vandalism due to their isolation from the core visitor traffic areas. The photo on the right shows the Resisting the Twisting exhibit component with a bike tire locked to its base, and graffiti marks on

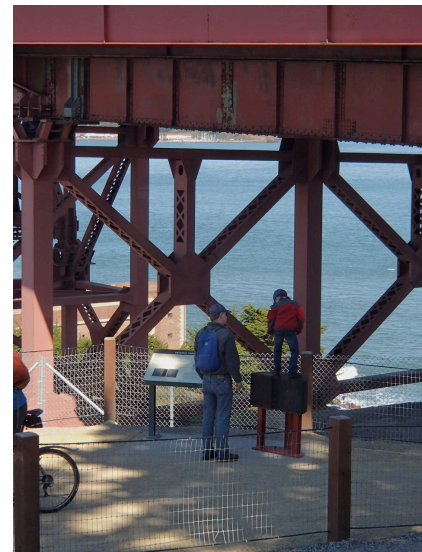


the panel backing. The interactive elements have already been removed due to earlier vandalism when it appears someone stood on the two bridge span sections, jumping on them until they bent downward and were no longer usable to explain the concept intended. This type of damage is costly to repair and can leave a negative image in a visitor's mind if left in ill repair.

While isolated exhibits seem to take the worse beating, even exhibits located in the Battery suffer from unusual treatment or vandalism. The photo on the left shows a severed cable on the Suspension Cable/Tower Height exhibit component. This hazardous condition was noticed first by the evaluator and reported to District staff who immediately responded by replacing the torn cable.

On the same visit, the DHA evaluator noticed a young boy standing on the Isolator Seismic Retrofit display while an adult watched (see photo to the right). While this may appear at first glance to be improper use of an exhibit, on reflection one could imagine the boy simply testing the strength of the isolator buffer as if there was an earthquake in action. Fortunately in this case, the unit is strong enough to withstand this type of experimental use.

It is important to note that according to project staff and other stakeholders it is not clear where funds for ongoing maintenance of the exhibits will come from once all the NSF award funding is depleted. Most likely, the Bridge District will need to include funds for regular maintenance in future operating budgets since as fiscal agent for the grant they are the overall keeper of the outdoor exhibit collection. That said, according to some stakeholders, as individual exhibit units become severely worn or vandalized, replacement of specific parts or entire components may be too costly to support through such annual budgeting. There currently are no documented plans for additional fundraising to support the Golden Gate Bridge Outdoor Exhibition, and this was a concern of some stakeholders.



Placement of the Outdoor Exhibits on the Site

Due to a number of factors, some of which will be discussed in a later section of this report dealing with strategic lessons learned, some of the current exhibits have been installed in locations not originally planned. This is especially true of the four exhibits located along the bike trail to the West and East of the main visitor pavilion area. While one consequence of this exhibit isolation is vulnerability to vandalism, another consequence is that visitors have difficulty benefiting from the entire collection of exhibits because they often can't see or locate the units along the trail. Some stakeholders feel this has a negative impact on the overall visitor experience, resulting in a disjointed or incomplete experience. Others, notably the Conservancy staff and volunteers who operate the visitor center, feel that having exhibits scattered across the site is a good thing in that it spreads visitor crowds out more and allows for wandering outside the main traffic patterns to explore the bike trail locations which are often not explored by those making a quick tour stop or more focused on walking the bridge. So, while deviation from the original design layout has definitely had an impact on the overall storyline and visitor experience, there are perceived advantages and disadvantages to this situation.

Nature of Visitations to the Site

One stakeholder felt that there are three distinct types of visitors to the Golden Gate Bridge, the *streakers*, the *strollers*, and the *studiers*. *Streakers* are passing through quickly, possibly via a bus tour, on bike, or on a quick family stop, and have very limited time to read exhibit text and/or engage with an innovative hands-on interactive. *Strollers* come in their own cars or take public transportation and are willing and prepared to spend more time engaging in a variety of activities on-site. *Studiers* are intrinsically interested in the Golden Gate Bridge and are inclined to spend more time soaking up the rich stories and topical content presented in history panels and exhibit explanatory text. Time is the defining factor for all three of these visitor types, and personal commitment of time determines the level of visitor engagement. As mentioned earlier in this report, many visitors to the Golden Gate Bridge arrive as part of a scheduled bus tour of San Francisco, with the bridge being only one stop on their route. According to stakeholders familiar with these tour operations, most buses stop for only a 20-30 minute window of time. The first order of business is most often use of the public restroom facility, which has proven to be far smaller than the demands placed on it by the high tour bus traffic to the site. Since it is one of the few public restrooms on the tour route, drivers tend to encourage their passengers to wait until they get to the Golden Gate Bridge to use a restroom facility. This means that half to two thirds of an organized tour visitor's time at the site may be spent standing in line for the restroom, severely limiting the time available to explore the site and interact with hands-on exhibits. The Golden Gate Bridge Highway & Transportation District is in the process of replacing the current restroom with a larger facility, but this still does not address the fact that the tour operators have not adjusted their tour schedules to allow a more extended visitor experience. Individuals and families who visit the site with their own transportation find parking difficult and expensive, another deterrent to an extended visit to enjoy the interpretive exhibits. Even though the District's website lets visitors to the site know the exhibits exist, there is little in the way of trip planning advice to suggest allowing more time for their visit to include them.

...there are three distinct types of visitors to the Golden Gate Bridge, the *streakers*, the *strollers*, and the *studiers*.

Finally, there are multiple attractions at the south end of the Golden Gate Bridge, including a walk on the bridge itself, visiting the Visitor Center operated by the Golden Gate National Parks Conservancy, taking photos of the bridge from numerous outlooks on-site, and visiting the soon to reopen restaurant in the historic roundhouse. While the exhibits are recognized by most to be an enhancement to the site, they are not the only attraction defining a visitor's experience on site. Again,

visitors need some level of advance planning advice to map out their visits ahead of time, and to plan enough time to enjoy multiple elements of the Golden Gate Bridge when they do visit the site. Stakeholders from the Conservancy and the independent volunteer operated San Francisco City Guides suggested that there be more extensive training and awareness building available on the exhibits for tour operators and guides so that they would be more likely to include them in their literature and/or on-site tours. Project staff concur with this suggestion and have recruited one City Guide volunteer to incorporate more of the exhibits into her tour of the site, but no systemic effort has been made to orient and train all tour operators and guides operating at the Golden Gate Bridge.

STRATEGIC IMPACTS & LESSONS LEARNED

Every project funded by the National Science Foundation's Division for Advancing Informal Science Learning (AISL) is expected to produce some project outcomes that inform and advance the field at large. The Golden Gate Bridge Outdoor Exhibition project produced a number of outcomes that can be considered lessons learned for the field. From the project's Logic Model there were three Strategic Impacts that were studied as a part of this summative evaluation:

1. Development of a scalable model for engaging the public in informal science learning in public works venues.
2. Documentation of lessons learned that could inform other public works/informal science learning collaborations.
3. Increase in the number of public works venues that provide science learning activities



One of the most significant measures of impact for this particular project is the opinion shared by a broad spectrum of stakeholders that the Golden Gate Bridge Outdoor Exhibition project served as an essential catalyst for dramatically improving the overall visitor experience at the Golden Gate Bridge. As mentioned earlier in this report, prior to 2008 the landscape on the south end of the bridge was haphazard at best, and did not include much interpretation of the bridge or the site.

One of the first deliverables for this project was development of a Golden Gate Bridge South End Master Plan, completed on July 9, 2010. This extensive plan was developed by EHDD Architecture, a reputable and well-known Bay Area firm with years of experience working with the National Park Service on other San Francisco area projects. The plan laid out multiple options for site improvements, including the project team's favored plan for exhibits to be clustered in the Battery Lancaster and contextually connected to the bridge by way of a physical cut through the battery, opening up an unobstructed view line between the exhibits and the actual Golden Gate Bridge. The plan also proposed a future visitor center on the site. While this plan was the first of its kind for the site, and a terrific asset for future planning, it also became a flash point for the project's forward momentum once it was completed and presented to other agencies with a stake in the site. In particular, the level of detailed descriptions for proposed development of the site and alteration of the historic Battery Lancaster took some individuals in the National Parks Service by surprise. As

NPS personnel describe it, the agency was caught off guard by the plan and felt that had they been given more opportunity for input earlier on, they could have advised the District and CUREE on the complexities of historic preservation and Section 106 compliance.

Ownership jurisdiction and stewardship authority is a complex equation at the south end of the Golden Gate Bridge. According to representatives of the National Park Service (NPS), they are the official “owners” of the land, based on the formation of the Golden Gate National Recreation Area in 1972 and the historic transfer of land and lease agreements associated with the Presidio, formally a part of the Department of Defense. The Golden Gate Bridge Highway & Transportation District holds a lease on the site that was authorized by the Department of Defense, and yet is understood to sunset to the current landholder makeup. Which entity actually



has the authority to propose future development of the site is not entirely clear, but what was clear upon completion of the Master Plan was that at this juncture in the project, certain individuals in the NPS felt that they had not been adequately engaged in the conceptual development of the Master Plan and that the Bridge District had “overstepped” their authority in developing such a plan without more NPS input. It is important to note that NPS personnel were involved in this project early on, attended early advisory planning sessions, and were asked to provide input into the Master Plan. Some representatives from the NPS supported the Master Plan ideas and this gave the Bridge District and CUREE confidence that the plan could move forward. That said, there were a few personnel changes that occurred in the 2008-2010 window when this project was getting underway and there were some new NPS department level managers and existing staff that did not share some of the same enthusiasm for making a cut into the historic battery as their agency colleagues. According to the NPS Historian, presentation of a finished Master Plan to the NPS initiated a level of scrutiny around historic preservation that later resulted in a determination by the State Historic Preservation Officer that cutting through the Battery would degrade the site and have an adverse effect on the historic landmark. This altered future development and installation of some of the project’s signature exhibits, which in turn, affected the visitor experience on site, as well as the project’s overall impact with public audiences.

Simultaneous to the formation of this wrinkle in the multi-agency collaboration necessary to advance the Golden Gate Bridge Outdoor Exhibition project, the NPS and their long-time non-profit partner the Golden Gate Bridge National Parks Conservancy, began an aggressive redevelopment of the site in preparation for the 75th anniversary of the Golden Gate Bridge. This effort was not on the radar screen when CUREE, EHDD and the Bridge District initiated their Master Plan process, so now there were two competing plans for the south end of the bridge. Inevitably, the NPS/Conservancy plan moved forward, and at a very rapid pace, requiring every other agency and organization active on the site to accommodate and cooperate with the undertaking. So, at a strategic time in the Outdoor Exhibition project when partner relations were strained with the NPS, the agency became, in the words of one stakeholder, “myopic” about getting ready for the anniversary, and the Outdoor Exhibition project took a back seat to this major effort. Establishing suitable locations for exhibit placement, even for piloting purposes; text panel design; choice of text fonts; and exhibit text content all became additional challenges for review and agreement among an expanded group of

partners with competing interests around visitor experiences and overall site development. In stakeholder interviews conducted by DHA this situation was described by numerous individuals as one of the biggest challenges for the project—reaching consensus among project partners. Consensus takes both planning and communication, and for some stakeholders neither of these criteria were met with enough conviction to overcome the differences of opinion or perspective. Specific stakeholder comments regarding project planning and communications included the following:

- NPS resistance to breaching the battery may have been prevented if certain individuals in the agency had been involved at an earlier stage in the planning
- The Conservancy was not included in the early planning, making it hard for them to understand and value the Outdoor Exhibition project when the time came to integrate it into the Conservancy’s own plan for the site
- Better clarification of partner roles and jurisdictions may have smoothed the pathway to success
- Working with the various project partners turned out being more difficult than anticipated
- No written correspondence was kept between CUREE and the NPS, so it was hard to use documentation as a tool for further analysis and consensus building



Figure 16 Original Plan Layout



Figure 17 Current Layout

In the end, this strained dynamic led to considerable delays in exhibit completion, placement, and evaluation. A comparison of the original plan layout (Figure 16) and the current layout (Figure 17) demonstrates the differences. In the current layout, some exhibits are located along the bike path, out of sight and out of mind for many of the visitors to the Golden Gate Bridge. In addition, the signature exhibit, a large-scale model of the bridge designed by a team of students and faculty from Princeton University and intended to be the centerpiece of the Outdoor Exhibition, will not fit in the available space inside the unaltered battery and therefore no longer has a place in the collection, an expensive and disappointing potential outcome for many of the project’s stakeholders. This explains the dispersed layout of the exhibit collection, temporary yet possibly permanent, and reflects multiple agencies and organizations each staking their own claims to the real estate, and to some degree the interpretive priorities, of this historic and heavily visited public site. While there is a strong determination on the part of the project leadership to see their original plan through, it was not clear at the time this report was being prepared if that will actually occur.

There are really three key lessons that come out of this unique project dynamic and intersection of multiple organizations and priorities at the Golden Gate Bridge:

1. Projects like the Golden Gate Bridge Outdoor Exhibition project can serve as catalysts for collaboration and advancing public works for public learning as long as all interested and vested partners are on board early and stay engaged.

2. Relationship building and transparency are essential components of a strong and sustainable collaboration.
3. A unified vision and plan are necessary to actively engage partners and successfully execute on the plan.

Interestingly, collaboration was a project priority from the start. According to the project leadership, the GGBHTD realized early on that they did not have the expertise to complete such a project on their own. They, and their lead partner CUREE, intentionally recruited individuals and organizations with proven skills and experiences in public education and outreach, science and engineering interpretation, and exhibit design, fabrication, and evaluation, different skills and expertise than the District. Project staff and some other stakeholders praised the various organizations and individuals working on the project as one of the best-assembled project teams imaginable. And yet, as one stakeholder described it, this collaborative team may have been too large, complex, and “unwieldy,” involving multiple stakeholders for the site, and multiple designers, developers, and fabricators for the exhibits and other print and web-based resources. This created additional challenges for project staff and as timelines became stretched and changes had to be made, an extraordinary amount of additional communication and negotiation became necessary to keep the project on track and/or remain flexible enough to adapt to the situation at hand.



This speaks, in part, to the first Strategic Impact identified by the project originators, development of a scalable model. Selecting a reasonably sized team, and a realistic set of deliverables at the front end of a project like this is critical to its future success. As long as these tenets are adhered to, any size public works venue should be able to mount their own version of an outdoor exhibition, public outreach program, or set of educational resources. The keys are finding the right partners, with the right expertise for the project, and maintaining a quality and level of

communications and inclusive planning that ensures collective and sustainable commitment and enthusiasm for the intended outcome, even in the face of unanticipated challenges and/or competing priorities along the way.

Stakeholders interviewed by DHA identified additional “lessons learned” from this project that, if shared broadly to both the public works and informal science education fields, may lead to more projects of this nature being initiated and attaining success. These are further itemized below:

4. Sites with historical significance and/or designation require additional research and due diligence.
5. Outdoors exhibits installed in locations with 24/7 accessibility, must be extra sturdy and durable to withstand the damages that come with exposure to the natural elements as well as vandals.
6. The project plan should be scaled to match available finances, personnel, and time.
7. Project teams should retain a degree of flexibility in their plan, as well as an attitude that promotes solution finding when unanticipated situations arise midway through the project.

8. When multiple agencies and other organizations are involved, sort out jurisdictions, authorities, and ownership issues in advance of project initiation.
9. If hands-on exhibits are a project focus, budget for both short-term modifications based on formative evaluation feedback, as well as long-term maintenance and replacements as needed.
10. Be sure that individuals tasked with facilitating public engagement at a public works venue have all the training, tools and resources needed to succeed at that task.

Here are some specific stakeholder quotes that help tell the story of this particular project’s overall success and impact:

“The Golden Gate Bridge Highway & Transportation District accomplished something really valuable and important in a way that none of the project partners could have done on their own.”

“To make amazing things happen requires both naiveté and ambition!”

“The Outdoor Exhibition has greatly enhanced the Golden Gate Bridge visitor experience.”

DHA asked each of the project staff and stakeholders interviewed to assess, using a scale of one to ten with 1 being not at all and 10 being significant impact, whether they thought the project had resulted in an increased potential for informal science education to occur in other public works venues. While the responses ranged from 2-10, the average was closer to 8, meaning in general those closest to the project felt that indeed the work done at the Golden Gate Bridge would lead to more opportunities to develop similar experiences at other public works sites. Another indicator of this occurring is that the students who participated in the *Public Works for Public Learning* conference, and in exhibit design and fabrication demonstrated a sincere commitment to public outreach as a part of their professional duty as future practicing engineers. One student from Princeton continued to work on the bridge scale model even after graduation and beginning employment at an engineering firm in

“This project has definitely impacted the way the Exploratorium thinks about and produces outdoor exhibits.”

New York City. While the book being written by the Billington siblings is intended to be a more scholarly publication than a “how to” manual, it will likely be read by practicing engineers and engineering students as a seminal documentation of the Golden Gate Bridge story, which may in and of itself foster additional efforts to chronicle the history, science, and engineering of other notable public works sites across the globe. Participants in the APWA online course also reported feeling better prepared to explore this type of project at their own

public works sites. The two evaluation teams engaged on this project, Inverness Research and David Heil & Associates, Inc. have prepared a Case Study article aimed primarily at the informal learning community that describes both the potential for interpretation inherent in public works venues as well as some of the complexities and challenges that emerged during this particular undertaking at the Golden Gate Bridge.

Finally, the Exploratorium, a partner on this project and an innovative leader in the science center field, has established an entire division dedicated to designing and installing outdoor exhibitions, some of them interpreting public works installations. According to the director of that enterprise, “This project has definitely impacted the way the Exploratorium thinks about and produces outdoor exhibits,” which provides the science museum field with an experienced role model as pioneer for advancing public works informal science learning opportunities in the future.

RECOMMENDATIONS

Front-end and formative evaluations are the traditional vehicles for documenting research-based recommendations for guiding future project decisions and progress. In this case, the summative evaluation findings also provide DHA with an opportunity to identify a few key recommendations for the project team to consider as they wrap up their work and position the GGBHTD for on-going maintenance and management of the Golden Gate Bridge Outdoor Exhibition and related resources.

- I. The Golden Gate Bridge Highway & Transportation District should strengthen their interagency collaboration with the National Park Service and the Golden Gate National Parks Conservancy in order to ensure a greater impact from their investment in the outdoor exhibition.
 - Leaders from all three entities should meet to “reboot” their discussions about the outdoor exhibition, identifying mutually agreed upon strategies for optimizing their placement at the site to maximize visitor engagement and impact.
 - Employees from all three entities should receive an orientation and training on the Outdoor Exhibition’s value and how to effectively facilitate visitor interaction with the exhibits
 - The three entities should sign a written Memorandum of Understanding (MOU) mapping out future roles and responsibilities for promoting, maintaining, and replacing exhibits as needed.

- II. Tour operators offering tours at the Golden Gate Bridge should be convened to identify ways in which they can contribute to improving the on-site visitor experience for their customers.
 - The GGBHTD, NPS, and Conservancy should collaborate on this effort in order to present a unified voice and force for change.
 - Tour packages and schedules should be adjusted to allow for longer tour stops to accommodate the more extensive visitor services now available—Visitor Center, Restaurant, Interactive Exhibits.
 - Tour guides from both for-profit and non-profit providers should receive orientation and training on how to effectively incorporate the outdoor exhibition into their tours and facilitate greater visitor engagement with these rich learning resources.

- III. The Golden Gate Bridge Highway & Transportation District, in collaboration with the NPS and Conservancy, should create and disseminate marketing messages and materials that inform prospective visitors to the Golden Gate Bridge of the expanded visitor engagement opportunities and services available on site.
 - Messages should be developed collaboratively and universally applied across all platforms.
 - Costs for developing and disseminating these materials should be shared among stakeholders.

- IV. The Golden Gate Bridge Highway & Transportation District should work with CUREE and other project partners to complete all deliverables and resolve all outstanding project issues by March 2016.
 - All web-based public and educator resources should be posted on the GGBHTD website.
 - The ferry exhibit should be completed and installed on the selected ferry.
 - The large-scale bridge model should be completed and installed in a location that ensures a high level of public engagement and impact.
 - The scholarly book should be completed and made available in both print and digital formats.

- V. The Golden Gate Bridge Highway & Transportation District should work with CUREE and other project partners and contractors to further disseminate lessons learned from the Golden

Gate Bridge Outdoor Exhibition project over the next two years in order to maximize project impact on the field.

- Presentations should be made at select professional association conferences by project staff and evaluation team members to share evaluation findings and lessons learned from the project.
- Target organizations should include, but may not be limited to, the following:
 - American Public Works Association (APWA)
 - Association of Science Technology Centers (ASTC)
 - National Association for Interpretation (NAI)
 - The American Institute of Architects (AIA)