Technological Innovations for Museum Evaluation: 
A New Model to Understand Visitors

by
Rebecca Suzanne Wahlberg

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**Technological Innovations for Museum Evaluation: A New Model to Understand Visitors**

Written by Rebecca Suzanne Wahlberg
Has been approved for the Department of Museum and Field Studies

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Abstract

Wahlberg, Rebecca Suzanne. Master’s of Science in Museum and Field Studies

*Technological Innovations for Museum Evaluation: A New Model to Understand Visitors*

Thesis directed by John Patrick Kociolek, PhD

The American Association of Museums 2011 Mobile Technology Survey, and the Museums & Mobile 2011 Online Conference and Survey provide evidence that the museum community recognizes that increasingly prevalent smartphone technologies offer new potentials for museums to engage visitors. Central to this thesis lies a proposed technology that will use smartphones and location-sensing technology to (a) provide visitors with a platform to engage with museums and other visitors, and (b) provide museums with ways to collect and analyze evaluative data in the forms of visitor feedback, timing and tracking of visitors’ movements, and analytics of smartphone use. This thesis addresses features and impacts of the technology on visitors but primarily compares the existing evaluation methods with those of the proposed technology. The author conducted semi-structured interviews with eighteen museum evaluators to provide a framework of professional opinion about pros, cons, and implications of this technology on the field of museology.
Dedicated to Bill Coon, for being my best friend, and for your endless love and encouragement. May our professional journeys be as happy and fruitful as our personal ones.
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Table of Contents

1. Introduction 1

2. The Proposed Technology 15
   I. General Description
   II. System Intentions and Overview
   III. Visitor Benefits
   IV. Museum Benefits & Tools for Evaluation
   V. Technology Components

3. Technology in Museums 47
   I. The Early Days
   II. Impacts of the Internet
   III. Multimedia and Interactive Technology
   IV. The Age of the Smartphone
   V. Differences Between Proposed and Existing Technology

4. Participation and Technology 68
   I. The Push to Engage
   II. No-Tech Participation
   III. Technological Participation
   IV. Proposed Technology’s Potential for Participation

5. Museum Evaluation and Evaluators 84
   I. History and Applications of Evaluation
   II. Types of Evaluation
   III. Interviews with Museum Evaluators
   IV. Role of Evaluators Today

6. Using Visitor Feedback in Evaluation 103
   I. Applications, Considerations, & General Methodologies
   II. Surveys
   III. Interviews
   IV. Comment Boards, Comment Cards, Card Sorts, & Focus Groups
   V. Implications and Ideas for the Proposed Technology

7. Timing, Tracking, and Observational Studies 126
   I. General Methodologies
   II. Applications and Impacts
   III. Traditional Tools: Paper, Pencil, Stopwatch
   IV. Technological Tools Used in Tracking and Timing
   V. Personal Studies
   VI. Challenges with Tracking and Timing
   VII. Statistical Analyses for Tracking and Timing
   VIII. Considerations for the Proposed Technology
8. Professional Perspectives on the Proposed Technology 161
   I. Positive Interest
   II. Concerns
   III. Recommendations

9. Conclusions 174
   I. Ideal Applications
   II. Next Steps and Further Considerations
   III. Possible Impacts for Museology

Bibliography 182

Appendix
   A: Informed Consent Form 190
   B: Interview Questions for Museum Evaluators 195
   C: Map of the Center for Community 198
   D: Map of Modern Life Gallery 199
List of Tables

Table 1. Work experience of in-house versus independent evaluators. .......................... 93
Table 2. Educational backgrounds of respondents. ........................................................... 94
Table 3. Years of experience practicing museum evaluation. ........................................... 95
Table 4. Views on the primary role of museum evaluators. .............................................. 98
Table 5. Summary of described qualitative evaluation methods that rely on visitor feedback. 108
Table 6. Summary of timing and tracking projects and the number of visitors observed. ...... 128
Table 7. Summary of tracking and timing projects according to type of evaluation. ............ 131
1. Introduction

**Precendence for Focusing on Smartphone Technologies**

The use of mobile devices has exponentially proliferated in the last decade, with the number of worldwide mobile phone subscriptions more than doubling from 2.2 billion in 2005 to an estimated 5.3 billion in 2010 (ITU 2010). As mobile devices have become more all-encompassing sources of services able to connect to the Internet, as in the case of smartphones, they have increased the capacity and speed for individuals to connect with each other and multimedia information. With these advances in mobile technology come new opportunities for museums to “redefin[e] the notion of interactivity itself” and develop a “new museum interpretation medium” (Astic et al. 2011).

In December of 2010, the American Association of Museums (AAM) launched their *2011 Mobile Technology Survey* in which 2,285 individual AAM members responded, representing over 1,090 different museums. The published results of the survey were launched on March 15, 2011 and provide evidence that museums are excited about the potentials of mobile technology, and believe that mobile technology is not a fad. Though the survey respondents showed enthusiasm for emerging forms of mobile technology, less than half of American museums offer any mobile technology to visitors, and most of this technology is still audio-only, with only 5% of responding museums offering emerging technologies like smartphone applications (apps). (AAM 2011)

Around the same time, Pocket-Proof and Learning Times, two independent companies, collaborated to produce the *Museums & Mobile Survey 2011*. This survey reflected the responses of 738 individuals from America and other countries, more than triple the volume of responses received in previous years. The results of this survey
unveiled that some museums are employing mobile technology and many others are planning to launch mobile interpretation programs in the next few years, thus echoing the sentiments expressed in AAM’s survey. (Tallon 2011)

The Museums & Mobile II: Online Conference and Virtual Expo, held from March 22-23, 2011, hosted by Pocket Proof and Learning Times, was attended by over 1,500 individuals from around the globe and showcased presentations from over 17 professionals working with emerging mobile technologies in museums. The presenters represented many different cities, both in America and abroad, and reflected a diversity of positions ranging from independent writers, in-house museum educators, in-house media technology designers, and independent technology companies. The presentations, discussions, and polls in this conference centralized around ideas, case studies, challenges, and potentials related specifically to smartphone applications for museums. (Tallon & Finkelstein 2011)

According to Don Kellogg of The Nielson Company, “as of December 2010, nearly a third (31%) of all mobile consumers in the United States owned smartphones, cell phones with app-based, web-enabled operating systems,” with overall smartphone users increasing across the board (2011). According to the New York Times, with multiple platforms available at different prices, the smartphone market is expected to grow in 2011, with increases of up to fifty percent (Bilton 2011). The findings of the AAM 2011 Mobile Technology Survey, the Museums & Mobile Survey 2011, and the Museums & Mobile Online Conference all reflect that there is awareness in the museum community that smartphone technologies have great potentials to engage audiences who are becoming increasingly familiar with these technologies. Many museums have
launched apps for smartphones including the American Museum of Natural History, the Brooklyn Museum, the Museum of Modern Art, the San Francisco Museum of Modern Art, the National Museum of the American Indian, the Fowler Museum at UCLA, the Metropolitan Museum of Art, the Los Angeles County Museum, the Portland Museum of Art, the National Gallery in London, and more. These institutions are employing different combinations of audio, images, text, video, navigational features, and social media in these apps (Tallon & Finkelstein 2011, Grobart 2011, Rothstein 2010, Tedeschi 2010).

The Internet and smartphones offer numerous capabilities for access to immediate information, customization, personalization, social networking, practical uses, and novel uses. “Prevailing trends in education and leisure show an evolution of convergence, an evolution of museums as spaces with more attractive digital applications, and leisure centers as models of attraction with an enhanced educational flavor” (Roussou 2010, 262). Today, museums are not only competing for visitors’ leisure time and money, they are also competing for ways to seamlessly integrate their offerings into visitors’ daily use of technology. These efforts to engage audiences through emerging technologies that are becoming increasingly prevalent in society reflect John Cotton Dana’s longstanding views that museums have a responsibility to remain relevant and accessible to their audiences (1917). As evidenced by the surveys previously mentioned, museums believe that there is value in creating multimedia interactive experiences that are accessible through visitors’ own personal devices, which have a personal relevance in their daily lives. By providing an experience on their own personal device and providing extended opportunities for visitors to connect with museums beyond their in-person visits,
museums are attending to the need to “engage actively in the design and delivery of experiences that have the power to inspire and change the way people see both the world and the possibility of their own lives” (Skramstad 1999, 131-132).

**Technology in Museums, Historically**

Automation technology was first used in museums in 1963 when a project at the Smithsonian Institution’s National Museum of Natural History was first launched to help automate collection databases (Jones-Garmil 1997). Since then, we have seen the invention of early computers and videodiscs in the 1970s, desktop computers and relational databases in the 1980s, and digital imaging and the commercialization of the Internet and cell phones in the 1990s (Jones-Garmil 1997). Since the publication of Jones-Garmil’s *The Wired Museum* in 1997, society has been introduced to interactive kiosks, social media platforms like Facebook and Twitter, and smartphones. Museums have reflected these changes by implementing technologies to aid in their own operations and to enhance the visitor experience. The Internet and software programs have improved collection management databases and their accessibility; government funding, expanded networking abilities, and increased information/technology staff have helped institutions share information and collaborate more easily (Roberts 2010). In museum galleries, visitors have seen increasingly interactive displays including computer screen kiosks, interactive heat-cameras, and handheld devices.

Museums first implemented handheld technology in 1952 at the Stedelijk Museum in Amsterdam in the form of the Short-Wave Ambulatory Lectures which were “delivered through a closed-circuit short-wave radio broadcasting system in which the
amplified audio output of an analog playback tape recorder served as a broadcast station, and transmission was via a loop aerial, and picked up by visitors through a portable radio receiver with headphones, when inside the loop” (Tallon 2008, xiii). These first mobile experiences were a type of audio guide, which would become one of the most widely implemented forms of visitor technology. Evolving forms of audio guides included cassette tape tours on Sony Walkman devices until 1993 when the Louvre deployed digital random-access audio tours that allowed visitors to receive information in the order of their choosing (Tallon 2008). Interactive approaches in Swedish museums developed handheld technology for children by masking the digital device within stuffed animals, allowing children to hear stuffed animals tell them stories about objects in the museum (Gottlieb 2008). The decade of the 2000s saw an evolution of handheld media ranging from personal digital assistants (PDAs), MP3 players, and eventually smartphones. PDAs provided museums with opportunities to provide multimedia information and games to users. The first iPods were released in 2001, and as MP3 players became increasingly popular, podcasts created both by visitors and institutions allowed individuals to download audio recordings that could then be listened on portable audio devices in gallery settings or other locations. The San Francisco Museum of Modern Art (SFMOMA) created Artcasts, “an online, illustrated audio zine designed to project a variety of art concepts and voices out into the community, and to invite the community back into the museum” (Samis 2008, 7).

Launched in February of 2004, Facebook created new standards for social networking that allow users to have public and personal dialogues, share photographs, post status updates, “tag” people and information, and create their own online persona.
This platform allows for an expansive degree of connectivity between users and allows users to curate their own lives; the content that individuals offer is connected to others, and this connected content is then displayed back to the individual. Nina Simon calls this the “network effect” which “translates individual actions into community benefits” (Simon, 2010, 88). Museums have connected to social media networks like Facebook and Twitter by creating their own profiles, connecting with users, and offering rewards for participating (Preston 2011, Vogel 2011, Miller 2011, Bowell 2011).

**Museums & Current Smartphone Apps**

Though other companies had created earlier versions of smartphones, Apple launched its first iPhone in 2007, and since then smartphones have become increasingly common. Today, iPhone, Android, and Blackberry are the most commonly used smartphones, making up over 30% of American mobile devices. As a handheld technology, smartphones today primarily use touch screens and allow users to make phone calls, connect to the Internet, email, listen to music, use calendars and calculators, take photos and video, and download applications (apps) from an “App Store.” Once downloaded, these apps can be accessed on the smartphone without needing to connect to the Internet. These apps reflect a wide range in applications to people’s lives: weather reports, checking in to flights, sharing information on social media, news and current events, weight loss, money management, frivolous games, interactive recipe books, nature guides, and much more. “On January 22, 2011, the 10 billionth app was downloaded from [the] Apple App Store” (“App Store” 2011).
The National Gallery in London was one of the first museums to respond to the emerging market of smartphone apps by releasing its “Love Art” iPhone app in June of 2009 (Grobart 2011). More museums began to respond to society’s changing technological landscape, and now 5% of museums are offering smartphone apps (AAM 2011). On October 1, 2010, the New York Times published an article evaluating the iPhone apps for the American Museum of Natural History, the MOMA, and the Brooklyn Museum. Its author, Edward Rothstein, reported:

“But the [American Museum] app’s limitations overshadow its strengths. The information is generally far less than what appears on the museum’s labels. There is no audio. Even when novel snippets are offered, […] finding the objects and tapping through several screens is more effort than just walking around and looking. The app also ends up undermining the structure of individual galleries, particularly when they have narratives. The app isolates objects rather than connecting them.

[For the Brooklyn Museum app,] you have to type in strings of as many as eight or nine digits to get information about an object, though many cannot be found in the system; some offer less information than the museum’s label. […]

It is best to consider all these apps flawed works in progress. So much more should be possible. Imagine standing in front of an object with an app that, sensing your location, is already displaying precisely the right information. It might offer historical background or direct you through links to other works that have some connection to the object. It might provide links to critical commentary. It might become, for each object, an exhibit in itself, ripe with alternative narratives and elaborate associations.

And best of all, you could save it for later, glance up from the screen and look carefully at what faces you, all scrims removed, all distractions discarded. Like this! There must be an app for that!”

Though this author provided positive commentary for the potentials of museum tour apps, he raises worthwhile criticisms of museum apps in their infancy of evolution. In general, they are only taking advantage of a fraction of smartphones’ multimedia capabilities. There is no a seamless way for visitors to access the information. Strategies for connecting visitors with specific exhibit information include: browsing through menus, typing in a numerical code, or taking a photo of a QR code (similar to a barcode).
Cornerstone: The Proposed Technology

About two months before the publication of Rothstein’s critique of existing apps for three New York museums, the author of this thesis and her partner, a computer scientist, began to brainstorm a technology system that would allow precisely what Rothstein speaks of: a way for visitors to immediately receive information about exhibits as they physically approach them. As soon as the seed was planted, the two individuals began to develop and refine the goals of this technology and how to create it. If we developed a system that would provide visitors with information through location-aware components, this same system would be able to time how long visitors were in that location. The ideas immediately expanded into a system that would not only be beneficial for visitors, but would simultaneously provide museums with valuable information about their visitors. Thus far, there is no known system that uses smartphones to provide museums with the kinds of evaluative opportunities herein proposed.

Herein referred to as “the proposed technology,” this system is the cornerstone of this thesis. The proposed technology system will use smartphones and location-sensing components to provide new opportunities to both museums and their visitors. Visitors can use smartphone apps in museums to receive multimedia information and opportunities about exhibits automatically as they physically approach them. Museums will be able to gather, analyze, and visualize evaluative information about visitors in three different forms: tracking and timing, visitor feedback, and analytics of how visitors are using the apps. This thesis will investigate the potentials for the proposed technology to engage audiences, and will primarily provide a professional framework for how this proposed
technology could help museums better understand their visitors by automatically
collecting both quantitative and qualitative data from visitors using smartphone tours
during their museum visits. The tracking and timing, and visitor feedback evaluation
potentials of this system will be contrasted against existing methodologies that share the
same goals.

Eighteen professionals in the field of museum evaluation participated in semi-
structured interviews to provide information about their backgrounds in evaluation,
projects they have conducted that rely on observational methods like timing and tracking,
evaluation projects they have conducted that have utilized visitor feedback, and their
views on general technology in museums as well as the proposed technology. Those
interviewed included Judy Diamond, Deborah Perry, Patty McNamara, Steve Yalowitz,
and Ross Loomis, among others. These interviews, conducted both in-person and over
the phone, were audio-recorded, and pieces of the interviews were transcribed. The
responses from these interviews are reflected throughout sections of this thesis and are
quoted according to the degree of anonymity in which the respondents selected.

Though the researcher has had experience with projects relying on visitor
feedback, she had never conducted any methodical tracking and timing or observational
studies. In order to compare and contrast the proposed technology against traditional
methods of tracking and timing studies, she sought a firsthand awareness of these
traditional methods and conducted some of her own unobtrusive observations in two
different locations.
Connections to Museum Evaluation

The key advantage of the proposed technology over existing smartphone apps for museums is its ability to provide museums with evaluative information about their visitors. Museum evaluation primarily serves as a way to assess the success of exhibits and programs and provide museums with tools to better understand their visitors. Evaluation is a means to close “the gap between a museum’s often lofty educational intentions and the failure to realize those objectives with actual visitors” (Serrell 1998, 1). Evaluation is often divided into three categories based on when during a project is conducted: front-end (beginning), formative (middle), and summative (after). Two other key divisions in evaluation relate to the type of information gathered: qualitative evaluation involves more open-ended responses that emphasize a deeper level of understanding, while quantitative methods involve numerical values and aim to categorize findings into specified categories (Diamond et al. 2009). Within these frameworks, many different evaluation tools can be utilized to allow researchers to address a wide array of nuanced goals. Among these methodological tools are surveys, interviews, focus groups, pre- and post-tests, personal meaning mapping, and observational studies.

In observational studies in museums, researchers observe qualities of visitors’ behavior. These observations may be made unobtrusively without the visitor knowing, or researchers may inform the visitors that they observe. Observational data can include counts of visitors, visitors’ movements, the time they spend in the museums, time at specific exhibits, looking at labels, if they are conversing with other visitors, laughing, sitting, pointing, bending, or moving physically interactive exhibit components (Diamond
Tracking and timing studies involve recording where visitors stop and for how long; other behaviors might also be recorded in these studies. The deeper goals of museum evaluation are often to assess cognitive change in visitors and understand how the museum experience has changed a person. Though observational studies do not directly assess this, they can provide evidence how and where learning might be occurring. Beverly Serrell argues that “‘time on task’ is positively related to the amount of learning, and intrinsic motivation to pay attention is a prerequisite for constructing personal meanings in an informal learning environment” (1998, ix). She goes on to argue, “Before we do any more research on how visitors learn in informal museum exhibitions, we should create exhibitions that visitors choose to experience thoroughly. Then we will be able to use those exhibitions as laboratories for investigating what visitors are really learning” (1998, 4). Traditional methods of conducting observational studies involve a researcher in a gallery hall with a stopwatch, taking notes with a pencil on a clipboard as they observe a single visitor, usually unobtrusively. The researcher may remain stationary in one spot and observe visitors until the visitor leaves their field of vision, or the researcher may choose to follow the visitor through a specified space (usually one main gallery hall) until the visitor leaves the space (Diamond et al. 2009). In these traditional methodologies, researchers are capable of observing additional behavior and are able to omit time when visitors are not attending to exhibits (a benefit), but the researcher is only able to observe one visitor at a time, and the process is often very time consuming. In comparing and contrasting these traditional methodologies against the proposed technology, many of the pros and cons relate to the volume of data that is capable of being collected and potential sources of error.
Most evaluation projects today use a mixed-methods approach that utilizes multiple types of evaluation tools to assess the given issue from multiple angles and corroborate their findings (Diamond et al. 2009). For example, a summative evaluation of a newly opened exhibit may include: tracking and timing studies to better understand which elements are getting the most use; surveys to understand generalizable sentiments; and interviews to gain an in-depth understanding of how individuals are reacting and understanding the exhibit. Similar to this mixed-methods example, the proposed technology will allow museums to collect evaluative data of three different types: tracking and timing, visitor feedback, and analytics of how visitors are using apps. Visitor feedback in the proposed technology could be in the form of general comments, answers to specific open-ended questions, multiple choice answers to prompted questions, or ratings of exhibits. These types of visitor feedback may traditionally be gathered through surveys, comment boards, or simple interview questions. The proposed technology would allow museums to automatically gather tracking and timing data, as well as qualitative visitor feedback. One might expect to see a larger volume of responses and more positive feedback at exhibits that are also being stopped at more frequently and for longer periods of time.

Increasingly, mechanisms for providing feedback can double as an entry point for participation between visitors and museums. Well-constructed physical and digital comment boards can serve as vehicles for conversations between individual visitors and between visitors and museums (Simon 2010). Allowing visitors to provide feedback via text message format and through social media opens potential opportunities for museums
to engage with their audiences in deeper capacities, especially when the museum utilizes that feedback to engage in conversation.

**Goals and Objectives**

The goals of this proposed technology are both to engage museum visitors in new and meaningful ways, while simultaneously providing museums with evaluative data about their visitors. The proposed technology offers the potential for museums to gather and analyze larger volumes of data about their visitors than has been previously possible. As the system will allow museums to quickly visualize these different forms of evaluation, the hope is that museums will be able to better understand their audiences with ease, engage with their audiences more deeply, and make more informed decisions about exhibits and programs. To more accurately assess the capabilities of the proposed technology, evaluation of the actual technology must be executed as it is developed. Studies should be conducted to compare the proposed technology’s ability to collect and analyze accurate information in comparison with more traditional methods of evaluation.

First, the proposed technology will be explained in-depth: how it can prove beneficial to visitors and museums, and how it works systematically and technologically. The history and applications of technology in museums will be investigated to provide a contextual framework for how museums have arrived at current smartphone technologies. Forms of museum evaluation, particularly tracking and timing and visitor feedback, will be explored to provide a basis for how the proposed technology might alter methodologies in museum evaluation. Finally, the strengths and weaknesses of the
proposed technology will be enumerated upon through the lens of experienced museum evaluators.
2. The Proposed Technology

   I. General description
   II. System Intentions and Overview
   III. Visitor Benefits
   IV. Museum Benefits & Tools for Evaluation
   V. Technology Components

I. General Description

The technology hereafter referred to as the “proposed technology” aims to implement increasingly prevalent smartphone technologies in museums in a way that could enhance the visitor experience while simultaneously providing museums with useful information about their visitors. The proposed technology will utilize smartphones and location-sensing technology to serve two main purposes: (a) provide visitors with a platform to connect with multi-modal content about specific exhibits and interact with other visitors, and (b) serve as an instrument to collect evaluative data about visitors.

For museum visitors, the proposed technology will operate very similarly to existing and planned museum apps like the American Museum of Natural History, the Brooklyn Museum, and the Museum of Modern Art. These apps, as well as others, implement or plan to implement varying degrees of multimedia information (e.g. text, audio, video) and interactive abilities for visitors (e.g. location-sensing, social media, and tagging) (Rothstein 2010, Tedeschi 2010, Grobart 2011, Tallon & Finkelstein 2011). The proposed technology intends to expand on these types of multimedia and interactive qualities, but will provide one key difference. In order to access information in the museum using an existing app, users either must scroll through series of menus, type in a number, take a photograph of a QR code (similar to a barcode), or make a phone call, all of which require some effort and time from the user (Rothstein 2010, Tedeschi 2010,
Tallon & Finkelstein 2011). The proposed technology aims to use Radio Frequency Identification (RFID) technology to detect when visitors are within a range of about five feet of an exhibit and then provide visitors with immediate, location-aware exhibit information. The proposed technology hopes to meet Edward Rothstein’s requests for “an app that, sensing your location, is already displaying precisely the right information” (2010).

While the immediate delivery of location-aware information should prove fruitful to visitors, the most substantial difference that the proposed technology will offer, in comparison with other museum app systems, is the ability to collect, analyze, and visualize evaluative data about museum visitors. The three types of evaluation data that can be collected include: (a) tracking and timing visitors’ movements throughout museums, (b) feedback that visitors submit to the museum via smartphones, and (c) how visitors use features of the smartphone apps. To collect tracking and timing information about how long visitors are spending at individual exhibit stops and the routes they are traveling, the system will use the same location-sensing RFID components that provide visitors with immediate, location-aware information. While the collection of visitor feedback does not rely on the RFID components, visitors may submit feedback (e.g. comments, ratings, answers to questions) at potentially any exhibit stop. Analytic systems can collect data about what app features visitors are using on their smartphones. All of this data can be automatically collected when visitors are simply using museum apps during their visits; the data is all collected unobtrusively and visitors do not have to take any special action to provide museums with this data. Museum staff may then use software included in the proposed technology system to quickly analyze and visualize
these different types of data.

The model of this project involves three different teams: (1) a technology team to develop, install, and maintain technological components, (2) a content team to consult with museums in developing content for their apps, and (3) an evaluation team to consult with museums about the evaluation data that is collected by the system. All three teams will work together to consult with museums to tailor the technology system to best address the museum’s needs and provide training sessions for museum staff to ensure their understanding of the technology.

II. System Intentions and Overview

In order to achieve the two main goals of providing visitors with a platform to connect with content and other people, and enabling museums to automatically collect evaluative information, many components must be synchronized into a complete system. Below is a listing of the main components for the overall system. Specific information about the technology components can be found in the Section V of this chapter entitled “Technology Components.”

System Components

- **Smartphones:** Mobile devices such as iPhones and Androids will deliver information to users via apps (applications) made for museums. Visitors may use their own devices, or museums may offer devices to visitors who do not own one.
- **Apps:** A well-designed and thoroughly tested user-interface will allow visitors to use smartphones as a tour guide platform to interact with museum content about
exhibits and programs.

- **Content development:** A software template allows developers to add text, images, audio, and video into information fields to populate apps with multimedia museum content.
  - Museum staff will be required to participate in training sessions to understand how to use the software to edit, add, and delete content.
  - Museums can develop and enter their own content into the template, using the system as an “off the shelf” tool.
  - Museums can contract external vendors to develop and organize content for them.

- **Location sensing:** The technology system will use RFID (radio frequency identification) tags and readers. This technology will allow information to automatically appear on the smartphone screen as soon as a visitor approaches a specific exhibit, thus allowing visitors to immediately connect with digital content about the exhibits they are physically approaching. It will also allow museums to track and time how visitors are moving through the museums.

- **Museum evaluation:** Software will allow museum staff to quickly analyze and visualize the tracking and timing data that will be automatically collected by the technology system. Visitor comments and feedback about exhibits will also be collected, and the evaluation features of the software will enable museums to generally sort these responses. Analytics about how visitors are using the features of the apps will also be developed into this software.
  - Museum staff will participate in training sessions to ensure their understanding of the software.
  - Museums may consult with independent evaluators to conduct evaluation
projects to best utilize the evaluative features of the system.

- Training sessions may also be offered for independent evaluators who contract with museums to ensure their understanding of the evaluation technology so that they can make the best use of the technology as a tool for understanding visitors.

These components together constitute the foundational framework of how the proposed technology will be used in a holistic system to benefit both visitors and museums.

III. Visitor Benefits

Smartphone apps present multiple opportunities for visitors to connect with museums in new ways, explore variable layers and modes of information, and experience personalized features and tours. Visitors can investigate content in more depth than is possible with physical exhibit displays because the content is not constrained by the limitations of printed label panels. Content can be conveyed using a variety of media such as text, images, audio, and video. This means that one exhibit can deliver information in a variety of forms, thus appealing to a variety of learning styles. Apps inherently offer networking abilities, gaming abilities, and connections to social media that provide opportunities for users to interact with each other and with museums. The apps will be designed so that individuals can access information remotely, but will provide additional information and abilities for onsite museum visitors. This model aims to draw visitors into the physical museum to appreciate the physical objects, environment, and social experience that a museum visit offers, yet it allows visitors to begin their museum experience before the actual visit, and extend their experience
afterwards.

To experience smartphone museum tours, visitors can download a free app for a museum on their own smartphone, or museums may choose to loan out smartphones for visitors who do not own their own device. Onsite visitors will open a museum’s smartphone app, and as the visitors explore the museum, the proposed technology will automatically detect which exhibit stop they are standing near. As visitors approach a stop, information about that stop will immediately appear on their smartphones. Visitors can then choose to explore more information about that exhibit component though text, audio, images, video, games, or web links. They can leave feedback on specific exhibit stops, rate exhibits, answer questions about exhibits, read others’ comments, and share information via email, Facebook, or Twitter. The app can solicit feedback with a general invitation (“Leave a comment”), or by specific question prompts (e.g. “What do the shapes in this painting remind you of?”). There are eight key capabilities that the proposed technology system can provide to visitors.

1) Anywhere all the time: Users with personal smartphones can access information anywhere at any time.

Individuals can:
• Access exhibit information remotely, even if they are not geographically or physically able to attend the museum in person. Visitors can browse exhibit listings of gallery halls and choose which exhibits they would like to focus on;
• View exhibit information ahead of time in order to better plan in-person visits;
• View museum calendars of events, hours, and information before visiting the museum; and
• View exhibit information after in-person visits to extend the museum experience.
The Internet has provided museums with opportunities to connect with visitors before and after onsite museum visits, as well as connect with visitors who cannot visit the physical museum. By providing mobile access to information about the museum and its content, individuals can access museum information at home, in the passenger seat of a car, in a waiting room, or on a subway. Many visitors, including schoolteachers, report that they would like museums to provide resources that they can access later (Walker 2008, Rothstein 2010). By providing access to additional information about exhibits that pique visitors’ interests, museum apps can facilitate learning experiences that extend beyond the walls of galleries.

The term “advance organizers” comes from the field of psychology and describes individuals’ prior knowledge about what to expect from a given experience. “Study after study has shown that people learn better when they feel secure in their surroundings and know what is expected of them” (Falk & Dierking 2000, 139). Examples of advance organizers include orientation (knowledge of the physical layout of space and navigational directions), prior knowledge of key concepts, and concept maps that will demonstrate how information is organized and presented. By providing access to organized menus of multimedia information about exhibits, schedules of special events, and maps of museums, smartphone apps can provide an array of “advance organizers” to help visitors become mentally primed for a museum visit.

2) Layers of multi-modal information: Content can be delivered in multiple modes to allow visitors to personalize their museum experience according to their interests and learning styles.
Individuals can:

• Explore multiple modes of content for exhibits:
  o Read additional text
  o Listen to audio on headphones or through built-in speakers
  o Watch videos
  o View additional images
  o Play games related to content;

• Choose what types and modes of content to focus on based on their needs and interests, thus creating a more personalized museum experience;

• Control the depth of exploration: skim the surface or deeply investigate topics;

• Focus on exhibit topics that are the most personally appealing; and

• Explore content in more depth than would be possible with physical exhibit displays that are constrained by spatial dimensions.

Many different education theorists have addressed that learning is a personal experience, different people learn in different ways, and the manner and environment in which information is exchanged affects the learning outcomes (Piaget, Vygotsky, Gardner, Falk & Dierking, Hein). First developed by Jean Piaget (1896-1980), and later contextualized by George Hein, constructivism is a learning theory that states that people will inevitably construct their own knowledge and meanings based on their prior personal experiences and ideas. Therefore, in order for museums to connect with their visitors, who arrive with their own pre-existing ideas and knowledge, it is best to provide many different modes of interpretation, multiple physical and mental access points, multiple points of view when interpreting content, and many learning outcomes (Hein 1998). The proposed technology will allow visitors to explore different modes of interpretation (audio, video, text, images, games), explore depth of information in varying degrees, access information in any order, and explore various points of view for different topics.
In this model of multi-layered, multi-modal, random access information, visitors will hopefully uncover pieces of new information that connect to pre-existing ideas to create a broader network of personal understanding and meaning.

Howard Gardner’s original theory of multiple intelligences outlines seven different intelligences by which individuals learn (Gardner 1983). The multimedia nature of smartphones offers capabilities for individuals to use many of these original seven intelligences. Below are the seven intelligences and the features of the proposed technology that inherently or potentially correlate to each intelligence.

1. **Spatial (ability to visualize information):** Information is displayed through visual images and video on smartphone apps.
2. **Linguistic (ability to learn through written and spoken words):** Content is conveyed through typed text and spoken audio on smartphone apps.
3. **Logical-mathematical (ability to understand logic, recognize abstract patterns, and exercise scientific reasoning):** Games, puzzles, and inquiry prompts on smartphone apps can utilize numbers and logic to encourage scientific reasoning.
4. **Bodily-kinesthetic (ability to control bodily movements and reflexes, skillfully handle objects, and build things):** The nature of the proposed technology system relies on physical interaction: visitors must move through the museum with their smartphone to receive additional information about exhibits in their proximity. Written or spoken prompts might encourage visitors to use their smartphones or physical exhibit elements in certain kinesthetic ways.
5. **Musical (ability to understand sound, music, rhythm, pitch, and tone):** Smartphone apps can play spoken audio, musical audio, and can also allow visitors to record their own audio. Games might utilize musical audio as an instructional guide.
6. **Interpersonal (ability to interact with and understand other people):**
Conversational prompts in smartphone apps might encourage visitors to interact with each other. Social media platforms that enable networked connections and conversations between individuals are inherently virtual but can lead to in-person interactions as well.

7. **Intrapersonal (ability to self-reflect and understand oneself):** Feedback prompts on smartphone apps might encourage visitors to introspect about their opinions and thoughts about various issues and questions.

The multimedia nature of smartphone apps inherently connects with the spatial and linguistic intelligences by offering visual, textual, and audio information. When thoughtfully constructed, smartphone apps offer the ability to connect with all seven of the above intelligences.

John Falk, acclaimed researcher of free-choice learning, has proposed a structure to categorize visitors into five types of identities: explorers, facilitators, professional/hobbyists, experience seekers, and spiritual pilgrims. These different “visitor identities” are categorized by different motivations to come to museums and different behaviors while at museums.

“Explorers are curiosity-driven, with a generic interest in the content of the museum,” one might expect explorers to browse through exhibits in a scattered manner, paying attention to whatever catches their interests (Falk 2008). While using museum apps, explorers would likely appreciate the ability to browse through exhibits to access deeper information about whichever exhibits they find interesting without having to sift through information about less-interesting exhibits.

“Facilitators are socially motivated. Their visit is focused on primarily enabling the experience and learning of others in their accompanying social group” (Falk 2008). Facilitators would likely appreciate museum apps as a way to extend conversations about
exhibit topics and multimedia modes (images, audio, video) that the others in their group find most fascinating. Facilitators who are parents would likely appreciate specialized family tours that provide conversational prompts and highlight information and activities geared towards children.

“Professional/hobbyists feel a close tie between the museum content and their professions or hobbies. Their visits are typically motivated by a desire to satisfy a specific content-related objective” (Falk 2008). One would expect this type of visitor to deeply explore the additional layers of information offered on museum apps for focused areas of content. If a visitor of an art museum was a professional painter greatly influenced by impressionism, one might expect this professional/hobbyist to spend most of their visit in a gallery of impressionist paintings and would deeply explore the app features related to this specific content area.

“Experience seekers are motivated to visit because they perceive the museum as an important destination. Their satisfaction primarily derives from the mere fact of having ‘been there and done that’. […] These are the visitors who will gravitate to a tour of collection highlights” (Falk 2008). One might expect experience seekers to explore the breadth of museum apps more than their depth. These individuals may appreciate the novelty of using a system that provides location-specific information and offers many features, even though they might not explore these features in much depth. They might also appreciate a highlights tour on the app that will guide them to a selected handful of popular exhibits.

“Spiritual pilgrims are primarily seeking to have a contemplative, spiritual, and/or restorative experience. They see the museum as a refuge from the work-a-day world”
These visitors may be more likely to use headphones to listen to audio tours alone. They might appreciate audio tours that feature tracks that fade in and out depending on what exhibits are in physical proximity, thus allowing the visitor to wander to whichever exhibits enhance their contemplative or restorative experience. They may also be more inclined to introspect on feedback prompts that relate to the exhibit environment.

3) **Wayfinding and location-aware information:** The location-sensing components of the proposed technology aid onsite visitors in wayfinding and provide immediate, automatic exhibit information based on physical proximity.

Visitors can:

- Wander the museum with the app open to immediately and automatically access information about the exhibit they are closest to
- Browse through menus of exhibits that are not in physical proximity
- Use an interactive map that displays the visitor’s current location, museum exhibits, restrooms, exits, seating, eateries, and gift stores

Some of the biggest frustrations visitors commonly face during museum visits are challenges with finding restrooms, seating, and wayfinding in general. In Judy Rand’s *The Visitors’ Bill of Rights*, the first right is **comfort**. “Visitors need fast easy, obvious access to clean, safe, barrier-free restrooms, fountains, food, baby-changing tables, and plenty of seating. They also need full access to exhibits” (158). The second right is **orientation**. “Visitors need to make sense of their surroundings. Clear signs and well-planed spaces help them know what to expect, where to go, how to get there and what it’s about” (158). In his essay, “Where is the Restroom? Wayfinding and the Handout Map
in American Village Museums,” Dennis O’Brien echoes Rand’s sentiments that it is crucial for museums to provide accessible instruments to help visitors locate restrooms and find their way through the institution. By enabling quick access to directions to restrooms, seating, food, exhibits, the interactive map is intended to help alleviate visitor frustrations related to comfort and orientation. These issues of orientation and wayfinding also relate to the previously discussed psychological idea of “advanced organizers” that help prepare visitors for learning experiences (Falk & Dierking 2000).

4) Social media and participation: The networking and connective abilities inherent in smartphone apps allow for visitors to participate in the culture of the museum.

Visitors can:
• Share photos, video, and links through email and social media like Facebook and Twitter
• Rate exhibits, “like” exhibits, and “tag” exhibits
• Leave feedback comments about exhibits for the museum
• View and respond to other visitors’ comments
• Answer question prompts about exhibits or programs
• Receive virtual rewards for answering questions, using social media, and leaving feedback

In The Participatory Museum, Nina Simon describes the “network effect” as the “backbone of social networks” (88). The network effect involves three stages that ultimately allow users to see and interact with networked content that includes their own responses in connection with other people’s responses. By “publishing lifstream-style feeds of status updates and short-format content for mass audiences,” social media platforms like Facebook inherently provide a structure for layers of participation between
many users” (125). Facebook has become “a personally relevant content stream, a
dynamic newspaper created for each user (and shared with the rest of the world by
default)” (125). By allowing visitors to connect to social media like Facebook through
museum apps, museums can become a part of personal dynamic newspapers, extending
the time of a visitor’s museum experience and connecting it to other people.

Allowing visitors to rate exhibits, pick favorites, leave feedback, and interact with
exhibits both physically and digitally, the proposed technology system offers potential to
implement a recommendation engine.

5) **Recommendation system:** The proposed technology system could feature a
recommendation system to suggest exhibits and features based on visitors’ feedback as
well as exhibits and features they have already been choosing to use (which the system
knows through the tracking and timing components enabled by the RFID technology).
This recommendation system would be similar to those featured by Amazon and Netflix,
and would aim to provide a personalized experience for each visitor based on his/her
interests and preferences. Other professionals have reported that “mobile, electronic
handheld guides offer the opportunity to improve a visitor’s experience by
recommending exhibits of interest, and adapting the delivered content. The first step in
this personalization process is the prediction of a visitor’s activities and interests.”
(Bohnert et al. 2008, pg 195). The RFID location-aware components of this system, and
the abilities for users to rate exhibits will serve to predict visitor activity and interest.

Nina Simon champions recommendation systems like those of Netflix and
Pandora because their high degree of personalization not only gives you what you want,
but also “exposes you to new things, and it gives you a vocabulary for articulating and refining why you like what you like. The world opens a little wider and hopefully, you keep exploring” (65). In applying the idea of recommendation engines in museum settings, she acknowledges that:

“While visitors make many active choices across a single cultural experience—what to do, in which order, for how long, with whom— institutions track very few of these choices. Unless your institution is ready to invest in systems to allow visitors to rate exhibits, collect favorites, or register their paths through the institution, recommendation engines may seem out of reach” (62).

The proposed technology offers all three of those requirements; it would allow for visitors to rate exhibits, select favorites, and the system would record visitors’ paths through the museum, thus making a recommendation system more feasible.

6) **Tours for children:** The flexibility of the proposed technology will allow for the development of specialized tours for specific audiences. Child tours and features could be developed specifically for families or school groups. These features might include:

- Scavenger hunts,
- Interactive educational games,
- Text, audio and video specially interpreted to engage children and families,
- Highlighted objects and exhibits that are particularly appealing to children, and
- Conversational prompts and questions to engage young audiences.

Though young children are not intended to be direct users of the proposed technology, the technology has potential to be used by adults, like parents and teachers, who are facilitators of museum visits with children. Research in the past decade has come to emphasize the social and interactive qualities involved in family learning, and focus not only on children, but the adults who are facilitating the children’s learning
experience. More often, researchers focused on family learning hope to see families
talking together, playing, and reading labels out loud to children (Ellonbogen, Luke,
Dierking 2004). In this context, the proposed technology could offer guidance, multi-
person interactive games, suggestions, and conversational prompts to aid in family
learning.

7) Multi-lingual abilities: Apps have the ability to present content in multiple languages,
thus presenting the potential for a wider spectrum of audiences to connect with museum
offerings that would otherwise be largely inaccessible. Content can be translated to
multiple languages and offered through the app in text, audio, and video.

Often times, when museums tackle bilingual or multilingual interpretations, they
face challenges of how to convey these different interpretations. One solution is to
provide multiple copies of translated label panels at each exhibit stop, although this takes
up at least twice as much space. In this scenario, museums are advised to keep the text
short so that the volume of words does not overwhelm visitors. As an alternative to
multiple wall panels, Beverly Serrell suggests that “laminated, portable, reusable labels
can provide two or more languages, as can free handouts, brochures, or audio tours”
(Serrell 1996, pg. 101). A project entitled “Evolution in Action” conducted by the
American Museum of Natural History disseminated DVDs with trilingual subtitles to a
variety of learning communities across the country. The goal of the project was to
“present science research to the public by introducing the research in context”
(Macdonald 2010, Pg 1). The summative evaluation of the project revealed that the
subtitles and the visual nature of the videos did in fact help scaffold the learners’
understanding of science research.

In *Excellence in Practice: Museum Education Principles and Standards*, the first principle of best practice for education in museums is accessibility. This principle addresses the need for museums to engage a diverse array of museum audiences and allow those audiences to access museum offerings through multiple access points. To do so, museums must breakdown barriers that reduce accessibility to museums in physical, economic, and cultural contexts. Only offering interpretation in English can certainly be considered a barrier for non-English speaking audiences. (AAM EdCom 2005)

Unbounded the physical space constraints of conventional labels, handheld smartphone devices offer a multimedia platform that supports multiple pages of text, as well as audio and video interpretation. With these capabilities, some of the traditional challenges of presenting multilingual interpretation dissolve, thus allowing new possibilities for multilingual interpretation. Non-English speaking audiences are often underserved audiences who do not have as many opportunities to interact with technology as many other museum visitors. Further research should be conducted to determine how multilingual interpretation on smartphone devices should be addressed in order to most effectively provide new inclusive opportunities for non-English speaking visitors.

8) **Tours for disabled visitors:** The handheld and location-sensing qualities of the proposed technology offer great potentials to develop enhanced and specialized experiences to accommodate disabled visitors.

* • For visually impaired visitors, museums can develop purely audio-based tours that provide spoken information in response to the location-aware RFID components. In
addition to audio versions of textual content, these audio tours could include navigational
cues, audio descriptions of visual elements and objects in the museum, and
recommendations for exhibits that offer tactile components.
• Visitors with mobility impairments (particularly wheelchair users) may appreciate the
  smartphone apps because the mobile device alleviates the challenge of viewing content
  that is placed in physically unsuitable locations (e.g. labels positioned high up on the
  wall). The interactive map can also help guide them to the nearest wheelchair-accessible
  pathways.
• For hearing impaired visitors, museums can caption any spoken information included in
  audio or video content. These visitors may especially appreciate the additional visual
  components offered by the smartphone apps.

Just as the principle of accessibility (AAM EdCom 2005) encourages museums to
provide inclusive opportunities for diverse cultural communities, it also urges museums
to provide greater access to communities who face physical barriers and disabilities.
Creating location-aware audio tours may be especially helpful to visually impaired
visitors, who have been found to most benefit from verbal delivery of information in
museums (Asensio and Simón 1996). For hearing impaired visitors, the interactive map
may be especially helpful, because often times communicating with hearing people to
receive directions is quite challenging (Majewski 1987). For visitors with mobility
impairments, particularly wheelchair users who are able to hold a handheld device at
exhibit stops; they may also appreciate the interactive map, and the ability to view
multimedia information at a close distance and an angle of their choosing. Exhibit
elements that are placed to high, at flat angles, or in small font are often difficult for
mobility-impaired visitors to access (Majewski 1987). As in other efforts for museums
to create a more inclusive environment for disabled visitors, museums and the company
of the proposed technology should consult with disabled visitors in order to create the most effective experiences possible (Massman 2001).

IV. Museum Benefits & Tools for Evaluation

The proposed technology is not only intended to provide visitors with new opportunities to connect with museums, it is also intended to provide museums with new opportunities to connect with and understand their visitors. The proposed technology system provides potential opportunities for museums to serve broader audiences (multi-lingual and disabled), and allow all audiences to engage in more personalized (and potentially meaningful) museum experiences. The technology may also increase visitors’ length of stay within museums. Though it would be very worthwhile to further investigate how the proposed technology might alter the visitor experience and the relationships between museums and visitors, evaluating these topics will require the technology to be in place; they are not the focus of this thesis. Two benefits that the system will inherently offer to museums are the ability to edit content, and the ability to gather and analyze evaluative data about visitors.

1. **Editable content**

   The proposed technology will allow museums to create and edit the content that is displayed to visitors on the smartphone apps. Once a museum contracts the company to implement the proposed technology system, the company will provide training sessions, training manuals, and phone support to help ensure that museum staff can take advantage of the system’s offerings.

   For the initial content development required to first launch a museum app, the
museum can choose whether they would prefer to hire the company to help develop the app content, or whether they would prefer to develop the content themselves through the software template that the company provides. If they develop it themselves, the technology will function as an “off the shelf” system that offers an empty template that museum staff can populate with exhibit content in the form of text, images, audio, and video. The empty template will include places for titles, overview text, in-depth text paragraphs, photographs, audio, video, and a feedback section. The museum can populate as many or few of these areas as they wish for each exhibit.

Whether the museum or external consultants develop the initial content, the museum will always have the ability to easily and quickly edit, add, and delete content. Changes in content can be immediately visible to users as soon as the museum chooses to finalize the changes. Museums do not have to hire software programmers to design the system or to change the content, nor do they have to communicate with a third party to make changes to the content. Museums are in control of what information is featured on their apps.

2. Tools for evaluation

The cornerstone of this thesis focuses on the potential of the proposed technology to provide museums with evaluative data about visitors. The system will collect data about visitors in three different areas: (a) tracking and timing, (b) visitor feedback, and (c) visitor use of the app itself. The system will also allow visitors to anonymously provide demographic information that can then be used in sorting the three main areas of evaluation data. The company will develop a software program that will allow museum staff to easily visualize statistical analyses of these three areas of collected evaluation
data. The system will gather and analyze data within these three areas without requiring any staff involvement to collect, enter, or analyze the data. Museum staff will be able to quickly see visualizations of the data, and can then apply those findings in whatever ways will help them accomplish their goals.

Ideally, museums will already have evaluation methods in use and questions in mind, and they will use the proposed technology to expand their evaluation practice. Like all evaluation methods, this technology is intended to serve as a tool to better understand museum visitors so that museums can improve exhibits and programs to better serve their audiences. The museum is automatically provided with visitor demographics, customized visitor feedback, and visitor tracking data.

a. Demographics

When visitors first open a museum’s smartphone app, they may be prompted to enter demographic information, then allowing museum staff to sort evaluative data by demographic information. This will allow museums to determine if there are trends in how certain demographic groups of visitors use the museum. For instance, sorting the tracking and timing data of an exhibit about fashion may quantitatively reveal that 70% of visitors are women between the ages of 30 to 50 years of age.

- The system can collect demographic information and sort data accordingly.
  - The demographic information might include areas like: gender, age, zip code, ethnicity, first time or repeat visitor, and number of people in a group.
  - Visitors can reply with “No Answer” to any question.
b. Tracking and timing

The RFID location-sensing technology that will allow visitors to automatically access information about exhibits will also allow the museums to track and time visitors as they move through exhibits. This tracking and timing information will be automatically collected and then stored on a museum server. Though visitors will be informed that such information is being collected, the process of collection will be completely invisible to them and will not require any researcher or observer to record, collect, enter, or analyze this quantitative information.

- The system will collect tracking and timing information about users throughout the museum, throughout the day, every day. It will record:
  - Total stay time in museum,
  - Total stay time in individual gallery halls,
  - Specific stay time at each individual exhibit components, and
  - Routes traveled between stops (stops will be recorded in order).

This automatic data collection system will provide museums with an opportunity to gather information about their visitors with a level of magnitude and specificity that would be humanly impossible to collect. Museums can use this tracking and timing data to determine which exhibits are being viewed the most, and identify exhibits that are being overlooked. This information can then be used to investigate what factors are motivating visitors to spend more time at certain exhibits and less time at others. These statistics can be compared across different demographic groups. For more information about the history, use, applications of timing and tracking, and what features may be offered through the software of the proposed technology, refer to Chapter 7, “Timing, Tracking, and Observational Studies.”
c. Visitor feedback

For each exhibit component, staff can include a section in the app that allows visitors to leave feedback in various forms. Feedback left by visitors about specific stops will be automatically collected and stored on a museum server and processed through the evaluation features of the software. Responses can be analyzed using the software to determine if trends exist, and compare responses across different demographics.

• Visitors can provide feedback in different formats. They can:
  o Rate exhibits and programs (e.g. give a thumbs-up “Like” or tap a rating on a 5-star scale)
  o Text comments in response to general open-ended prompts (e.g. “Leave a comment.”)
  o Text comments in response to specific open-ended prompts (e.g. “What do the shapes in this painting remind you of?”)
  o Answer multiple-choice questions (e.g. “Which of the following insects are you most interested in learning more about? (a) bees, (b) moths, (c) grasshoppers, or (d) dragonflies?”)

• Museum staff can edit feedback prompts for individual exhibit components to serve different purposes. They can utilize visitor feedback to:
  o Ask questions for formative evaluation (e.g. “Which one of these two titles do you think better communicates the theme of this exhibit? Why?”)
  o Test prototypes (e.g. “Which one of these three graphics do you find the most appealing?”)
  o Assess user understanding of learning objectives (e.g. “What was one of the main ideas that surprised you?”)
  o Solicit recommendations for improvements (e.g. “What can we do to make this easier to use?”)
- Determine interest levels in different topics (e.g. Count how many visitors voluntarily provided positive open-ended feedback at different exhibit stops. Do certain exhibits inspire more users to provide better quality and in-depth responses?)
  - Museum staff can use the software to sort, analyze, and visualize feedback data to better understand how their audiences are connecting to exhibits and programs.
    - Natural language sorting can categorize the frequency of key words and phrases like: broken, interesting, I love…, I didn’t know that…, I didn’t like…, I was surprised…, and my kids…
    - Responses can be generally categorized and counted as positive, negative, or neutral for each exhibit stop.
    - For specific exhibits, key words can be counted. For example, if you have asked, “What was one of the main ideas that surprised you?” for an exhibit about bees, you might categorize and count responses according to key words like: diversity, honey, female, population decline, species, UV, pollination.

It is possible that visitors, particularly those who are already comfortable using smartphones, may be more likely to provide feedback for museums via handheld devices compared to providing written comments or talking with researchers. This feature is intended to serve as a tool to collect responses to gain a general awareness about visitors, to aid in formulated evaluation projects, and to serve as a platform of communication between the museum and the visitors. For more information about how visitor feedback can be used as a form of participation, see Chapter 4 “Participation and Technology,” and for more information about how visitor feedback can be used in museum evaluation, see Chapter 6, “Using Visitor Feedback in Evaluation.”

d. Analytics on use of app features
The evaluation features of the software will also allow museum staff to visualize how the app itself is being used. This information will also be helpful for the company in order to identify and correct problematic areas within the system. The analytics system will provide answers to the following types of questions:

- Are visitors using the app at the museum or remotely?
- Which app features (audio, video, games, etc) are visitors using for each exhibit component?
- Are onsite visitors looking at app features for the exhibits they are standing near?
- What percent of visitor’s time in the museum is spent using the app?
- For individual users: which types of features do they use the most/least, which types of exhibits do they view the most/least?
- Are there trends for which types of features are the most/least used for individual exhibit components?
- Which exhibits are being shared the most via social media?
- Which social media platform is the most used?
- At which exhibits are visitors providing the most feedback?
- Do certain times of the day or year show more app activity than others?
- Do certain demographics of visitors use apps more than others?
- Do certain demographics use certain types of features (video, audio, etc) more than others?
- Do certain demographics explore app features for certain exhibits more than others?

V. Technology Components

The basic flow of information for typical use will include four major hardware components in the system, and two software systems:

- Hardware:
  - Mobile smartphone devices,
  - Radio Frequency Identification (RFID) scanner apparatus that attaches to the smartphone,
• RFID tags, and
• A local server that stores exhibit content information (pictures, text, video, or audio), and evaluation information.

• Software:
  • Museum app (application) that runs on smartphones, and
  • A software program that runs from the server that handles both:
    ▪ Content development, and
    ▪ Evaluation

**Basic Overview**

Radio Frequency Identification (RFID) relies on “tags” and “scanners” that communicate through radio frequency waves. In this system, RFID technology is used in conjunction with smartphone technology, a wireless server, and software. This technology system allows museum visitors to receive immediate location-aware information about exhibits, and allows museums to track and time visitors’ movements.

The location of visitors will be determined using the RFID tags/scanner capabilities while the flow of information between the smartphone and the server will rely on a WiFi system. This combination of accurate location sensing using RFID, communication between the smartphone and the local server, and specialized software programs will provide capabilities for museums to capture visitor feedback and tracking/timing data in a fashion that has not yet been possible. The acquired data will include the amount of time spent at each exhibit, pathways taken through the museum, demographic information volunteered by visitors, and visitor feedback such as ratings and comments. All of this data will be automatically stored and organized on the server, and can easily be viewed, analyzed, and exported by museum staff using the evaluation
features of the software. Museum staff will also have the ability to create and modify the content that is displayed to the user from an interface on the local server.

RFID tags may be placed on exhibits anywhere in the museum, as well as on pathways. As a visitor navigates the museum using an app on a smartphone, the RFID scanner attached to the phone will sense when RFID tags are in range, and will communicate with the local server to receive and send information. This location-aware system will allow for an automatic exchange of information between visitors and the museum. The following steps detail the series of interactions that will convey information between visitors and the museum:

1) RFID scanner attached to smartphone approaches an RFID tag, and recognizes the tag’s identification number.
2) RFID scanner conveys the RFID tag’s ID to the smartphone
3) The smartphone uses Wi-Fi to relay the tag's ID number to the local server housed in the museum.
4) The server retrieves content information (text, images, audio, video) associated with that RFID tag and sends that information back to the smartphone.
5) The smartphone displays interactive content to the user on the app.
6) The smartphone communicates with server to convey which app features (audio, video, social media, feedback, etc.) the visitor is using.
7) The smartphone will periodically communicate with the server to record the duration of time a visitor spends at each RFID tag. This information will include the location of each tag (which exhibits or pathways the tags refer to), the duration of stay at each tag, and the sequence of stops. The evaluation features of the software can then analyze this tracking and timing information.
8) Anytime a visitor leaves feedback about an exhibit through the app, this information will be sent to the server via Wi-Fi, so that it can then be assessed in the evaluation features of the software.
9) As visitors move about the museum, the smartphone will also update the visitor's location on the interactive map that the visitor can reference at any time.

For comparisons between this proposed technology and similar existing technologies, see Chapter 3: “Technology in Museums.”

**RFID Tags for Location Sensing**

RFID technology has been chosen for this system as the most practical and accurate method for tracking where visitors are spatially located within a given area. RFID tags can easily be placed, moved, and removed with minimal effort. Tags may be placed anywhere the museum staff feels appropriate, and they will be immediately recognized by RFID scanners within their range. There are three types of RFID tags that may be used: low frequency, high frequency, or ultra-high frequency tags. The three types of tags have different ranges in which the tags and scanners can communicate; different tags may be chosen depending on the desired outcome. In this way, smartphone tracking may be localized to a variety of ranges. The communication between the scanners and tags is invisible to the user, and does not require any special action to be performed by the user, except for low frequency tags which require the user to first wave the smartphone over the tag to receive information.

Low frequency tags may be used to sense close ranges of less than 1 foot in order to allow users to wave their mobile device in front of “hot spots” on an exhibit that they would like to receive additional information on. This may be useful in large single exhibits that offer opportunities to interpret different components. For example, on an exhibit of a large Apatosaurus, low-frequency tags may be placed on different areas
around the dinosaur to convey specific information about their size, their diets, and the environments in which they lived.

High frequency tags can be used in a range of a few feet in order to determine that a visitor is directly in range of an exhibit. With these tags, visitors will need only to approach within a few feet of an exhibit to receive immediate information; they will not need to wave their phone directly over a tag. This will allow multiple users to stand near an exhibit and all receive the same content simultaneously. These high frequency tags will likely be the most commonly implemented tags throughout a museum.

Ultra-high frequency tags may be used in the range of up to 100 feet, which would be useful in determining a visitor's general location in the museum (especially larger museums) in order to provide feedback to the interactive map.

**RFID Scanner Apparatus for Location Sensing**

The sole function of the RFID scanner apparatus will be to detect any RFID tags that are within its range and relay the tags’ ID numbers to the mobile device. Each RFID tag has a unique identification number that it transmits when prompted by a scanner. The scanner will capture this ID number and transfer the data to the mobile device either through a physical connection with the device's serial port or by transmitting to the device's Bluetooth receiver. The scanner will be physically attached to the mobile device either by plugging into its dock (the phone’s charging port), or by attaching with a custom case that fits the mobile device.

**Software: Content Development and Evaluation**
The software included in the proposed technology system will serve two key functions: (1) to organize content for the smartphone apps, and (2) gather, sort, analyze, and visualize evaluative data about visitors using the app.

One of the key benefits of this system is that museum staff can edit, add, and delete content displayed on the visitor interface of the app. Staff can choose what forms of media should be displayed for specific RFID tags, and change that content as exhibits change. Not only can museum staff change the multimedia content associated with exhibits, but they can also change the positioning of RFID tags and the relationships between tags and their associated information. This is beneficial when exhibits change, or elements are moved around. Staff can simply change the physical positions of RFID tags, and update new information for that particular tag through the software program. Staff can also move the virtual location of an RFID tag. For example, if an exhibit is moved to a different location in the museum, the staff can move its location on the interactive map as well.

The software will also allow museums to gather, sort, analyze, visualize, and export evaluative information associated with visitors using smartphone apps. The types of evaluative information include: tracking and timing, visitor-generated feedback, and how visitors are using the app itself. To gather the tracking and timing information, the software relies on communications between the RFID technology, Wi-Fi, the smartphones, and the server. To gather visitor-generated feedback and information about how visitors are using the app, the software relies on Wi-Fi, the smartphones, and the server.
**Smartphone Mobile Device and App**

The smartphone will have several responsibilities in this system. It will be able to receive data from the RFID scanner that is attached to it, and will communicate with the server located in the museum via a wireless Local Area Network. The smartphone will run an application (app) designed to manage the content that is displayed to the user. When a new identification number is received from the RFID scanner, the app will relay this data to the server over WiFi and wait for instructions on what actions to perform next. The smartphone will then receive instructions from the server to display new content, update the visitor’s location on its interactive map, or a variety of other actions depending on the nature of the tag's defined behavior. Once new data is transferred to the device from the server, the device application will be responsible for displaying multimedia content and depicting the user's location on an interactive map. The application will also be responsible for responding to user actions and commands in order to let the user navigate the user interface.

**Server**

At the heart of this system lies the museum server, which stores all of the multimedia content that is disseminated to the smartphone apps, the correlations between the RFID tag numbers and their corresponding content information, and all of the user-generated data (tracking/timing, feedback, and which app features visitors use). All of the content information associated with each RFID tag will be created in the software system, and the server will be able to access this database of content to then transmit it to the smartphone apps.
One of the key features of the server will be to process the RFID tag numbers sent by smartphones and perform the appropriate actions that correlate with that RFID tag. Once a smartphone gives the server an RFID tag number, the server will locate the data associated with that tag and send the appropriate multimedia or navigational information to the smartphone app.

The server will also receive periodic updates about the tracking and timing data associated with each user, which it will archive and make available to museum staff through the software program. In addition to this timing and tracking data, the server will collect and store all user-generated feedback submitted through the app, as well as information about which app features visitors are using.
3. Technology in Museums

I. The Early Days
II. Impacts of the Internet
III. Multimedia and Interactive Technology
IV. The Age of the Smartphone
V. Differences Between Proposed and Existing Technologies

I. The Early Days

Audio for the Audience

Remarkably, mobile audio technologies in museums actually preceded the first computers. In 1952, the Stedelijk Museum in Amsterdam introduced the Short-Wave Ambulatory Lectures, which were “delivered through a closed-circuit shortwave radio broadcasting system in which the amplified audio output of an analog playback tape recorder served as a broadcast station, and transmission was via a loop aerial fixed around the gallery or galleries” (Tallon 2008, xiii). These lectures were recorded in four different languages and intended to interpret museum content in a new, more individualized, and more accessible manner. However, visitors listening to the lectures could listen to specific sections at a time and “groups of visitors would move through the galleries and look at exhibits as if guided by an invisible force, in complete synchronicity” (Tallon 2008, xiv). The recordings only provided “tombstone-like information” and were only useful for an elite, educated audience who already possessed knowledge and appreciation of the artworks of the museum (Giusti 2008, 98). Though it fell short of providing rich content in a very accessible fashion, the Short-Wave Ambulatory Lectures laid early groundwork for what would eventually be a revolution in museum interpretation.
Early Computers: Rooted in Collections Management

Hereafter, the term “digitization” will refer to information (such as text, images, and audio) that can be read as binary code by machines like computers. Museums’ first forays into digitization began in 1963 at the Smithsonian Institutions’ National Museum of Natural History when the Automated Data Processing (ADP) committee initiated the Self Generating Master (SELGEM) project. This project allowed four museums to enter text and numbers into an automated database. Thus began the long history of digitizing collections of museum objects. Efforts to create automated databases continued throughout the 1960s and into the following decades with the launching of projects like GRIPHOS (Generalized Retrieval and Information Processing for Humanities Oriented Studies), Canada’s National Inventory Programme (NIP), and the DARIS (Detroit Arts Registration Information System). (Jones-Garmil 1997)

The first Apple computer was developed in 1977, and as Apple and IBM desktop computers became more prevalent in the mid-1980s, database applications became more stable and available for museums. “Museums no longer needed to depend on university computing groups or special software consultants to write applications for them. Software written specifically for museum applications became available from companies that worked exclusively in the museum marketplace” (Jones-Garmil 1997, 42).

It is not surprising that the first museum computerization endeavors related to databases; “databases are a ‘natural’ match for the requirements of museums, which typically maintain details about thousands of items in their care” (Jones-Garmil 1997, 52). In the history of computers, word processing and data entry abilities preceded those of graphics and games (Jones-Garmil 1997). In the history of museums, the focus on
collecting and preserving objects preceded the focus on the visitor experience (Alexander & Alexander 2008, Anderson 2004). Museums began as places to showcase novel objects from around the world to appease the curiosity and musings of intellectual elites. As such storehouses of collections and knowledge, museums have yielded the potential for scholarly research, and it has always been important for museums to maintain records of their objects and objects’ associated information. Until the age of computer databases, these records were typically kept in the forms of ledgers and field notes.

Computerized databases have allowed museums to store volumes of object-related information on machines. Increasingly, these databases have become more relational, creating many connections between many pieces of information. Digital databases have allowed museums to create multiple copies of information, thus reducing the risk of losing all information in a fire or flood. As computers evolved to handle larger volumes of digital information, computerized databases could store more information and take up less space than traditional ledger books. They also allow users to quickly search for information. When digital scanners became increasingly available in the 1990s, this technology allowed for photographic images to be digitized and included in databases. Fundamentally, collection management systems are rooted in controlling inventories of objects and keeping records of such objects; historically, these computerized systems have a poor user-interface (Besser 1997).

**Evolving Audio Tours**

As computers were evolving through the 1980s, audio tours were evolving too. The 1980s and early 1990s saw a proliferation in the use of recorded cassette tape tours.
These developments reflected attitudinal shifts to provide more accessible interpretation to broader audiences (Giusti, 2008). These audio tours, such as one at the Metropolitan Museum of Art, allowed wider (and less artistically educated) audiences to learn “about what was considered important in art, and why and how artists influenced one another. […] But to follow the cassette tour, visitors were obliged to surrender a level of personal control over their visit and follow a predefined, linear path through the galleries,” just like in the 1952 Short-Wave Ambulatory Lectures (99).

II. Impact of the Internet

Networks of Information

Networks allow computers to connect to each other to enable the sharing of information. In a network, computer users can retrieve information housed on other computers, send information to other computers, and use the shared devices, like printers (Hermann 1997). In The Wired Museum, which was published around the time that the Internet was becoming more accessibly to society, Guy Hermann emphasizes the importance of networks for the evolution of communication.

“Without networks, information cannot flow from one computer to another. […] Networks are the plumbing of the wired museum. [They] provide the essential infrastructure for exchanging information [and] are the common denominator on which all the other technology rests because they allow computers and computer users to communicate with each other. As such, they become the foundations for the future digital communities we are only beginning to understand” (75-76).

While there are different kinds of networks, the two main types are Local Area Networks (LANs) and Wide Area Networks (WANs). LANs allow computers in physical proximity to be connected in a network. For example, all staff computers in one museum building may be connected through a LAN, allowing employees to access shared
information. For example, a staff member in marketing may need digital photographs from the anthropology department to create advertisements for an upcoming exhibit. A LAN will allow the marketing employee to access these records from their own computer, even though the original information is stored on a computer in the anthropology department. Wide Area Networks (WANs) connect LANs together to create larger networks. The Internet and the World Wide Web are examples of very large WANs whose networks span around the world.

**Sharing Information Within, Between, and Outside of Museums**

With the dawning of the Internet, came the birth of a whole new way of communicating and sharing information. As the Internet and scanners became more prevalent and accessible, museum professionals postulated that “the rapid conversion of text and images into digital form will affect work processes within the museum. Coupled with the advent of high-speed digital networks, this convergence will permit the museum to provide more information to a wider general public” (Besser 1997, 153). Another museum professional remarked that, “The real power of interactive technology is to be harnessed through networking. Innovations of expanded memory have allowed for image storage, processing, and retrieval. But the transfer of such image bases over high-speed networks, with links enabling searches in any language from collections globally, is certain to transform art historical research and education” (Anderson 1997, 26).

Indeed, the wider general public has much greater access to information thanks to the Internet and other technologies. The Internet today enables us to access answers to questions instantaneously, send and receive letters at the click of a button, have virtual
face-to-face video chats with people on the other side of the planet for free, share
information in many forms (text, audio, video, images), watch television, create
personalized radio stations, and have group conversations. The Internet has changed the
way society operates on a macroscopic scale.

Museum exhibit developers can develop content by researching information on
the Internet, collect images and request copyright permission from the owners, identify
materials from other museums to use in exhibits, identify suitable collaborators by
looking at organizations’ websites. Educators can develop content for programs by
searching through websites, access educational materials from other organizations, and
quickly contact volunteers to help run programs. Museum staff who focus on objects can
learn more about their objects by accessing information about similar objects in other
institutions around the world, share resources for best practices of collecting and
preserving objects, and broaden the scope of research by using information about
collection objects around the world and collaborating with other individuals around the
world. The Internet facilitates communication of information both within and between
institutions. (Zorich 1997)

When websites were first becoming widespread, some individuals worried that
providing text and images about museum collections would decrease visitors’ interest in
coming to actual museums. Others believed that websites would help encourage onsite
visitation:

“In the emerging landscape of online images, the appetite for the original will only deepen, as
people of all ages become better acquainted with the works of art that appear on their screens. The
Pavlovian reflexes so skillfully honed by the world of advertising will be no less in play in the
arena of art reproductions. […] The demand for the original work will increase rather than
decrease, following repeated exposure at an institutionally authorized site on the World Wide Web
or its successor” (Anderson 1997, 19).
Luckily, this scenario has proved to be true. Nowadays, it is rare for a museum (or almost any organization or institution) to lack a website, and visitors are still coming in the doors of museum buildings. Websites provide quick access for visitors to get simple information to better plan their visits, and also explore more in-depth educational offerings. Though websites have become standard requirements, museums that make larger commitments to their websites are able to create more attractive and in-depth sites (Falk and Sheppard 2006).

III. Multimedia and Interactive Technology

The Move Towards Interaction

While museums used to be repositories of knowledge and objects accessible only to the intellectual elite, there has been an increasing push in the last century for museums to provide more engaging experiences to a wider spectrum of audiences (Dana 1917, Anderson 2004, Hein 1998, Simon 2010).

“Today, a typical museum includes more than just objects in glass cases. Exhibitions are increasingly designed as immersive experiences, augmented by surround video, mood-enhancing soundscapes, and even smells. Disappearing are the old-fashioned taped tours, replaced by random-access CD players and increasingly interactive palm-size computers that can provide audio, video, and GPS-guided ‘intelligent’ information keyed to where you are and what you want to know. Once industry jargon, ‘hands-on’ is now in the public vernacular and has come to represent the visiting public’s expectations; ‘quality’ museum exhibitions will be interactive” (Falk and Sheppard 2006, 215-216).

As demonstrated by Falk and Sheppard, innovations in technology for visitors are rooted in the goals to design more “immersive experiences” that appeal to a broad range of senses, learning styles, personalities, and personal preferences.

Further Iterations of Audio Guides
The 1990s saw the increased use of compact discs (CDs) as a means to deliver audio. Like cassette tape tours, mobile CD players allowed visitors to access audio recordings about exhibits, but now visitors could select different audio tracks without having to listen to an entire recording with a prescribed order of information. Thus gave way to “random access” or “direct access” audio tours. As MP3 players became more common in the 2000s, these devices could provide more audio information without needing to put a physical object (like a tape or CD) into the device. Like CD players, they allow visitors to control which audio excerpts they would like to hear, thus allowing a more self-directed learning and individualized learning experience. “Direct access to information provided [a free-choice museum experience], and this is now a basic expectation of all subsequent generations of handheld technologies” (Giusti 2008, 99).

As MP3 players and cell phones became more ubiquitous in society, new opportunities emerged for museums to structure experiences that visitors could access through their own devices. Visitors already know how to use these devices and have personal connections to them—“No need to rent and familiarize yourself with an unknown technology; just bring your preloaded MP3 players or use your mobile phone to access new layers of information and interpretation” (Giusti 2008, 99).

Focus on Graphics and the User-Interface

While collection management systems are typically used for keeping records of information about objects, computerized exhibit elements are typically used to explain information and make that information accessible to audiences. Collection management systems often have lackluster user-interfaces and link large volumes of discrete pieces of
information together. Exhibits, on the other hand, emphasize graphics and user-friendly interfaces, and provide a narrative structure for a specific set of information. (Besser 1997)

Interactive kiosks are an example of a stationary, digital technology that allows visitors to create personalized experiences suited to their interests. These types of kiosks often feature interactive touch screens that give rise to menus and listings of information or sometimes games. These types of technologies “can be robust and very effective exhibit. They are extremely popular with visitors, especially children, although not to the exclusion of other forms of exhibitory” (Gammon 2010, 281).

Digital technology, including great strides in graphics and user-interfaces, allows museums to provide visitors with opportunities to take part in educational gameplay in which they can engage in simulated experiences that would be impossible in real life because of the size, scope, price, or speed of a given experience. At the “Energy—Fuelling the Future” exhibit at the Science Museum in London, visitors could play an interactive computer game in which they acted as a government official for energy policy in an imaginary country. In the game, visitors made decisions about energy policy over the span of twenty-five years and could see how their decisions affected the environment, the economy, and their political careers (Gammon and Burch 2008).

Personal digital assistants (PDAs) allow visitors to access multimedia information like text, images, and games on a handheld device. While stationary computer kiosks allow visitors to exercise some control over their experience, handheld multimedia technologies allow a greater degree of personalization because an individual can have control over the mobile device throughout their visit.
“Multimedia is a proven learning tool outside of the museum context, and specifically in museums, in the context of mobile interpretation, preliminary data seems to confirm that visitors using multimedia tours have more extensive learning experiences, demonstrate a deeper level of understanding and critical thinking, make more connections to their own history and background, and engage in greater personal learning” (Filippini-Fantoni & Bowen 2008, 82).

IV. The Age of the Smartphone

The Journey to the Smartphone

As discussed above, as it became increasingly common for visitors to own MP3 players and cell phones, museums began to provide opportunities for visitors to connect with audio content using these personally owned devices. Today, many museums allow visitors to access audio information by calling a number on their cell phones and then pressing different numbers to hear different audio selections (AAM 2011). PDAs allowed museum interpreters to consider different approaches to provide multimedia information on mobile devices. Smartphones today combine the text and graphic abilities of PDAs, the audio abilities of MP3 players, are able to connect to the Internet, take photos, and can store information for later reference.

In his essay, “The Shape of Things to Come: Museums in the Technological Landscape,” Simon Knell offers a quote from the 1993 U.S. Information Infrastructure Task Force which serves as a very early description of what would eventually become the smartphone:

“Imagine you had a device that combined a telephone, a TV, a camcorder, and a personal computer. No matter where you went or what time it was, your child could see you and talk to you, you could watch a replay of your team’s last game, you could browse the latest additions to the library, or you could find the best prices in town on groceries, furniture, clothes – whatever you needed” (Knell 2010, 439).

That device has arrived. Smartphones are phones that also include functions of cameras, video cameras, global position systems (GPS) that aid in navigation, and the ability to connect to the Internet through Wi-Fi networks and the 3G mobile telecommunication
network. This ability to connect to the Internet allows users to watch TV, connect to social media websites, video chat, and search for general information about any given topic. Apps (applications) provide individualized tools for users; their content may be in a variety of forms and may address a variety of topics: weather, sports, task managers, exercise, horoscopes, games, puzzles, music, and many more.

Downloaded apps remain on the user’s smartphone device and allow users to save information and access it at any time. This quality may prove to be one of the most important features for visitors to extend their museum experience. Research on general mobile devices in science centers concluded that “a device’s most useful function in a [hands-on] science center is to record information for later reference” (Gammon & Burch 2008, 50). If “post-visit tasks can be conducted directly on the mobile device, this is ideal because they can be done anytime, anywhere. Mobile technologies now facilitate these tasks, with large touchscreens and always-on connectivity” (Walker 2008, 120).

While the worldwide smartphone market continues to burgeon (Kellogg 2010), the museum community is realizing the potentials for smartphones to aid museums’ strategies to connect with its visitors (AAM 2011, Tallon 2010, Tallon & Finkelstein 2011). In presenting “Developing Mobile Experiences and Content” in the Museums & Mobile Online Conference II, Sandy Goldberg purports, “We are at a tipping point. Content is now a destination and a free-floating entity. Content is king, but how to get to that content is another issue” (Goldberg 2011). In other words, the connections between museums and their audiences will continue to heavily rely on content, but museums are facing new challenges and opportunities to redesign the platform from which to deliver that content. There were 2,285 museum professionals who voluntarily completed AAM’s
2011 Mobile Technology Survey, and 738 museum professionals voluntarily completed the Museums & Mobile Survey 2011. This large volume of responses indicates that the museum community feels the need to respond to the growing smartphone market and create standards for how to use these technologies to best aid in museums’ missions.

Contemporary Considerations

Conversations in the Museums & Mobile Online Conference II focused on many different facets of using emerging mobile technology. These topics, ideas, and challenges ranged from widespread implications for the field of museums to seemingly small technical considerations. Many of the key ideas presented at the Conference have direct implications for benefits and challenges for the proposed technology. Some of these key points and implications are enumerated upon below.

• *New models for collaboration.* There is a changing landscape for how museums and independent vendors can work together in increasingly flexible ways. Museums can develop projects in-house, collaborate with vendors, or completely outsource projects to vendors; different components for one project might be addressed differently (Samis 2011, Moad 2011). The proposed system intends to offer this type of malleable structure to provide museums with more control.

• *Evaluation of the technology itself.* Multiple presenters emphasized the need to evaluate both the technology products and the audiences’ willingness to use the products before, during, and after developing the mobile experience. Museums should conduct front-end evaluation to gather an understanding of their audiences’ potential attitudes about the planned mobile experience. While developing the mobile
app, museums should test different prototypes and versions in order to refine the product. After launching the mobile experience, museums should conduct unobtrusive observations to discover how visitors are approaching the experience (Wallace 2011, Downe 2011, Grinsted 2011, Davis 2011). With the proposed technology, it will be important to understand how visitors are using smartphone apps in order to assess the reliability of the evaluative data that the system collects.

- **Accept that technology will change.** It is not a question of “if,” but “when” technology will change (Moad 2011). This sentiment has been expressed before, “How do we cope with this flux [of technological change]? First we need to accept that the system we have today in all likelihood will not be the system we have five years from now. The only parts likely to be the same are the network connections (possibly) and the information itself…” (Hermann, 1997, 70-71). More research should be conducted to determine how the proposed technology could be affected by various potential changes in the technology industry, and what components could remain unaffected.

- **Develop a content management system.** Though technology will change, much of museums’ content related to permanent collections will not change. When creating mobile experiences in this digital age, museums should use content management systems so that when technology does change, the content that might fit into a new technology system can be more easily transferred (Moad 2011). The content development software in the proposed system should be carefully constructed to ensure that the content will still be usable in the future, even if the content is eventually displayed on a technology other than a smartphone.
• *Use analytic programs.* There are free programs such as Flurry, appFigures, and Google Analytics to help museums understand how visitors are using features of their apps (Downe 2011, Svenonius 2011). These types of analytics will be designed into the proposed system.

• *Infrastructure may be problematic.* Can Wi-Fi reach throughout the museum building? For institutions that largely exist outdoors or have structural challenges within their buildings, is it possible to deliver consistent experiences throughout the institution? (Wallace 2011)

• *Challenges of providing devices.* Many museums that have created apps for smartphones have also procured iPod Touch devices to allow visitors who do not own a smartphone to have access to the same mobile experience. While visitors appreciate these devices, there are many logistical challenges regarding how to charge, store, and distribute them (Black 2011, Gemmel 2011, Samis 2011).

• *Variety of platforms.* Each different platform (like iOS for Apple and Android for Google) requires different coding languages to produce apps, and the consumer market is shifting. In developing mobile experiences, museums should spend time deciding what platform to start with (McLaren 2011).

• *A different tone for content.* When thinking about developing content for smartphones, bear in mind that for visitors using their own device, this is a very personal device. Museums should consider the tone of the content, and steer away from impersonal, highly scholarly voices and consider ways to present content in a more personalized tone (Goldberg 2011, Davis 2011).
Other Implications of Emerging Technologies

Emerging smartphone technologies offer other opportunities and challenges for visitors and museums staff. Some of these issues relate directly to the format of the technology, while other issues are reflections of indirect considerations.

• **Lure of the screen.** There is a concern that visitors are magnetized to computer screens, sometimes at the cost of ignoring the objects and other labels that museums exhibit. “Screen-based multimedia tours are further accused of distracting the visitor from looking at the exhibit; but do visitors look at exhibits while reading labels?” (Tallon 2008, xxi). “It is difficult to get visitors to see external instructions or directions (i.e. label text) because they tend to immediately focus on the computer screen” (Gammon 2010, 284). These two statements demonstrate that museums have varying perspectives about what visitors should be paying attention to; introducing digital screens may further compound the variety of opinions and concerns about visitors’ attention. Content on smartphones should be carefully crafted to provide cues for visitors to look and connect with physical elements and other people in museum spaces.

• **Headphones and speakers.** “The risk of mobile digital technology disrupting conversation seems to be particularly acute when headphones are used…” (Gammon and Burch 2008, 48). Some studies have shown that visitors do not feel that audio tours inhibit their social interactions; however, there exists no large body of research on this subject area (Smith and Tinio 2008). While museums continue to develop audio programs for mobile tours, it would be highly beneficial for the field of museums to conduct further research about the social implications of listening to
audio tours on headphones. In what scenarios would it be possible and/or helpful to play audio recordings through smartphones’ built-in speakers? Should museums provide equipment to enable multiple pairs of headphones to be plugged into one device? Can these issues be counteracted simply in the writing of content by providing conversational and behavioral prompts and cues?

- **Screen size.** As headphones are accused of creating isolating experiences for visitors, the screen size of smartphones may present similar challenges. While computer exhibits can typically be used by a few people at a time, smartphones have much smaller screens that are difficult for more than one person to view at a time. Research should also be conducted to assess how smartphones’ screen size affect social dynamics. How do dynamics change when one visitor within a group has a smartphone? What happens when everyone within a group has their own device? How do adults facilitate child interactions with these devices?

- **A good user-interface.** “User interface design is an important part of multimedia production; a badly designed interface will make the program difficult to use and can negate impressive and rich content. […] When providing additional information for the more interested users, it is more effective to offer it in layers, keeping the interface simple and intuitive” (Economou 2010, 397). Gammon echoes this need for layered complexity in the context of young audiences, “It is better to accept that whatever you do, children will form part of your target audience, and layer the information/complexity of the activities so that children can gain something from the exhibit while more interested or knowledgeable visitors can delve deeper” (Gammon 2010, 284). Creating standards across museums will help the whole field because
each museum affects each other; if apps are not working in one museum, people might be less inclined to use apps in other museums (Goldberg 2011).

- **Research the learning experience.** In this emerging landscape of visitors using their own mobile devices, research should be conducted to better understand the technologies’ impacts on learning. “The exploration of the complex relationship among interactivity, learning, and the virtual reality medium should continue in order to provide insights as to how people interact in virtual environments and how interactivity should be designed to achieve meaningful leisure and learning experiences” (Roussou 2010, 262).

- **Personalization.** Allowing users to browse information that is most personally relevant and interesting, bookmark information, select favorites, leave feedback, and create personal profiles are all ways that smartphone apps can yield opportunities for personalized experiences. “Handhelds can permit the design of a personally relevant experience that can be customized to a person’s interests. The handheld is not just a mini personal computer but should be orchestrated and situated into a whole set of human interactions and experiences that are actively personal” (Hsi 2008, 144).

- **Benefits of using user-owned devices.** There are multiple benefits for museums to enable experiences that can be accessed from users’ own devices, one of the foremost reasons being cost. However, it may take time to perfect these systems.

  “… It is safe to assume that, for the next several years, multimedia tours will probably continue to coexist with other solutions such as traditional audio guides, downloadable online tours, and mobile phone tours. In the long term, services offered on visitors’ personal devices, including audio, text, and multimedia content, will become more prominent, allowing museums to save on distribution and hardware costs. However, this might take time for a series of reasons including quality of the experience, compatibility issues, and costs” ” (Filippini-Fantoni & Bowen 2008, 91-92).

**Summary**
While it is safe to assume that technology will change, it also seems safe to assume that personalized mobile devices are here to stay, and that the market of smartphone users will continue to grow as these devices become more affordable. Though a new technology may eventually replace smartphones, that technology is likely to maintain all of the multimedia and personalization abilities featured in smartphones. It seems that society is becoming increasingly reliant on these types of devices and that this human to technology connection will continue to grow stronger. When thoughtfully designed, these personalized, multimedia, mobile devices have the potential to serve as a platform for deeper levels of engagement between visitors and museums. Museums are positioned to use these devices to provide fun, interactive, and educational experiences. In fact, it seems that if museums do not find ways to implement these technologies, they are missing opportunities to connect with their audiences who are becoming increasingly familiar with and connected to these devices. That said, these technological systems must be carefully and creatively designed to ensure seamless and intuitive experiences for their visitors.

V. Differences Between The Proposed Technology and Other Technologies

In October of 2010, Edward Rothstein expressed a plea for an app that would enable sense a visitor’s location and automatically display information about the object directly in front of the visitor (Rothstein 2010). Silvia Filippini-Fantoni and Jonathan Bowen express the need for reliable location technologies in order for multimedia tours to become the choice interpretation device (Filippini-Fantoni & Bowen 2008).
Museums are attempting to provide location-aware information through smartphone tours and are employing a variety of tools in these attempts. The American Museum of Natural History (AMNH) uses Wi-Fi triangulation to try to detect visitors’ locations, but there are limitations to the accuracy of this method (Rothstein 2010). This system is able to detect visitors’ locations enough to identify which gallery hall they are in, but does not know what exhibit they are directly in front of. This allows visitors to receive navigational directions through the museum, and can narrow the menu selection of exhibits to those in the gallery hall where the visitor is standing, but it does not present the “right” information automatically. Also, this technique requires a large volume of routers to be plugged in throughout the museum.

While AMNH attempts to provide location-specific information, it still requires users to browse through menus of exhibits in order to select the correct one. In general, the main current tools for delivering specific information include: (a) browser menus in which visitors can search exhibits by gallery or alphabetically, (b) QR codes where a visitor takes a photograph of a code that can then direct them to specific information, (c) typing in numbers for different stops, or (d) a combination of some of these.

The proposed technology includes many of the features that other apps are already taking advantage of: multimedia content, interactivity, and personalization. However, it offers two key differences compared to existing smartphone technologies: (1) exhibit-specific location sensing, and (2) the ability for museums to collect evaluative data about visitors, particularly tracking and timing. By placing high frequency RFID tags on exhibits and attaching RFID scanners to the smartphones, visitors will be able to automatically access information about exhibits that are within about a five-foot range.
This location sensing will also allow the system to provide an interactive map showing the visitors’ current location. Though RFID and Bluetooth technology were mentioned in the *Museums & Mobile Online Conference II* as areas to explore, no presenters discussed any existing museum smartphone projects that use either of these technologies.

Perhaps of greater value is the ability for the proposed technology to collect evaluative data about visitors. Programs like Google Analytics make it easy for app developers to gather data and develop statistics about how the actual app is being used; existing museum apps can easily take advantage of such services, and the proposed technology will also rely on these analytic programs. However, the proposed technology aims to collect deeper and more varied levels of evaluative data. With the exception of the Brooklyn Museum’s “Gallery Tag” feature, most existing museum apps do not allow visitors to participate in any sort of dialogue with the museum. As discussed in the previous chapter, the structure of the proposed technology enables visitors to leave a variety of feedback about specific exhibits that can then be sorted and analyzed using evaluation software to help museum staff develop a richer understanding of how their visitors are connecting to exhibits and programs.

Most uniquely, the proposed technology will collect tracking and timing data about how visitors are moving through the physical space of the museum. Though other museums can assess how often visitors are accessing information about individual exhibits, they cannot time how long visitors are spending standing in front of those exhibits. The proposed technology will be able to track and time how long visitors are spending at individual exhibit stops and will be able to sort, analyze, and visualize this data for museum staff.
4. Participation and Technology

I. The Push to Engage
II. No-Tech Participation
III. Technological Participation
IV. Proposed Technology’s Potential for Participation

The purpose of this chapter is to address how the proposed technology may be designed to encourage participatory experiences, which may simultaneously inform evaluation practices to provide museums with a better understanding of their visitors. To address these potentials, the road leading to participation must be paved. Educational and psychological theories that have moved museums to become places of engagement will be acknowledged, and contemporary examples of participatory experiences will be provided.

I. The Push to Engage

**Becoming More Audience-Centric**

In 1917, John Cotton Dana urged museums to become more accessible to wider audiences with focuses on teaching and advertising. He urged museums to become more like department stores in certain regards: be centrally located in a city, stay open during times of day when most people are able to visit, employ courteous greeters, showcase the most intriguing objects and make others available upon request, organize objects in ways that are sensible to patrons, change exhibits, and offer conveniently located restrooms (Dana 1917).

As museums came closer to Dana’s vision of audience-centric institutions, George Hein provided a framework for museums to approach the constructivist theory of
learning. This approach claims that visitors will inevitably create their own meanings based on prior ideas and experiences (Hein 1998). Given the multitude of prior experiences that might play into any person’s learning experience, museums should represent a broad range of perspectives, deliver content through multiple mediums to accommodate different learning styles, and provide a variety of mental and physical access points. By providing varied learning opportunities and points of view, museums should be able to connect with a wider spectrum of visitors.

John Falk and Lynn Dierking extended the theory of constructivism into their “Contextual Model of Learning,” which demonstrates the complexities of meaning making in museums (Falk & Dierking 2000). In this model, there are three overlapping spheres that affect a learning experience: physical, personal, and sociocultural. In the framework of a museum visit, the personal context accounts for an individual’s expectations and motivation for visiting, as well as their existing interests, experiences, and knowledge (Falk & Dierking 2008). The sociocultural context involves an individual’s social interactions with people in their group and others in the museum, as well as their cultural backgrounds. The physical context relates to the qualities of the physical space of the museum: the architecture of the building; the design of programs, exhibits, and technology; and orientation in the space. Throughout a person’s life, these three spheres factor into experiences all the time and affect each other over the span of time; therefore, events like museum visits may develop other meanings as time passes and new experiences affect a person’s perception of previous ones. Similar to Hein, Falk and Dierking urge museums to provide multiple layers and styles of learning opportunities, offer opportunities for visitors to “construct connections between museum
experiences and their lives, both before and after the museum experience” (Falk & Dierking 2000, 188), and create opportunities for social dialogue and interaction.

In her book, *The Participatory Museum*, Nina Simon focuses on ways that museums can create better opportunities for visitors to engage with each other and the museum. Supporting the educational theories of Dana, Hein, Falk, and Dierking, Simon argues that cultural institutions can provide participatory opportunities to visitors in order to “reconnect with the public and demonstrate their value and relevance in contemporary life” (Simon 2010, pg i). Echoing this push to engage, Kevin Walker claims, “Learning occurs when museums cease to view visitors as passive containers and begin recognizing them as active constructors- not only of meanings inside their heads but also of connections and creations in the world, on the screen, in the museum, and beyond” (Walker 2008, 121).

**Defining Participation**

Nina Simon defines a participatory cultural institution “as a place where visitors can create, share, and connect with each other around content” (Simon 2010, ii). In such a place, “the institution serves as a ‘platform’ that connects different users who act as content creators, distributors, consumers, critics, and collaborators, […thus enabling] opportunities for diverse visitor co-produced experiences” (2).

While his book *Confronting the Challenges of Participatory Culture* primarily addresses participation in terms of educating young people, Henry Jenkins defines participatory culture as one with “relatively low barriers to artistic expression and civic engagement, strong support for creating and sharing creations, and some type of informal
mentorship whereby experienced participants pass along knowledge to novices” (Jenkins 2009, xi). Jenkins also emphasizes the importance of creating an environment in which participants feel that “their contributions matter and [they] feel some degree of social connection with one another” (xi).

It is important to understand that participatory experiences allow for different levels of engagement and roles for participants, including creators, critics, collectors, and spectators (Simon 2010). “Not every member must contribute, but all must believe they are free to contribute and that what they contribute will be appropriately valued” (Jenkins 2009, 6).

**Structuring Participation, Making it Personal**

Russian psychologist Lev Vygotsky introduced the educational theory of instructional scaffolding, which acknowledges that in order for a person to move from one level of conceptual understanding to the next, material and ideas should be introduced in an incremental manner, one building upon the previous one. “Educators or educational material provide supportive resources, tasks, and guidance upon which learners can build their confidence and abilities. […] The best participatory experiences are not wide open. They are scaffolded to help people feel comfortable engaging in the activity” (Simon 2010, 12-13). In order to create stable scaffolding, Simon encourages museums to provide more constraints and more personal access points, “First, participants thrive on constraints, not open-ended opportunities for self-expression. And second, to collaborate confidently with strangers, participants need to engage through personal, not social, entry points” (Simon 2010, 22).
In a project at the Kew Gardens, visitors were able to leave feedback in the form of self-recorded audio, but the software limited the recordings to fifteen seconds. Researchers observed visitors taking the time to carefully script their responses; visitors were more engaged in the process and provided more interesting responses because of the technologically imposed time constraint (Walker 2008). At an exhibit entitled *Side Trip* at the Denver Art Museum, visitors were provided with clipboards, dry erase markers, and reproductions of psychedelic rock posters. They were then allowed to trace over different pieces of different posters and create their own re-mixed psychedelic posters. While an unstructured corollary would provide only markers and blank paper, this project provided scaffolded constraints to make it a rocking success: from 90,000 total visitors to the exhibit, 37,000 posters were made, and visitors spent an average time of twenty-five minutes creating their posters (Simon 2010). These examples support the idea that narrowing a projects’ scope and providing more structured constraints increase the visitors’ willingness to engage in participatory experiences (Simon 2010, Walker 2008).

Simon proposes a five-tiered structure for museums to encourage participation. At the foundation of this system lies museum content and at the top rung is social engagement between individuals. Simon is particularly focused on creating opportunities for strangers to engage in social participation together, not just individuals who arrived at the museum together. Below are Simon’s five stages of participation:

Stage 5 – Individuals Engage with Each Other Socially
Stage 4 – Individual Interactions are Networked for Social Use
Stage 3 – Individual Interactions are Networked in Aggregate
Stage 2 – Individual Interacts with Content
Stage 1 – Individual Consumes Content

(Simon 2010, 26)

A simple comment board can serve as a model. In an exhibit about quilts, the first stage of participation begins with individuals absorbing content about quilts. At a feedback station, a prompt could encourage visitors to engage with content: “What are your earliest or most vivid memories of a quilt?” If a visitor wrote a response and submitted it to a closed box, the participation would end here. If visitors were encouraged to leave their responses on a wall for others to see, this would qualify as a stage three interaction. The museum could provide three sections on the wall in which visitors could categorize their responses into: (1) it was a quilt someone made for me, (2) it was a quilt I made for someone, or (3) it was someone else’s quilt. The museum could provide larger sticky notes of one color for people to write their responses on, and provide smaller sticky notes of a different color and instructions that the latter should be used to leave comments on other visitors’ stories. Allowing visitors to categorize responses as well as respond to others’ comments would bring the experience to a stage four interaction. At this point, visitors would have more structured opportunities and personal entry points in which they could verbally engage with other visitors about quilts, a stage five interaction.

When thoughtfully designed, this five-tiered structure can offer multiple opportunities for individuals to take on different roles such as creator and spectator. Different projects may best be suited to represent different stages; some exhibits and programs may intrinsically lend themselves towards higher degrees of participation than others. Many of the project examples in the following sections demonstrate how many
participatory tools, both technological and not, can inherently serve as platforms for museums to evaluate and understand their visitors.

II. No-Tech Participation

While types of technology may be well suited to foster participatory experiences in some circumstances, there are many examples of innovative ways to create participatory experiences using no electronic technology at all. Recently, the San Diego Museum of Natural History presented an exhibit entitled “Case by Case.” In this exhibit, the museum selected collection objects to put in cases in the gallery hall, but instead of asking curators to direct the development of interpretive labels, they provided no interpretation and asked visitors to leave questions and observations about the given object in the display case (the first one selected was a hornet’s nest). They then categorized responses into seven most commonly addressed topics or questions and created an interpretive label to very succinctly address these. This project not only provided opportunities for visitors to participate with the museum, but it also allowed the museum to conduct front-end evaluation and better understand how their visitors perceived museum objects. (Simon, March 2011)

In the Denver Community Museum, a small, temporary organization, the founder/director, Jaime Kopke, presented monthly “challenges” for the community to curate their own exhibits. In the challenge Bottled Up! community members were invited to “fill a bottle with the memories of people and places from your life.” What resulted was an exhibit of twenty-nine community members of all ages, showcasing their creations, some of which were participatory experiences in themselves. While the
twenty-nine contributors participated in the exhibit with a deep level of engagement, other visitors were allowed to contribute on smaller scale. Kopke “designed a simple interactive tree collage that hung on one gallery wall, holding open bottles with phrases like ‘First Love’ and ‘Beliefs You Hold Sacred.’ Visitors could write a memory on a slip of paper and add it to a bottle if desired” (Simon 2010, 205). While the example from the San Diego Museum of Natural History used visitor feedback to contribute to the decision-making of the exhibit process, the Denver Community Museum allowed participants to co-create the total exhibit. These two projects, which require no digital technology, exemplify how different levels and types of participation may be best suited for different venues and projects.

III. Technological Participation

As discussed in Chapter 3, Technology in Museums, the graphical abilities, interactive user-interfaces, and networking abilities of some types of technologies inherently offer opportunities for interaction and participation. These technologies can take many forms including handheld devices, interactive kiosks, online social media, digital projections, and many others.

“While museums have long strived to be welcoming places as well as havens of learning, social media is turning them into virtual community centers. On Facebook or Twitter or almost any museum Web site, everyone has a voice, and a vote. Curators and online visitors can communicate, learning from one another. As visitors bring their hand-held devices to visits, the potential for interactivity only intensifies” (Vogel 2011).

Stationary Interactive Technology

The Museum of World Culture in Gothenburg, Sweden invited young children to select collection objects that they found most interesting; these objects were then put on
display. An interactive touchscreen allowed visitors to click on virtual representations of the objects and then watch video projections of the children explaining why they selected their objects. In this case, the process of selecting the objects was a participatory experience, but it was revealed to the museum visitors through the medium of an interactive touchscreen and video projection. (Simon, April 2011)

*Internet Arm Wrestling* was an interactive exhibit installed in six science centers across America in 2004. In this case, the networking abilities of the Internet combined with a physical interactive, prompted visitors to engage in silly, physical play.

“When you sit down to use it, you grasp a metal arm (meant to simulate our competitor’s arm) and are connected to another visitor at an identical kiosk. This visitor may be a few feet from you in the same science center or hundreds of miles away at another science center. You receive a ‘go’ signal, and then you start pushing. The metal arm exerts a force on your arm equal to the force exerted by your remote partner on his own metal arm. […] Each player can communicate through a webcam feed to her partner as they play.” (Simon 2010, 98)

**Mobile Participation**

Mobile devices like PDAs, cell phones, MP3 players, tablets, and smartphones offer an extended degree of personalization because they typically have a one-to-one relationship with the user carrying them. Also, “mobile digital devices [that can connect to the Internet] also provide the opportunity to build communities of learners through the use of wireless networking, allowing visitors to communicate at a distance with others in or out of the museum, to share information, ideas, and experiences, or even to engage in multiplayer games” (Gammon & Burch 2008, 37). One type of game “called "participatory simulations” […] use[s] handheld devices to mediate a role-playing game that commonly centers on emergent phenomena like disease transmission, economic trading, or trait inheritance” (Hsi 2008, 141).
These devices can also be designed to foster participation between museum visitors and staff members. At the Alabaster Museum of Natural History, certain visitors took part in a project that revolved around mobile multimedia devices. These devices were able to maintain a digital memory of each user’s interests, ability level, and age to deliver a personalized experience in which users could research museum content and engage in digital projects and games related to museum content. In this model where regular visitors were specially selected to engage with this technology, staff were able to play an integral role to aid in the visitor experience; docents were notified when these visitors arrived, and were able to help guide their visits and develop personal relationships with these visitors. The handheld device aided in conversations between the visitors and the museum staff both in the museum and beyond the museum’s walls. Visitors could “write in questions [to the device], some of which could be immediately answered by the device’s database, [while] others would need to be answered later by the museum’s staff and e-mailed back to [the visitor]” (Falk and Sheppard 2006, 5). The system made personal recommendations for each user based on their interests, and would sometimes send them the emails of other users of similar interests, thus providing a somewhat structured way for museum visitors to connect with other visitors using technology as a medium. (Falk and Sheppard 7)

**Websites, Crowdsourcing, and Social Media**

Websites have become increasingly interactive and can serve as a window to allow visitors to have a behind-the-scenes look into museums. On the website of the Indianapolis Museum of Art, “users can track its endowment, its membership, the
number of visitors it had that day and even how much energy it is using” (Vogel 2011). The Brooklyn Museum and the San Francisco Museum of Modern Art have posted videos on their websites of behind-the-scenes installations and restoration projects (Miller 2011, Vogel 2011). The Brooklyn Museum just offered a visual quiz on their website about Indian Paintings; visitors viewed series of Indian paintings (paired two at a time) and had to click on the one they found most interesting. The results of this interactive survey will be used to help the museum choose which paintings are put on display. (Vogel 2011)

While the Internet may serve as a means to conduct interactive surveys, it can also serve as an inlet for visitors to contribute their own creations. The term “crowdsourcing” refers to using audience contributions in the process of content development. These contributions could be in the form of ideas, objects, or interpretation. The Brooklyn Museum developed, Click! A Crowd-Curated Exhibition in 2008. The first invitation for contributions came with the prompt for individuals to submit photographs of “the changing face of Brooklyn.” Then, the Museum invited individuals from the community to judge which photographs displayed the best artistic quality and best addressed the theme. This judging process was done online, users could not see any aggregated scores, and the only demographic information provided was geographic region and self-reported artistic knowledge.

“The [Museum’s staff] team used these data points later to run comparisons so they could see if self-described experts rated photos differently than their novice counterparts, or whether Brooklyn denizens had different perspectives on the ‘changing face of Brooklyn’ than judges in other areas. In the end, the photos were displayed, both virtually and physically, sized relative to their rank in the judging scheme. […] Interestingly, the top ten photos selected by judges of all levels of self-reported art knowledge included eight of the same images, suggesting that ‘crowds’ of people with little art knowledge are likely to make comparable choices to those made by experts” (Simon 2010, 116)
Click! served many purposes all at once. It provided a participatory platform for visitors to express their artistic perspectives on their community. It placed the power of authority in the hands of the visitors (instead of curators) to judge and select the best photographs. It provided a physical space in the Museum and a virtual online space for contributors to take pride in their work and share it with others. And it also served as an evaluation tool for the Museum to better understand the differences and similarities between people from different geographic regions and with different artistic backgrounds.

In this era of increasingly social networks and interactive websites, “public participation is taking different forms at different museums” (Vogel 2011). The American Museum of Natural History invited visitors to participate in their first Tweetup in January; visitors were invited to an free after-hours wine and cheese event to talk with curators about the exhibit The Brain: The Inside Story; the only requirement was to post tweets about the experience on Twitter (Preston 2011). The Metropolitan Museum of Art posted a video on their website and Facebook page of a young staff member discussing some of the Museum’s works that she finds the most romantic for “Date Night” on Valentine’s Day; almost instantly, over 100 fans “liked” the Facebook posting (Vogel 2011). Museums are finding that the tools of social media can be useful to not only “expand marketing and development efforts, but to also listen to visitors and involve them in the creative process” (Preston 2011).

Summary

Museum professionals have increasingly recognized the social aspects of learning and have addressed them by designing increasingly social experiences mediated through
objects, people, and technology. With the advent of the Internet and all of its connective power, technology has come to provide increasingly social opportunities. With the evolution of personal handheld devices, technology has come to provide increasingly personalized opportunities. When museums skillfully connect to social media platforms like Facebook and Twitter, they are plugging into an existing system of personalized networks of social interactions. When museums skillfully implement interpretation through the vehicle of visitors’ own mobile devices, they are connecting through a personalized entry point. While the Internet, social media, and mobile devices all provide opportunities for museums to provide content to visitors, they also provide opportunities for museums to better understand their visitors, to involve their visitors in participatory experiences, and to evaluate those interactions.

IV. Proposed Technology’s Potential for Participation

Because the proposed technology has the ability to connect to the Internet and social media sites, it has inherent potentials to connect visitors to museums and to each other. Visitors can post questions to museums, rate exhibits, “like” exhibits, take and share photos of themselves interacting with exhibits, and share information with their friends through email, Facebook, Twitter. Like the American Museum of Natural History’s Tweetup behind-the-scenes evening event, these social media platforms, accessible anywhere on smartphones, may be leveraged as a way to advertise for special events and become an integral part of such events.

Different approaches may be thoughtfully designed to help structure opportunities for visitor feedback to increase the usability and level of engagement for such
experiences. For example, when visitors walk into a gallery hall, the location-aware proposed technology could prompt them to answer a question about the gallery’s subject (e.g. “What are the first three words that come to mind when you think of the Amazon River?”). Responses could be projected as real-time word clouds at the gallery entrance, allowing visitors to see an immediate visualization of their responses in context with other visitors’ responses. By providing an immediate visualization of reflective responses, this scenario might help spur conversations related to a given prompt. Depending on the physical layout of a gallery space, these word cloud projections could even be constructed as pre- and post-test interactions, prompting visitors before they walk into a gallery and as they are leaving to allow visitors see how the exhibit might have influenced people’s ideas.

In addition to projecting word clouds, museums could also project live feeds of comments and feedback for other types of prompts like, “Please complete the sentence: Before this exhibit, I never realized…” allowing visitors to see their own responses immediately (and anonymously) displayed. Algorithms could be developed to automatically sort these projected responses into different clusters. In this way, visitors could see other people’s thoughts and react to them. For prompts like, “What would you like to know more about?” responses could be projected, and a museum staff person could actually respond to them in real time. Of course this would require staff time and might not be a sustainable approach, but it would be one solution to quickly close the feedback loop between visitors and museums. “Too many participatory projects have broken feedback loops, where the ability to see the results of participation are stalled by opaque and slow-moving staff activities like content moderation or editing. […] If a
delay is required, it should be communicated clearly to participants” (Simon 2009, 19). In soliciting visitors to provide feedback for museums via smartphone apps, it will be important for museums to consider how they will respond to these comments and how they will communicate that process to the visitors.

The proposed technology could also enable recommendation engines to offer personalized suggestions for visitors depending on their interests. These suggestions could even be specific to the time of visit: when an individual opens the app and inputs their demographic information (e.g. I’m visiting with children), the app might offer a recommendation based on what other visitors have been doing that day (e.g. Families with children visiting the museum today have spent the most time at the following five exhibits…).

The abilities for the proposed smartphone technology to provide multi-modal layers of information as well as various opportunities for social participation fit into the three different spheres of Falk and Dierking’s Contextual Model of Learning. The proposed technology fits into the personal context of learning by: (1) allowing visitors to easily access information about the museum ahead of time, serving as advance organizers, (2) allowing visitors to access additional information about whatever exhibits appeal to their existing interests and experiences, and (3) allowing visitors to access and explore different modes of information like text, images, audio, and video. In the sociocultural context of learning, the proposed technology serves to: (1) provide conversational prompts to encourage visitors to converse with other visitors (likely those that are in their group), (2) provide access to social media and online sharing, and (3) provide structured opportunities for visitors to provide, and allow that feedback to be
socially aggregated and visualized. The design of the technology, using the technology in the space of the museum, using it to access location-aware information about exhibits, and using the technology to help navigate through the museum all play into the physical context of learning.

Special attention should be paid to the design of visitor feedback prompts to a clear communication of how and when museums will use and respond to feedback. Observational studies should be conducted to assess how different technologically-enabled participation (like providing feedback that is shown in a word cloud) can lead to person-to-person interactions and participation. Ideally, museums will use the proposed technology to offer structured, specific, personal, and transparent opportunities for technological interactions that can easily lead to face-to-face interactions between visitors.
5. Museum Evaluation & Evaluators

   I. History and Applications of Evaluation
   II. Types of Evaluation
   III. Interviews with Museum Evaluators
   IV. Role of Evaluators Today

The purpose of this chapter is to provide an overarching framework for how the proposed technology could aid in museum evaluation. To build this framework, this chapter addresses the history, types, and general uses of museum evaluation. It introduces the eighteen museum evaluators who were interviewed for this thesis, and enumerates upon the protocols and goals of these interviews.

I. History and Applications of Evaluation

History of Evaluating Visitors in Museums

A few museum professionals were publishing research about visitor behavior as early as the 1920s and 1930s (Melton 1935, 1936; Robinson 1928). Evaluation publications were released by Harris Shettel in the 1950s; Chandler Screven and Robert Bechtel in the 1960s; and Ross Loomis, Michael O’Hare, and Beverly Serrell in the 1970s. Though this list is not exhaustive, the number of people devoting their attention to the field of museum evaluation was fairly sparse until the 1980s. By 1988, there were enough individuals contributing to this work to form the Visitor Studies Association (VSA), a professional organization devoted to increasing the awareness and competencies related to research and evaluation of visitors. Since the formation of VSA, visitor studies have become increasingly recognized by museums as an important field of study, and an
increasing number of museums have formed internal departments solely dedicated to researching and evaluating their visitors.

**Applications of Evaluation**

Wikipedia defines evaluation as a “systematic determination of merit, worth, and significance of something or someone using criteria against a set of standards… [it] is the comparison of actual project impacts against the agreed strategic plans” (“Evaluation”). By definition, evaluation aims to develop a better understanding of an audience, situation, or project. As informal educational institutions, museums often conduct evaluation that focuses on learning: understanding visitors’ behaviors, attitudes, knowledge, and interests related to museum experiences. Museum evaluation may be used to aid in the understanding of many different components of museums’ public activities may be evaluated to inform the practices of many different departments including exhibits, educational programs, marketing, membership, guest services and more. Evaluation may be used to help exhibit developers and designers to create better interpretive materials and physical elements and to understand the impacts of these efforts. Educational programs can use evaluation to create more effective and impactful programs. Marketing departments can use evaluation in order to reach broader audiences and draw more visitors into their institutions. When museums are renovated, architects might request museums to conduct evaluation to better understand how the physical layout and elements of the museum building affect visitors. Often times, funding agencies and sponsors require museums to conduct evaluation to assess the success of the projects they have helped enable. Evaluation can help guest services departments
understand how to create more satisfactory experiences for visitors and can help gift stores and cafés increase their sales. Evaluation can also be used as a unifying force to ensure that multiple departments are all working towards the same goals and help them understand their combined impacts.

Eleven museum evaluators directly responded to the question, “What stakeholders do your evaluation projects most affect? What museum departments do you most frequently work with?” These respondents listed anywhere from one to six departments. One hundred percent of them (11 people) listed exhibits or interpretation, 82% (9) listed education or programs, 55% (6) listed marketing, and 9% (1) mentioned the following: fundraising, membership, administrators, grant writers, actors, guest services, curators, gift store, administrators, and the café. Though not every respondent listed guest services or curators, this may not mean that they do not interact with these departments, but that they may not interact very often with such entities. However, there was a clear trend that the respondents view their work most impacts the efforts of exhibits, education, and marketing teams.

II. Types of Evaluation

While museum evaluation can serve to inform the practices and efforts of many departments, different types and methods of evaluation will likely be applied for different purposes and projects. Evaluation is broken into different categories among different contexts: the timing of the evaluation in relation to the project, the type of information gathered, and the tools used to collect that information.
Front-End, Formative, Remedial, & Summative

In the context of timing, *front-end evaluation* is conducted before fully undertaking a project in order to understand how potential audiences might react to the proposed project. Though other tools may be used, surveys and interviews are commonly used in order to develop a foundational understanding of a targeted audience and their feelings, existing knowledge, and attitudes towards a proposed topic.

*Formative evaluation* is conducted during the development of a project to understand visitors’ responses to prototypes, drafts, or models of interpretive material that may include label text, graphics, or interactive elements. Formative evaluation may be conducted in iterative stages to make layers of revisions to improve the material at hand. Interviews or talk-aloud exercises may be conducted to hear people’s thoughts about the material, or observational studies may be conducted to observe how people naturally interact with the material.

*Remedial evaluation* is conducted shortly after a project is completed to identify and improve problematic areas. After an exhibit opens, it may become apparent that labels are placed at the wrong height, or lighting should be changed, or that the placement of signposts is blocking the flow of visitors’ movements. The problems and solutions identified in remedial evaluation are typically fairly simple issues.

*Summative evaluation* is conducted after a project is completed in order to understand its impacts. “Summative evaluation can be as simple as documenting who visits an exhibit or participates in a program, or it can be as complex as a study of what visitors learned. Generally, the results of summative evaluation will be used to improve future activities through an understanding of existing programs.” (Diamond et al. 2009,
4). To understand the overall impacts of a project, a wide variety of tools may be used including: surveys, interviews, observational studies, focus groups, and pre- and post-testing. When grant funding agencies and independent sponsors ask institutions to conduct evaluation, it is often in the context of summative evaluation to understand the overall impacts of the funded project.

**Qualitative & Quantitative Methodologies and Types of Tools**

As with many disciplines, qualitative and quantitative methodologies may be applied in museum evaluation to categorize and understand different types of data. Dealing with countable data, *quantitative methods* aim to categorize pieces of information into distinct groupings. Numerical and statistical comparisons can then be applied to these categories in order to understand relationships and differences between them.

*Qualitative methods* focus on in-depth explanations and complex problems; they are used to understand information that cannot easily be categorized and separated into discrete groupings. Qualitative methods often use open-ended questions that elicit longer, detailed narrative. Direct quotations and detailed observations of behaviors may be used in qualitative methods.

All of the eighteen evaluators interviewed for this thesis use a mixed-methods approach to evaluation; they employ a range of methods and tools that utilize both qualitative and quantitative techniques. In this way, they are able to achieve a deeper understanding of different facets of big questions. “For example, a single evaluation study may use qualitative methods to generate ideas, categories, and questions, while at
the same time it uses quantitative methods to verify those results for a larger population” (Diamond et al. 2009, 46). For one project, an evaluation team may conduct interviews, observational studies, and surveys. By triangulating their approach, evaluators can corroborate their findings if they acquire similar results through multiple avenues. The findings derived from one tool might shed light on a similar issue identified through another tool.

The following are common tools used by evaluators. Most of these tools can provide both quantitative and qualitative data depending on how they are designed.

- **Surveys or questionnaires** can be distributed people who are not in the physical museum and do not require an evaluator to be actively involved in the collection of data. They are often structured to include numerical ratings and discrete categories (yielding quantitative results), but can also include open-ended questions. They can be administered using paper or can be made available online. Museums can actively distribute them (e.g. using a volunteer or employee to hand them out to visitors), or can passively make them available (e.g. leaving a stack of them somewhere in the museum).

- **Interviews** can be conducted to gather more in-depth responses. Interviews can be very open-ended, allowing the respondent to direct the conversation; they can be highly structured, requiring the respondent and questioner to strictly adhere to a discrete set of questions; or they can be semi-structured, allowing respondents to respond to questions within a flexible framework.

- **Focus groups** gather together multiple participants, who usually share a common demographic feature or interest, to engage in group conversations under the facilitation of an evaluator. These conversations usually take the form of a semi-structured group interview and are often implemented when researchers wish to understand the attitudes, knowledge, or behaviors of a certain target audience.

- **Talk-aloud exercises** are a kind of guided interview in which the participant narrates their process as they go about interacting with a certain element. For
example, in developing a new physical interactive at a science center, evaluators may conduct formative evaluation in the form of talk-aloud exercises to understand how visitors think they are supposed to interact with the exhibit, and then they might change the design to make it more intuitive for users.

• **Observational studies** involve researchers observing visitors. These observations can be done in person (either unobtrusively or with the visitors’ knowledge), can use videotapes, or other methods. Tracking and timing studies fall under the umbrella of observational studies and are used to track visitors’ movements and time their stops throughout exhibit spaces. Behaviors like pointing, bending, talking, engaging with interactive elements, and laughing may be recorded. Researchers may also attempt to listen to visitors’ conversations.

• **Card sorts** usually feature graphics and words on cards and visitors are asked to select or categorize them according to specific question prompts. This tool provides an interactive element for respondents to identify and select their responses to questions that have discrete categories of answers. Evaluators might ask respondents to rank five cards of graphics according to which image they would find most exciting on a billboard.

• **Comment cards** can be used as a survey with only one or two questions. These cards can be actively or passively distributed, and can be deposited into a box, to a person, through the mail, or through a publicly visible medium like a corkboard. Comment cards can have predetermined answers for respondents to select, can be open and general (e.g. “Leave a comment about your museum experience”), or can be open and more specific (e.g. “If you were a millionaire in this city in the 1920s, what would you have done with your wealth?”).

Though there are many other tools for conducting museum evaluation, these are some of the most common and widely used techniques and have more direct implications for using the proposed technology to serve as an evaluation tool. Some
other techniques include personal meaning mapping, relationship maps, and pre- and post-tests.

III. Interviews with Museum Evaluators

For this thesis, eighteen museum evaluators were interviewed about: (1) their backgrounds in evaluation, (2) their experiences with tracking, timing, and observational evaluation, (3) their experiences with using visitor feedback in evaluation, (4) their views on general technology and usage of technology in their evaluation practice, and (5) their views and opinions on using the proposed technology as a tool for evaluation.

Interviewing Protocols and Goals

Sixteen semi-structured interviews were conducted with eighteen museum evaluators; two of the interviews included two evaluators who responded to questions together in the context of evaluation within their institutions. Respondents were selected based on publications that listed them as museum evaluators with experience in tracking and timing, or were identified through personal referrals. After respondents indicated interest in participating in the study, they were provided with an informed consent form and a list of questions. This list included five sections of questions (listed above), and each of these sections included at least five questions. To view the consent form and the complete list of these questions, refer to Appendices A and B, respectively. During these interviews, respondents were asked to respond to the five sections of questions, but it was acceptable for them to expound upon issues not explicitly stated in the questions, or to omit some questions. In this way, the interviews were semi-structured; some respondents
adhered to the list of questions more closely, while others responded in a more naturalistic manner. Interviews lasted between 54-119 minutes; all of them were audio-recorded and sections of interviews were transcribed. In the consent forms, respondents selected the degree of anonymity to which they would like to be cited, including options to remain completely anonymous, be referenced only in the bibliography, quoted anonymously, or quoted directly by name. Quotes provided without a named citation reflect the views of respondents who were happy to be quoted but wished for their quotes to remain anonymous.

The goals of these interviews were to develop a professional framework in which to investigate the potential benefits and challenges of using the proposed technology as a tool for museum evaluation with focal points on the areas of tracking and timing and different forms of visitor feedback. In order to compare the potentials of the proposed technology to correlative methodologies of tracking and timing and visitor feedback, respondents were asked to describe their experiences with evaluation projects within these two contexts. In order to better understand how the proposed technology might fit into the respondents’ existing toolsets, they were asked to describe the technologies that they rely on as evaluators. In order to better understand their views about technology in terms of the visitor experience, they were asked to provide examples of effective and ineffective uses of exhibit-related technology. A general description of the proposed technology was provided in the list of interview questions, and respondents were given the opportunity to ask the interviewer questions about the proposed technology before the interviewer asked to hear the respondents’ opinions and perspectives about the proposed technology. In order to provide a context in which to understand respondents’ answers to
the sections of questions described above, they were also asked to provide information about their backgrounds in evaluation.

Of the 18 respondents, 11 were interviewed in person and 7 were interviewed over the phone. The respondents included 15 females and 3 males. This high ratio of females is not altogether surprising; the *2009 Directory of Audience Research and Evaluators* lists approximately 24 females and 13 males (AAM CARE 2009). Though the ratio of females to males is higher for this thesis than it seems to be for the field of museum evaluation, it does not seem entirely misrepresentative of the field.

**Evaluators’ Experience**

Of the 18 respondents, 56% of them (10 people) currently work in-house for museum institutions, and 44% (8 people) currently work as independent evaluation consultants, either self-employed or with an independent organization. Of the 10 in-house evaluators, 20% (2) of them incorporate evaluation into their work but are not specifically titled as evaluators, and 20% (2) of them have previously worked as external evaluation consultants. Of the 8 independent evaluators, 38% (3) of them are not solely evaluators, and 50% (4) of them have previously worked as in-house evaluators within museum institutions.

<table>
<thead>
<tr>
<th></th>
<th>Percent of 18 Total Respondents</th>
<th>Those w/ previous experience in the opposite evaluation sector</th>
<th>Those whose title is not purely “evaluator”</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>In-House Evaluator</strong></td>
<td>56% of total respondents (10 people)</td>
<td>20% of the in-house evaluators (2/10)</td>
<td>20% of the in-house evaluators (2/10)</td>
</tr>
<tr>
<td><strong>Independent Consultant</strong></td>
<td>44% of the total respondents (8 people)</td>
<td>50% of the independent consultants (4/8)</td>
<td>37.5% of the independent consultants (3/8)</td>
</tr>
</tbody>
</table>

**Table 1. Work experience of in-house versus independent evaluators**
The pool of respondents reflected educational backgrounds ranging from bachelor’s degrees to doctoral degrees with predominant foci in Museum Studies and Psychology. A few of the in-house evaluators hold doctorate or bachelor’s degrees, but the majority hold master’s degrees; most of their degrees are either in Museum Studies or other areas such as Planetary Science, Zoology, Computer Science, or Education. Of the independent consultants, the majority of them hold doctorate degrees in applied or social psychology. The fact that more independent consultants hold doctorate degrees is not surprising because these individuals are typically hired as experts who can offer more specialized skills and experiences than can be found in-house at a museum. The table below summarizes the educational backgrounds of the respondents.

<table>
<thead>
<tr>
<th></th>
<th>PhD</th>
<th>Master’s</th>
<th>Bach.</th>
<th>Museum Studies</th>
<th>Psych.*</th>
<th>Other*</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-House Evaluators (10)</td>
<td>20% (2 people)</td>
<td>70% (7)</td>
<td>10% (1)</td>
<td>40% (4)</td>
<td>20% (2)</td>
<td>40% (4)</td>
</tr>
<tr>
<td>Independent Consultants (8)</td>
<td>62.5% (5 people)</td>
<td>25% (2)</td>
<td>12.5% (1)</td>
<td>25% (2)</td>
<td>62.5% (5)</td>
<td>12.5% (1)</td>
</tr>
<tr>
<td>Combined Total (18)</td>
<td>39% (7 people)</td>
<td>50% (9)</td>
<td>11% (2)</td>
<td>33% (6)</td>
<td>39% (7)</td>
<td>28% (5)</td>
</tr>
</tbody>
</table>

**Table 2. Educational backgrounds of respondents.** All of these degrees and subject foci reflect the highest degrees received by respondents. *The degrees represented in the Psychology category include applied psychology, social psychology, and educational psychology. The “Other” category includes Education, Planetary Science, Zoology, Computer Science, and Instructional Systems Technology.*

The 18 respondents reflected a range expertise ranging from those who have just entered the field to those who have been practicing and publishing in the field of museum
evaluation for multiple decades. The table below summarizes the number of years the respondents have been working as museum evaluators.

<table>
<thead>
<tr>
<th>Range</th>
<th>1-40 years of experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>14 years</td>
</tr>
<tr>
<td>Mean</td>
<td>15.8 years</td>
</tr>
</tbody>
</table>

Table 3. Years of experience practicing museum evaluation

Organizations Represented

The 8 respondents who work as independent consultants represent organizations including Randi Korn & Associates, Inc., the Institute for Learning Innovation, Selinda Research Associates, Visitor Studies Services, Wells Resources, Inc., and other private practices. The 10 respondents who work in-house represent 8 different institutions: Chicago’s John G. Shedd Aquarium, the Denver Museum of Nature and Science, the Museum of Science in Boston, the Saint Louis Science Center, the Children’s Museum of Indianapolis, the University of Nebraska State Museum, the Fort Collins Museum & Discovery Science Center, and San Francisco’s Exploratorium. According to interview responses and annual reports dating from 2007 to 2010 these institutions’ annual attendance varies from around 50,000 to 1.8 million. Two of the institutions attract fewer than 100,000 annual visitors (50,000 and 83,500); one institution attracts around 544,000 annual visitors; and five of the institutions attract over 1 million visitors (1.0, 1.2, 1.25, 1.7, and 1.8 million).

These institutions exhibit varying degrees and types of exhibits and collections, ranging from foci on natural history collections to live exhibits of animals to hands-on
interactive exhibits to combinations of these. While these institutions vary in their approach to exhibits, the content of all of these institutions is at least partially, if not completely, science-related. Half of these institutions also have exhibits and collections specifically related to culture, anthropology, or history.

Of the 8 independent evaluators who participated in these interviews, all of them reported that they work with a wide array of types and sizes of institutions, but 6 of them (75%) qualified this statement to highlight that most of their work is for science-related institutions. As expressed by multiple respondents, this weight placed on science institutions may be the result of grants funded by science organizations that require institutions to conduct evaluation, and sometimes specifically require this evaluation to be conducted by external evaluators.

This heavy focus on science, partial focus on cultural history, and lack of focus on fine art is not entirely surprising. In the 2009 Directory of Audience Research and Evaluators, there is a listing of in-house evaluators that categorizes them by type of institution. While many of these evaluators are cross-listed because they have had experience with multiple types of institutions, comparing their listed positions at the time of this publication results in the following approximations: about 56% (5 people) work in science-related institutions including aquariums, zoos, natural history museums, and science centers; 33% (3 people) work in cultural, history, or anthropology-related institutions; and 11% (1 person) work in an art museum (AAM CARE). In multiple interviews, respondents (both in-house and independent evaluators) mentioned that science-related institutions often place more emphasis on evaluation due to the
requirements of grants that they procure from agencies like the National Science Foundation.

IV. Role of Evaluators Today

In order to understand the tone and direction of museum evaluation today, the 18 respondents were each asked, “What do you think is the most important role of a museum evaluator?” Though exact words and phrases varied, two main answers emerged: (1) evaluators act as the visitor advocate to the rest of the institutions, and (2) evaluators inform an institution’s overall practices and decision-making process. One respondent replied that grants were the most important part of being an evaluator. While these two main responses could be viewed as intricately intertwined, it was interesting that they were expressed so clearly and distinctly. A few respondents actually made a point to distinctly list both of these roles in their response.

In reviewing literature from the field of museum evaluation, it is not surprising that these two answers emerged so clearly. The 1996 *Current Trends in Audience Research and Evaluation* states, “The unifying thread in this enterprise [of museum evaluation] has been a commitment to understand visitors to our multiple cultural institutions and, thereby, give them a voice” (ii). In the *Introduction to Museum Evaluation*, Minda Borun and Randi Korn claim, “Bridging the gap between visitors’ expectations and needs and the museum’s goals is the province of audience research and evaluation” (1999, vii). In the foreword to Beverly Serrell’s *Paying Attention*, Stephen Weil explains,

> Whereas it was once thought self-evident that museums were worthwhile institutions, they are increasingly faced with an unprecedented demand to explain to their resources providers exactly what sorts of results they are capable of producing. In part this problem is definitional. Museums
need to be able to explain in ways they have not hitherto had to do just what it is they are trying to accomplish. In perhaps equal part, however, the problem is methodological. Once a museum has defined what it is trying to do, how can its actual effectiveness be judged? (1996, vii)

Multiple authors in the field have expressed and articulated the twofold focus of museum evaluation to (1) close the gap between museums and their visitors and to (2) identify how to achieve these goals and measure their effectiveness.

While it is not surprising that the respondents, like other authors in the field, expressed these two key purposes of evaluation, it was interesting to find that there were clear trends amongst which populations (in-house and independent evaluators) provided these two main responses. As exhibited in the previous section, the evaluators interviewed for this thesis represent both in-house and independent evaluators who possess a range of experience and expertise. The trends in their educational backgrounds, as well as the nature of their job positions likely affect how they view their roles in museum evaluation. In-house evaluators generally described the most important role of a museum evaluator as being an advocate for the visitor, while the answers provided by independent evaluators focused on facilitating decision-making and informing process. The table below summarizes the participants’ responses.

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>In-House</strong> (10 people)</td>
<td>60% (6)</td>
<td>20% (2)</td>
<td>20% (2)</td>
<td>10% (1)</td>
</tr>
<tr>
<td><strong>Independent</strong> (8 people)</td>
<td>0%</td>
<td>75% (6)</td>
<td>25% (2)</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Total</strong> (18 people)</td>
<td>33% (6)</td>
<td>44% (8)</td>
<td>17% (3)</td>
<td>6% (1)</td>
</tr>
</tbody>
</table>

Table 4. View on the primarily role of the museum evaluator
Volume for the Voice of the Visitor

By nature of their position, in-house evaluators continuously work on projects within their institution and are guided by directives to help their institution better achieve their goals, objectives, and missions, and these missions have increasingly become more focused on connecting with visitors. Typically, these in-house evaluators work with multiple departments whose efforts relate to the visitor experience: exhibits, education, marketing, membership, guest services. The success of these visitor-related departments hinges upon their understanding of the visitors, and evaluators serve to help these departments be more successful. Therefore, it is not surprising that when asked, “What do you think is the most important role of a museum evaluator?” most of the answers provided by in-house evaluators focused on the visitor. Also, many of these in-house evaluators have degrees in Museum Studies and previous experience in museum education, areas that often place emphasis and the relationships between museums and their visitors. Common terms and phrases used by respondents whose answers focused on the visitor included:

- Serve as the *voice of the visitor*
- Be a *visitor advocate*
- Be a *bridge or channel* between visitors and museum staff
- Provide *checks and balances* between visitors and museum staff
- Represent the variety and types of visitors
- Gather visitor feedback and incorporate it into staff practices

Below are some of the exact responses provided to the question: “What do you think is the most important role of a museum evaluator?”

- Be the bridge between what staff [present] and how visitors react… Museum evaluators provide that check and balance. [They ask and answer questions like:] Did this idea come
across the way it was intended? How are visitors reacting to what we have presented? Do they understand it; do they not? Are they engaging in a way that we can take advantage of it? Are we doing what we wanted to? Is there something else we should be doing that we’re not? [Evaluation] really [places a] camera on the visitors…. It connects the two audiences [of museum staff and visitors.]

• (Bowell 2011)

• Be a visitor advocate… we hold up a mirror and say “This is what our visitors look like”… the most important role is to literally be the visitors’ voice… To show people [other staff] what visitors are actually experiencing. (Trainer 2011)

• … Building the bridge between the visitor, the public, and the museum staff. I think a lot of times there’s a disconnect. There are not many channels to do that, and the evaluator is one of those channels that can be an advocate for the visitor. (Jakubowski 2011)

• We consider ourselves the voice of the visitor. We’re there to gather visitor feedback, figure out what visitors are learning and what they’re doing, and make sure that voice is incorporated into the museum’s practices. (Anonymous respondent 2011)

• Really be a voice for the visitor in the planning and decision making of the institution. To represent the diversity of types of visitors… not just demographically… but also the different ways in which they learn, what knowledge they may or may not have about a given topic, and bringing all of that to the table when we’re developing something new or refining something… Reminding everyone who our visitors are. (Anonymous respondent 2011)

• Remain the neutral party that always keeps the visitors in mind. (Anonymous respondent 2011)

• Help museum [staff] get in touch with their audiences. (Loomis 2011)

**Informing Practice and Decision-Making**

External evaluators are often hired to provide expertise that does not exist in-house, teach museum staff new ways to improve their practices, and provide fresh, new perspectives and ideas. As displayed in the previous section, many of these external evaluators have doctorate degrees and backgrounds in applied psychology, a field that emphasizes scientific and statistical methodologies to understand human behavior. It is not surprising that when asked, “What do you think is the most important role of a museum evaluator?” these independent evaluation consultants more often emphasized their roles to inform the decision-making process, facilitate problem-solving, and improve process. External evaluators have the opportunity to offer guidance to the way
decisions are made between many departments within entire institutions. Based on their responses, their focus tends to be more about how to build that bridge between museum staff and visitors, identifying the type of bridge that is best for the situation, and identifying the best tools for building that bridge. The common terms and phrases used by those who emphasized process included:

- Inform planning and decision-making
- Understand impacts
- Help museum staff get better at what they do
- Build internal capacity for understanding how to improve
- Teach people how to think from an evaluation perspective
- Help staff be more reflective about what’s working, what’s not working, and why
- Develop instruments and guidance
- Help make problems/questions and answers/solutions more obvious
- Provide ways to better measure and achieve goals and objectives
- Help make the best programs and exhibits possible

Below are some of the exact responses respondents provided to the question, “What do you think is the most important role of a museum evaluator?”

- Help teams make more informed decisions. I don’t see evaluation as driving the decisions that are made, but really it’s… a very important layer to the decision making process… it increases the level of confidence, especially on really big expensive projects that are complex and complicated… there shouldn’t be any big surprises, you hope…. Evaluation is not asking the visitors to make decisions for you; it’s inviting them to provide feedback for you in a way that will be most helpful. (Anonymous respondent 2011)

- Help development teams make better, informed decisions so that they can make the best kinds of exhibits or programs [possible]… Evaluation is only a tool to help with exhibition or program development… [It’s] a process to get to something else. (Anonymous respondent 2011)

- Thinking [from an evaluation perspective]… It goes from the planning of a project—stepping back and helping staff think about what they want to achieve from the project—what are the goals and objectives, what do you want visitors to take away from the experience? Help staff clearly articulate objectives and develop a way to measure those goals… Provide practical information that museum educators and exhibit developers can
use to improve… Really inform their practice and help museum staff be reflective about what they do. (Anonymous respondent 2011)

- Inform planning and decision-making. (Wells 2011)

- …Synthesize what’s out there to help build internal capacity, almost to act as a filter for internal staff for those who don’t have the time or background to learn about the field [of museum evaluation]… [Help identify] what’s important for this particular project, what’s important to communicate to these people, what do they know, what do they not know. (Jakubowski 2011)

- You’re in a service position. Try to aid in the decision-making process. (Loomis 2011)

- Really help people [museum staff] make decisions. Help [them] be in a better position to be reflective about their own process… Help them understand what impact they’re having, and [encourage them] to think more about the impacts that they want to have… I really like to help people get better at what they do. (McNamara 2011)

**Summary**

Evaluation serves two key purposes: (1) to build a bridge between museum staff and visitors, and (2) inform decision-making and planning about how to accomplish goals and objectives. Another key purpose may be to acquire and fulfill grants. Some institutions have full time staff whose roles are purely dedicated to evaluation, some institutions have staff who incorporate evaluation into their other duties, and some institutions do not possess staff who focus on evaluation at all. Institutions within each of these categories may at times hire external evaluators to conduct evaluation projects. Independent external evaluators typically possess deeper knowledge and expertise and often focus on informing the decision-making processes within institutions. In general, museum evaluation serves to help museums understand their impacts and better achieve their goals, objectives, and missions.
6. Using Visitor Feedback in Evaluation

I. Applications, Considerations, & General Methodologies
II. Surveys
III. Interviews
IV. Comment Boards, Comment Cards, Card Sorts, & Focus Groups
V. Implications and Ideas for the Proposed Technology

In order to assess the proposed technology’s abilities to use visitor responses as an evaluation tool, existing methods are investigated in this chapter. Interview respondents were asked to provide examples of their previous evaluation projects that have utilized visitor responses. This chapter largely focuses the methodologies they described: surveys, interviews, and other methods like comment cards. After reviewing these methods, this chapter addresses how the proposed technology might be best designed to serve as a tool to evaluate visitor responses and feedback.

I. Applications, Considerations, & General Methodologies

Evaluation methods that rely heavily on visitor-generated responses can include: surveys, interviews, comment cards, comment boards, focus groups, and card sorts. These tools that utilize visitor feedback are often qualitative by nature; they can literally capture that “voice of the visitor,” and by doing such, they can sometimes paint a more holistic picture of exactly how visitors are feeling and responding to their experiences.

Emphasis is Usually Qualitative

Responses to surveys, interviews, and comment cards can sometimes be categorized or quantified depending on how they are presented (e.g. ratings and multiple-choice responses). Sometimes patterns of recurrent answers will emerge in the context of
short response open-ended questions. Take the question, “What exhibit in this gallery most closely corresponded with a recent conversation you’ve had?” A survey or interview might present this as an open-ended question, but a handful of discrete categories are likely to emerge based on the exhibits in the gallery, and responses can then be quantified according to these categories. That being said, evaluation methods that rely on visitor-generated responses often deal with words, and are often more qualitative in nature. In response to open-ended questions, visitors can express their feelings and thoughts in their own terms. In-depth, open-ended, unstructured interviews are the most qualitative method discussed here because they produce data that cannot be easily categorized or quantified. Though some evaluation techniques and projects represented in this chapter are more qualitative than others, they all have qualitative threads running through them. Kate Bowell expressed some of the benefits of these types of methods when she reported, “I’m a big fan of qualitative information… I think that museums are places that evoke emotion and memory and strong feelings and that [all of] that is best represented in qualitative data” (2011).

Speaking generally of open-ended methodologies, one interview respondent talked about using a “funnel approach” that is useful when there is not a lot of evaluation or information about a topic, or if you want to make sure you don’t miss an important component simply for not asking about it—“With the open-ended piece you have to be… working hard to cast a wide net and not go right to the specific questions that you want answered. First, just get people’s general feedback and then go specific… It’s more of a funnel approach” (Anonymous respondent 2011).
In this thesis, the term “visitor feedback” may include fairly simplistic and straightforward responses (e.g. “Likes,” ratings, or answers to questions like ‘What did you like best?’), but can also refer to more in-depth responses to more thought-provoking or emotionally-directed questions (e.g. ‘What questions were on your mind after seeing this exhibit?’ or ‘What about this exhibit made you feel uncomfortable?’). Some evaluators may draw a syntactical border between the words “feedback” and “data,” believing that feedback refers to the more surface-level questions of liking and disliking and that data refers to more in-depth, rich information. However, for the purposes of this thesis, “feedback,” “response,” and “data” are used interchangeably in this chapter.

**Practical Considerations**

While visitor feedback can provide evaluators with insightful glimpses into what visitors are really thinking and believing, these methods present some challenges for evaluators. Often times, it is a time consuming process to sort through these responses to make sense of them and use the findings in a useful way, especially for museums who do not have internal evaluation staff (Bowell 2011).

Evaluation methods that ask for visitors to provide responses onsite during a museum visit (e.g. answering a question about an exhibit using the proposed technology at a museum) present some concerns related to educational theory, particularly Falk and Dierking’s Contextual Model of Learning (2000). The Contextual Model of Learning states that individuals are able to better understand their experiences over a period of time, after they are able to reflect and connect a given experience to other experiences. Therefore, asking visitors to respond to questions about their museum experience in the moment may not accurately represent their attitudes. On the contrary, other museum
professionals, like Beverly Serrell, have argued that once visitors leave the museum, they are under the influence of many other factors, and that it is then difficult to differentiate what factors have contributed to their attitudes and beliefs (2011). Some evaluators and institutions use a combination of onsite and post-visit tools to address both of these perspectives. (Meluch 2011)

Another problem of asking visitors to respond onsite during a museum visit is that they often times are juggling many distractions. This is especially true for parents with young children. Sometimes these parents are monitoring multiple children of different ages, pushing strollers, and are on their way to other scheduled activities. These issues are often more apparent in children’s museums, zoos, and science centers whose constituencies are more largely comprised of families with young children.

When asking visitors to participate in an evaluation study, timing the interception of these visitors can be a logistical concern. For evaluation projects that deal with more comprehensive aspects of a museum visit, evaluators typically want to intercept visitors when they have completed their museum visit, but before the visitors have mentally moved on to the their next activity for the day. Visitors will likely be thinking about getting to their vehicle by the time they are right next to the exit, so a location a bit before the exit is sometimes the best place for evaluators to intercept these visitors (Meluch 2011).

If bilingual audiences are included in an evaluation, this inclusion can easily double the cost of an evaluation. In bilingual evaluations, special attention should be paid to understanding regional differences in languages, intergenerational differences, and differences in populations’ reading and speaking abilities (Meluch 2011.) In order to
accommodate for these kinds of variations, human-to-human interviews may be the best technique.

**Frequent Methodologies**

In the provided list of interview questions, respondents were asked to describe successful and challenging evaluation projects that relied on visitor feedback. In interviews, this question was further qualified: “Clearly this can include a broad range of techniques: surveys, interviews, comment boards, and more. The corollary to these methods in terms of the proposed technology would be allowing visitors to text comments or rank specific exhibit stops or answer specific questions related to different exhibit stops.” Because of time constraints, and maybe because the question related to too broad a spectrum of techniques, respondents tended to provide fewer details about these projects than with some of their other responses. The methodologies that were most frequently discussed were surveys and interviews, but other techniques like comment cards, comment boards, card sorts, and focus groups were also discussed. Some respondents spoke generally about such methodologies but did not describe any specific projects, while others provided one or two examples of specific evaluation projects related to specific exhibits or programs. A total of 12 descriptions of specific projects, and 13 descriptions of general methods were mentioned. The table below summarizes which types of projects were discussed the most frequently and whether these discussions related to specific projects or methodologies in general.
Table 5. Summary of described qualitative evaluation methods that rely on visitor feedback.

<table>
<thead>
<tr>
<th></th>
<th>Surveys</th>
<th>Interviews</th>
<th>Comment cards/boards</th>
<th>Card Sort</th>
<th>Focus Group</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Specific Project</strong> (12)</td>
<td>50% (6/12)</td>
<td>17% (2/12)</td>
<td>17% (2/12)</td>
<td>8% (1/12)</td>
<td>8% (1/12)</td>
<td>48% (12/25)</td>
</tr>
<tr>
<td><strong>General Methods</strong> (13)</td>
<td>23% (3/13)</td>
<td>69% (9/13)</td>
<td>8% (1/13)</td>
<td>0%</td>
<td>0%</td>
<td>52% (13/25)</td>
</tr>
<tr>
<td><strong>Total References</strong> (25)</td>
<td>36% (9/25)</td>
<td>44% (11/25)</td>
<td>12% (3/25)</td>
<td>4% (1/25)</td>
<td>4% (1/25)</td>
<td>100% (25/25)</td>
</tr>
</tbody>
</table>

In the section of the interviews relating to timing and tracking studies, many respondents talked about how they conduct short interviews or surveys with a visitor they have been unobtrusively timing and tracking, mostly to gather demographic data. It should be noted that these mentions of interviews and surveys are not included in this section, unless the respondent elaborated on these elements in response to the section of questions related to visitor feedback.

II. Surveys

As expressed in Table 4, out of the 25 total descriptions of projects and methods using visitor feedback, 36% (9/25) of these responses described surveys. Of these responses, 67% (6/9) described specific projects, and 33% (3/9) described survey methodologies in general. Some of the discussion topics related to paper versus digital forms of surveys, pairing surveys with other evaluation techniques, and how the results were used.
**Digital Versus Paper**

Of the 6 specific survey projects discussed, 67% (4/6) of them were administered through electronic mediums, and 33% (2) of them were administered on paper. Both of the paper survey projects were administered in the museum, and of the electronic surveys, 50% (2/4) were conducted in the museums and 50% (2/4) of them were made available online to be accessed at the visitors’ convenience. The electronic mediums all used digital survey forms like SurveyMonkey; two were made available online for visitors, one was featured on a digital kiosk within the museum, and one was conducted on iPod Touches by visitors within the institution. Some individuals expressed concerns that these types of digital formats resulted in lower rates of completion, and lower response rates in general. Also, it is more difficult to discern when someone (e.g., a child) is just messing around with an electronic survey compared to a handwritten paper survey (e.g., a card with scribbles on it). A great benefit of electronic surveys is their automated nature: evaluators simply have to download the responses and do not have to spend time entering data from paper surveys into a computer.

**Formative, Summative, & Big Picture**

The 6 specific survey projects were used in differing capacities: 17% (1) of them were used as a tool for formative evaluation, 33% (2) were used for summative evaluation, and 50% (3) were used to inform some “big picture” overall issues within museums. None of the specific examples were used for front-end evaluation. The formative evaluation survey was administered on iPod Touches and primarily asked respondents to rate titles and marketing images. The two summative surveys were parts
of bigger summative projects that evaluated new exhibit halls. Both of these summative projects also used tracking and timing studies, and the survey results were compared with the tracking and timing results to create a more comprehensive of visitor behavior and response to the exhibits. Two of the three surveys that related to “big picture” issues were surveys about visitors’ overall museum experiences.

The other “big picture” project, entitled Tracking Affect, was conducted at the Exploratorium and was a unique type of survey aimed at understanding the affective transitions of emotional demeanor that visitors experienced during their museum visit related to time and space. The evaluators of this project wished to understand how visitors were feeling throughout their visit: where were they feeling joyful, worried, disoriented, excited? Visitors were given paper forms and timers that sounded every twenty minutes. Every time the timer sounded, visitors were asked to list where they were in the building and place a check mark on the form under whichever emotional category best corresponded to how they were feeling at that moment. Assistant researchers attempted to track and time the respondents during their visits in order to create a more comprehensive understanding of their experience. Sixty people were randomly selected to take part in the study, and all but three of them completed the activity and took it seriously. Many of the visitors observed in this study used the activity as a focal point of dialogue and conversation within their social groups. While this study resulted in interesting information for evaluators, the evaluator reporting on this project did not feel that there were enough data points to make it a statistically valid study. Also, the implications of such a study are so broad and far-reaching that it could
be quite challenging to implement any major changes (such as architectural alterations) that would alter the affective experience of visitors.

Varying Degrees of Qualitative/Quantitative, Active/Passive, and Randomization

The survey projects and methodologies that respondents discussed reflected a range of qualitative and quantitative types of questions. Some of the surveys focused on open-ended questions that required visitors to provide qualitative descriptions of their feelings and attitudes, others asked respondents to provide quantitative ratings for different exhibit elements, titles, or images, and others provided multiple choice responses or selectable categories.

The surveys discussed also reflected a range of approaches for selecting the respondents. Some of the studies were randomized; evaluators actively selected visitors to take part in studies onsite or provide their email addresses to receive a survey later. Some surveys were made available through passive means; either stacks of paper surveys are placed in the museum or an electronic kiosk screen is placed somewhere in the museum and visitors can self-selectively choose to fill out surveys displayed on them. Other surveys might be distributed through the institution’s member email list. Randomization may be more important depending on what a project’s goals are and whom the results will be shared with. For example, if an institution is conducting evaluation research to fulfill the requirements of large grant (e.g. from the National Science Foundation), the methodologies of the study should be rigorous and statistically valid. A couple of the interview respondents reflected their beliefs that using volunteers and staff to actively distribute surveys and solicit participation can greatly aid in
increasing response rates and minimize the issues of self-selectivity that are inherent with passive surveys (Jakubowski 2011).

**Used By Different Departments**

The survey projects discussed were used to inform the practices of multiple departments: namely exhibits, education, and marketing. In descriptions of general survey methods, respondents from two institutions emphasized the importance of their work in conducting formative evaluation for exhibits departments. They often conduct surveys and interviews to help exhibits departments understand safety and usability issues of exhibits that are being developed. Open-ended survey questions can help education departments understand how effectively their programs are achieving stated learning objectives. Marketing departments can benefit from different demographic populations’ responses to imagery, titles, and slogans. Survey responses, particularly ratings and multiple-choice questions, can yield quantifiable data that can be transformed into visual graphs and presented to many different stakeholders and departments.

**III. Interviews**

Interviews were the most frequently discussed method of using visitor feedback. Out of the 25 descriptions of projects and methods using visitor feedback, 44% (11/25) of these responses described interviews. Of these 11 responses, only 18% (2/11) described specific projects, while the other 82% (9/11) mentioned general aspects of using interviews.
Structured to Naturalistic

The types of interviews discussed ranged from fairly structured to naturalistic and very open-ended. A more structured example was an interview conducted at the Denver Museum of Nature and Science about the exhibit *Amazon Voyage: Vicious Fishes and Other Riches*. This interview included six distinct open-ended questions with additional sub-questions, and was completed by 549 respondents. Some of the questions included: (a) Why did you decide to come to the Museum today? (b) What stood out to you or was memorable about *Amazon*? and (c) What do you think about *Amazon* being bilingual? The qualitative responses ranged from one word to a couple of sentences. These responses were coded, sorted, and quantified into categories of commonly expressed answers. (Trainer 2011)

This example utilized open-ended questions, and in the end, these qualitative responses were transformed into categories with associated numerical frequencies. Some other examples of interview techniques reflected more unstructured, naturalistic approaches. One independent evaluator commonly uses depth interviews with a very open-ended approach and a low amount of structure. She and her team of skilled interviewers start off with non-threatening questions to build rapport with the interviewee, and progress to more probing questions like “What kind of relationships did you see between this exhibit and other exhibits?” or “When you left the exhibit what kind of questions were going through your mind?” Then, interviewers will let the visitors’ interests guide the conversation, and the interviewers will ask questions that encourage the respondents to elaborate on their responses. Through a process called “inductive constant comparison,” interviewers begin analysis by comparing responses after each
new interview they conduct. Though patterns do emerge, this method of interviewing really focuses on the depth of response and allows interviewers to ask whatever questions will likely provoke the richest responses (Anonymous respondent 2011). This type of depth interview is conducted with smaller sample sizes than in the example of *Amazon Voyage*, but each interview is usually longer so that the researchers can understand the visitors’ experiences as fully as possible. For these longer types of interviews, a sample size of as few as six people can still be quite informative (Loomis 2011).

**Audio & Video Recording, Human Subjects Considerations**

A few respondents mentioned that they usually audio record interviews. Some independent evaluation groups regularly audio record interviews and then transcribe the interviews verbatim. In this way, they are able to capture respondents’ exact expressions and communicate them to various stakeholders. Ross Loomis mentioned the value of video recording interviews; evaluators can show these videos to stakeholders like curators who might not spend very much time interacting with public visitors (2011). Sharing audio and video recordings of actual respondents expressing themselves can sometimes help other staff members believe the results of a study more than they might if they were just presented with a written report of the findings (Loomis 2011).

Depending on the institution, Human Research Committees and Institutional Review Boards may need to be consulted to approve evaluation research that involves human subjects in any capacity. Video recording is especially of concern for Human Research Committees because participants can be personally identified through video recordings.
Used by different departments

Like other forms of evaluation, the interview methods and projects discussed by respondents can be used to gather information for multiple different departments within an institution. One respondent described an evaluation project at the Monterey Bay Aquarium that utilized in-depth interviews to understand people’s beliefs, attitudes, and misconceptions about sharks and rays. In these interviews, it became apparent that people were more interested in learning about sharks than rays. People also thought that to help sharks and rays, they simply needed to leave them alone. From this evaluation, the marketing department directed their efforts to focus on sharks in order to draw people into the exhibit, and the education and interpretation teams placed emphasis on active ways that people help in the conservation of sharks and rays. This is one example of how results from a single evaluation project, in this case in-depth interviews, can yield results that help inform the direction of multiple departments. (Anonymous respondent 2011)

Pros, Cons, and the Right People

Interviews may be the best evaluation tool for projects that demand an in-depth understanding of people’s ideas, beliefs, and attitudes. Sometimes, people are much more willing to talk about their ideas than they are to write about them, or type/text about them on an electronic device (Wells 2011). Interviews allow researchers to probe respondents to expound upon answers and to provide helpful contextual information that surveys cannot address. Because researchers can ask participants to clarify their responses in open-ended interviews, these interviews can achieve a high level of validity,
but because each interview will differ, the reliability is low (Wells 2011). “Validity refers to the notion that the instrument being developed is accurate and appropriate, given what you are trying to measure… reliability is a measure of how consistent a method is” (Diamond et al. 2009). In other words, interviewers can ask participants to clarify responses so that the researchers do not make inaccurate assumptions, but the types of information will likely differ from one respondent to another.

One clearly expressed problem with interviews is the need to have the right kind of person conduct the interviews. Of the 11 people who talked about interviews, 45% (5/11) of them, including Judy Diamond and Ross Loomis, expressed this need to have the right kind of people conduct interviews. One other respondent expressed this concern in the context of actively distributed surveys. One anonymous respondent reported that “interviews take the right person—it’s a higher skill set [than is required for tracking and timing].” The right person is friendly, approachable, not intimidating, and knows how to ask the right questions to prompt participants to elaborate on their ideas (Wolf & Tymitz 1979). Some respondents believe that this skill set is more innate and cannot really be taught. The right person also exhibits a fluency in talking differently to different audiences and personalities. For example, a good interviewer will change their tone and phrasing when interviewing a child, a young adult, a middle-aged parent, or an elderly person. As discussed previously in this chapter, bilingual audiences often exhibit a high degree of variation, even within individual family groups. To interview these audiences, a good interviewer is not only bilingual, but is also receptive enough to understand colloquial and intergenerational differences between visitors, and is flexible and skilled enough to respond to such differences.
IV. Comment Boards, Comment Cards, Card Sorts, & Focus Groups

Of the 25 examples of visitor feedback methods provided, 12% (3/25) related to comment boards, comment cards, or comment books. Of these, 67% (2/3) were about specific projects, and 33% (1/3) reflected general comments about such methods. Of the other responses, 4% (1/25) related to a specific example of a card sorting activity, and another 4% (1/25) related to a specific project that utilized focus groups.

**Comment Boards**

Of the 25 examples of visitor feedback methods provided, one of these examples was about a specific project that used a comment board. Some other examples of comment boards have been discussed as platforms for participation in Chapter 4, Participation and Technology. In this example, a comment board was used at the Fort Collins Museum and Discovery Science Center as a form of front-end evaluation to successfully inform the development of a new exhibit. Visitors were invited to share what came to mind when they thought of the American West. They wrote on sticky notes and posted them on the wall. Staff members had anticipated that visitors’ responses would reflect qualities of the “Old West” but were surprised by the volume of responses that related to the West today. This comment board helped inform the development process and steer it in a direction that would reflect the responses provided by their visitors. (Bowell 2011)

One drawback to these comment boards and comment books is that they typically are self-selective: participants voluntarily choose to fill out a card on their own accord, and these individuals are typically ones who are more strongly opinionated about the give
topic. Also, these mediums can be too unstructured, and it can be difficult to extract useful information from the responses. One of the independent evaluators talked generally about comment books and comment boards and noted the above drawbacks in her explanation of why she does not work much with these types of visitor-generated data. Also, as an external consultant, museums pay her consulting firm through funds separate from normal staff salaries. Typically, it is not financially worthwhile for museums to pay external evaluators to use methods that the internal staff may be more capable of conducting. (Anonymous respondent 2011)

**Comment Cards**

One of the 25 examples was an ongoing method of collecting visitor feedback through comment cards at the Saint Louis Science Center. Modeled after comment cards used by the May Company, these pre-stamped postcards include two prompts: (1) a 4-point scale in response to a statement about expectations that reads, “We want you to have a good visit to the Saint Louis Science Center. As part of our continuing efforts to see how we are doing, would you please tell us if your experience at the Science Center was…” with options ranging from ‘below expectations’ to ‘above expectations’ and (2) four blank lines for the prompt, “We would also be pleased to have any comments you may wish to make” (Israel 2011). The institution has been using these cards since 1996 and actively distributes them to random visitors throughout different parts of the institution. Some visitors fill them out and deposit them onsite at the institution, and others mail them back to the institution. Staff members distribute 2,000-7,000 cards a month, and about 100-200 cards are returned each month. The returned cards are coded
both for their tone and their topic. One of the main challenges is that sometimes the rating and the tone of the provided comments do not always match; it can be difficult to explain how the comment and the score relate to each other, and unlike interviews, there is no way to ask the respondents to clarify their responses. The results of the comment cards are shared with the rest of the institution in the monthly report and multiple departments (namely guest services, exhibits, education, and marketing) take action on issues that are raised. (Israel 2011)

Card Sorts and Focus Groups

One respondent mentioned a card sort activity that was used to learn whether people were surprised that certain factors impact human biology or evolution. This evaluator responded that this evaluation produced data that was not as helpful to the project team as intended because it was too complex; the methods used did not quite match the need (Anonymous respondent 2011). Another respondent talked about a project that was conducted for the development of child-focused interpretation at a new nature center. Focus groups of children were taken to eight nature centers and museums in the area. The children were asked to participate in a variety of activities and discussions related to each site. The data that was collected was used to create new child-centered interpretive principles for nature centers. (Wells 2011)

Summary

A variety of techniques may be used to gather responses from visitors to inform evaluation projects. Interviews and surveys were the most discussed methods, but comment boards, comment cards, and focus groups were also discussed as successful
examples of collecting feedback as well. All of these methods can exhibit varying
degrees of structure and abilities for randomization.

V. Implications and Ideas for the Proposed Technology

In the many examples and descriptions of techniques that rely on visitor-generated
responses, evaluators brought up issues of depth of responses, randomization, self-
selecting biases, and active and passive distribution of material. Based on their
descriptions and reflections on different methods of using visitor feedback, some
potentials and limitations for the proposed technology became evident.

Depth and Breadth of Responses

With the proposed technology, visitors’ interactions and feedback will be
mediated through smartphones. Smartphones have the ability to audio record, video
record, take still photos, and to receive textual information. While it would be possible
for visitors to leave audio and video commentary through smartphones, it is unlikely that
any visitor-generated responses (whether they be in the form of audio, video, or text) will
be as in-depth as in-person interviews. In-person interviews conducted by skilled
interviewers allow for a unique kind of in-depth qualitative exploration of visitors’ ideas
and beliefs. It is unlikely that any kind of evaluation technique could ever replace the in-
depth human-to-human interview. For evaluating bilingual audiences, interviews may be
the best solution because unlike technology, a skilled bilingual interviewer can respond to
differences in visitors’ language skills (e.g. reading versus speaking, colloquial, and
intergenerational language skills.
While, the medium of the smartphone may limit the depth of visitor responses, it may be able to accomplish a wide breadth of techniques all from one single device. The proposed technology could mimic aspects of surveys, comment cards, comment boards, and structured interviews. Multimedia smartphones are becoming increasingly familiar devices for many visitors, and in this way, they may serve as an easy entry point for visitors to engage with museums. Kate Bowell offers a perspective on how evaluation can be skillfully approached with visitors these days:

[Museums should] take advantage of technology that people are already using, especially those technologies that are already on the person’s body. [Museums should allow visitors to] use cell phones to dial a number or text responses… use surveys on Facebook…

I don’t want evaluation to ever impede the visitors’ experiences. [Museums should] find ways to make evaluation easy and fun so that it doesn’t feel like evaluation [to the visitor]. Social media is a good way to do this… [It can] redefine how visitors are either being evaluated or evaluating what's around them…[it] puts control in the visitor. Their unprompted responses and reactions become evaluation, while it seems like fun to the visitors. (2011)

Finding ways to solicit these unprompted responses in ways that are fun to the visitor, but useful to museum staff seems like a valuable approach for the proposed technology.

**Self-selecting Bias and Randomization**

For the ongoing, normal configuration of the proposed technology, visitors would be able to leave comments or rate exhibits on their own accord. When using these types of information in formal evaluation studies, the self-selective bias of this configuration should be acknowledged. As with comment cards and comment boards, evaluators may expect to see comments that are representative of more extremes: obvious satisfaction or obvious dissatisfaction. Though these comments may be useful, the methodological limitations of this type of data collection must be acknowledged and considered when developing conclusions from these responses.
If institutions wanted to use the proposed technology to collect data in a more methodologically structured manner for research (“with a capital R”), studies could be configured to increase the methodological validity. For example, a museum could retain a small fleet of their own smartphone devices (or iPod Touches). Visitors could be randomly invited to take part in a study, and would then be provided with one of the museum’s devices. They could use the device to explore multimodal layers of content, just like any other visitor using the museum’s smartphone app, but these visitors would agree to take part in, for this example’s sake, some survey questions. The proposed technology could be configured so that every time these particular visitors exited a gallery hall, three survey questions would pop up on their device. These questions might be open-ended short response questions, multiple-choice questions, or ratings. The subjects would then be random, and the survey questions they answer would be not be self-selective, voluntarily expressed reflections. The subjects could still voluntarily choose to leave self-selective feedback, but this information would not be included in the research study with the survey questions. The tracking and timing data related to these random subject participants could be paired with their survey responses to provide a more in-depth understanding of these visitors. This example will be addressed again as a way to reduce sampling bias in the next chapter, Tracking, Timing, and Observational Studies.

**Actively Encourage Participation**

A couple interview respondents talked about the benefits of actively distributing surveys, and actively inviting visitors to take part in evaluation studies (Jakubowski 2011). Wendy Meluch suggested that having a person (a volunteer or staff member) to
actively encourage and invite visitors to use the proposed technology to leave comments, ratings, and responses would likely increase the response rate and would help reduce the self-selection bias (2011). Using staff to actively encourage participation could be helpful for specially configured studies (like an exit survey for a new gallery hall), the continuous built-in features of leaving comments, or in interactive applications like the example of projected word clouds discussed in Chapter 4, Participation and Technology.

**Focus Groups and Focused Studies**

In studies that ask participants to complete series of activities or sequences of tasks, the proposed technology and smartphones in general could serve as a useful platform. For focus groups and specific studies, special features could be configured so that they were only accessible for those taking part in the given study. Marcella Wells commented that the proposed technology could be really beneficial in a study like the one she discussed that took focus groups of children to different museums and nature centers (2011). In this example, children could be asked to participate in activities on the smartphones at each site; potentially making the activity more exciting for the children (i.e. fancy interactive technology) and also making the data collection and entry more streamlined. The respondent who described *Tracking Affect*, believed that the proposed technology could have been really helpful in this study. Instead of using paper survey forms and timers, the museum could have invited random participants to use smartphone devices (their own or ones provided by the museum). Every twenty minutes, the smartphone could sound an alarm and automatically present questions and multiple-choice options for the participant to select their emotional demeanor. All of this
information could then be automatically matched with the participants’ tracking and timing information to understand how physical location and time of stay were impacting their emotional affect.

**Use Tools for Onsite and Post-Visit Responses**

For visitors who have their own smartphone device, evaluators may wish to develop tools that collect information from visitors while they are onsite and also after they leave the museum (e.g. three days later). In this way, museums could collect and compare the kind of responses provided in-the-moment and those provided after a period of reflection.

**Summary**

The proposed technology could serve as a platform for different types of qualitative studies including surveys, open-ended questions with short responses, focus groups, and virtual comment boards. On a regular basis, visitors could voluntarily leave comments about specific exhibit stops and natural language algorithms in the evaluation software could sort these comments automatically. This might help staff develop a better understanding of the attitudes of these self-selecting individuals. However, this data must be acknowledged as biased towards those who are self-selectively contributing their responses.

To avoid these issues of a self-selective bias and increase methodological validity, special evaluation projects could be configured. Surveys would probably be the easiest studies to configure for use in this system, but these surveys could involve a variety of
types of questions: multiple-choice, ratings, and open-ended short response. These surveys could also make use of the multimedia offerings of the smartphones to incorporate images, audio, and video if these elements would prove useful for the given survey. Museum staff could randomly invite individuals to take part in these studies, and if these individuals did not have their own smartphones, the museum could offer devices for them to borrow in these studies. These specially designed projects (e.g. surveys) could be made available only to these randomly selected visitors, and the tracking and timing data gathered from their devices could be used to corroborate and/or compare against the other data (e.g. the survey responses). For more about this situation, refer to the section “Pair Qualitative Feedback with Tracking and Timing” in Chapter 9, “Conclusions”.
7. Timing, Tracking, and Observational Studies

I. General Methodologies
II. Applications and Impacts
III. Traditional Tools: Paper, Pencil, Stopwatch
IV. Technological Tools Used in Tracking and Timing
V. Personal Studies
VI. Challenges with Tracking and Timing
VII. Statistical Analyses for Tracking and Timing
VIII. Considerations for the Proposed Technology

The purpose of this chapter is to provide a foundation related to tracking, timing, and observational studies in order to assess the proposed technology in terms of its potentials to aid in these types of evaluation. Interview respondents were asked to describe their experiences with tracking, timing, and observational studies, and to elaborate on projects that were especially successful and/or challenging. The researcher of this thesis also conducted observations to gain some firsthand understanding of what these methods involve. After reviewing tracking and timing methodologies and challenges, this chapter addresses the potentials and challenges for the proposed technology to serve as a tool to collect and analyze tracking and timing data about visitors.

I. General Methodologies

Observational studies can include any evaluation method that focuses on observing visitor behavior. Often times, these observations are done unobtrusively with a human evaluation researcher who visually observes visitors’ behaviors and/or listens to their conversations without informing the visitor. The most basic application of observational studies is simply counting visitors, but for most timing and tracking studies, researchers record any combination of the following: (1) visitors’ total stay times in museums or
Motivations for Tracking & Timing

Tracking and timing studies have historically focused on where visitors spend time in museums; some of the earliest studies inspected carpet-wear as an indicator of heavier traffic and circulation. In the last couple of decades, researchers have focused on quantifying where visitors go, how they spend their time, and what they are doing within museum spaces (Yalowitz and Bronnenkant 2009). These practices can be especially helpful for exhibit designers:

Knowing where a visitor moves within an exhibition space is important to museum professionals such as exhibition designers and planners. It enables them to determine how visitors are using the various components of the exhibition, whether the exhibition has good flow, and whether visitors are engaging with the exhibits in the manner intended. (Yalowitz and Bronnenkant 2009, 49)

Timing and tracking studies can help museum practitioners understand what visitors are doing, which can then steer museums towards better understandings of why their visitors behave like they do. If museums understand how visitors spend their time and what they are paying attention to, they will be in a more informed position to ask deeper questions in other evaluation methods like interviews and surveys. In her pivotal work, Paying Attention, Beverly Serrell supports the value of timing and tracking studies in order to inform museums about how visitors are spending their time, and how thoroughly they are using exhibit elements.

As museum practitioners, part of our job is to encourage diverse populations in the activities of learning and discovery and to adapt our exhibitions to reach the largest possible audience in an engaging and cost-effective way. We want visitors to feel that the time they invest is well spent.
One general indication that visitors are satisfied in this way is their thorough use of an exhibition. (1998, 5)

Before we do any more research on how visitors learn in informal museum exhibitions, we should create exhibitions that visitors choose to experience thoroughly. Then we will be able to use those exhibitions as laboratories for investigating what visitors are really learning. (1998, 4)

Interview Responses

The 18 interview respondents were asked to describe their experiences with tracking, timing and observational studies. They were asked to describe two different timing and tracking projects that they believed were particularly successful and challenging, or not as successful. Because many respondents believed that all of their projects were at least partially successful, some of them focused on single projects and discussed the challenges and benefits of these projects. A couple respondents did not discuss any particular projects but spoke generally about benefits and challenges of tracking and timing studies. A total of 22 tracking and timing projects were discussed. The tables below summarize some of the different approaches and features reflected in these studies, which will be discussed in more depth later in this chapter.

<table>
<thead>
<tr>
<th></th>
<th># of projects</th>
<th>Unobtrusive(^2)</th>
<th>Mean # of Visitors Observed</th>
<th>Median # of Visitors Observed</th>
<th>Range of visitors observed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Paper/Pencil/Stopwatch(^1)</strong></td>
<td>16 projects</td>
<td>94% (15/16)</td>
<td>174 visitors(^3)</td>
<td>93 visitors(^3)</td>
<td>40-714 visitors(^3)</td>
</tr>
<tr>
<td><strong>Technology-aided</strong></td>
<td>6 projects</td>
<td>100% (6/6)</td>
<td>85 visitors(^4)</td>
<td>87 visitors(^4)</td>
<td>20-175 visitors(^4)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>22 projects</td>
<td>95% (21/22)</td>
<td>148 visitors(^5)</td>
<td>93 visitors(^3)</td>
<td>20-714 visitors(^5)</td>
</tr>
</tbody>
</table>

Table 6. Summary of timing and tracking projects and the number of visitors observed.

\(^1\) Some of these studies did not time individual stops, and did not use a stopwatch. The three tools are paired together because of the high frequency in which they are used as a unit.

\(^2\) Only one project cued visitors beforehand to inform them that they would be watched.
Often times, tracking and timing studies are parts of larger projects. One respondent reported, “Tracking and timing is always part of a much bigger study.” Another anonymous respondent who primarily uses depth interviews reported, “Tracking and timing is a tiny piece of larger evaluation studies. I don’t often think of tracking and timing as a separate entity. Most of my studies don’t include it, but I use it sometimes to triangulate other methods.” These opinions reflect the ideas expressed by Wolf and Tymitz in their manuscript about naturalistic evaluation (1979). The interview respondents discussed a total of 22 separate timing and tracking studies, and of these, 41% (9/22) specifically mentioned other evaluation techniques that were used in the same overall study. Interviews were the most commonly mentioned other technique, but surveys, comment cards, and focus groups were also mentioned. These responses indicate that tracking and timing are most beneficial when paired with other techniques to approach different facets of the same problem.

**Combinations of Tracking, Timing, and Behavioral Observations**

Within the tracking, timing, and observational techniques, different researchers employ different combinations of tools depending on the goals and resources for a given project. Approximately 36% (8) of the 22 tracking and timing projects recorded total time, individual time spent at certain components, path traveled, and some other
observable behaviors (though the degree of detail recorded within each of these sections varied). The other 64% of the projects only focused on one or two of these components (e.g. they might have tracked and timed individual stops but did not record observable behaviors, or tracked visitors and recorded behaviors but did not time individual stops). Though one interview respondent mentioned a remedial evaluation study that only investigated observable behaviors (and did not include tracking and timing information), all of the 22 projects referenced and discussed in this chapter deal with tracking and timing visitors’ movements.

II. Applications and Impacts

Interview respondents mentioned a few different driving forces behind the projects they discussed. While a few tracking and timing projects emerged out of the need to understand flow and wayfinding for major building renovations (one of them was specifically requested by the architect), most of the timing and tracking projects were conducted to better understand how visitors were using specific exhibit spaces, and for how long they were engaging with the exhibitions. Longer periods of engagement indicate more opportunities for potential learning (Serrell 1998); tracking and timing studies often provide numerical data about visitors’ length of stay. These projects could fall into categories of formative, remedial, or summative evaluations. The table below summarizes the main context in which the tracking and timing projects were conducted. The formative, remedial, and summative evaluations related to a specific gallery hall or exhibit, while projects under the “entire space” category tracked visitors throughout an
entire institution or major section of an institution. Tracking and timing studies that were needed for building renovation projects fall under the “entire space category.

### Table 7. Summary of tracking and timing projects according to type of evaluation.

<table>
<thead>
<tr>
<th>Method</th>
<th>Formative</th>
<th>Remedial</th>
<th>Summative*</th>
<th>Entire Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper/Pencil/Stopwatch</td>
<td>1 project</td>
<td>3</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Technology-aided</td>
<td>1 project</td>
<td>0</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>9% (2/22)</td>
<td>14% (3/22)</td>
<td>55% (12/22)</td>
<td>23% (5/22)</td>
</tr>
</tbody>
</table>

*Approximately half of the summative evaluations were specifically for exhibits that had recently opened or were remodeled, and half of them were for exhibits and spaces that had been open for sometime.

**General Impacts**

As displayed in the Table 6, tracking and timing are generally used to help museum staff understand how visitors are using exhibit spaces. Understanding timing and movement can impact how exhibit designers arrange objects and labels, and determine which elements are the most successful in terms of how often and for how long they are being attended to, and which spaces and exhibits are being underused. If exhibit designers intend for visitors to enter through a particular entrance, they might arrange exhibits in a particular conceptual order that is dependent upon the assumption of visitors using that particular entrance. Tracking and timing studies could help confirm that trend or show that visitors are entering the space through a different access point and that the exhibit elements need to be rearranged.
Education sections can benefit from tracking and timing studies in order to better understand which of their programs and activities are being most and least utilized (Yalowitz and Bronnenkant 2009). Marketing departments can better learn what kinds of visitors attend to which exhibit halls and types of activities in order to increase these audiences.

If museums conduct multiple tracking and timing studies of their own and research the findings of other institutions’ tracking and timing studies, they can begin to set more realistic goals and expectations of how visitors will use their spaces (Yalowitz and Bronnenkant 2009, Serrell 1998). Comparative studies of the same space can help museum staff understand if new exhibit elements are having positive impacts on visitors. For example, a museum might realize that their existing labels in a particular gallery are not attracted visitors to stay at them for very long, and they want to create new labels—a comparative timing and tracking study could quantify how such a change might impact visitors stay time in such a gallery hall. (Yalowitz and Bronnenkant 2009)

**Formative Impacts**

As displayed in Table 5, 9% (2) of the 22 tracking and timing projects fell under the category of formative evaluation. One of these projects was conducted at the Exploratorium and aimed to understand visitor movement patterns in their *Mind* exhibit. To learn more about this evaluation, see Section IV of this chapter, Technology Used in Tracking and Timing.

**Case Study: The Trail of Time at Grand Canyon National Park.** Eric Gyllenhaal and Deborah Perry of Selinda Research Associates conducted this first-stage formative
evaluation in order to assess “overall layout of the Trail of Time and get a sense of whether visitors understood the timeline aspect of the Trail of Time, as well as investigate visitors’ interest and the previous knowledge they brought to the experience” (Gyllenhaal and Perry 2004). The evaluators conducted unobtrusive observations of 89 visitors over the span of two days and noted different levels of engagement (physical, intellectual, emotional, and social). They “usually found a place where interesting behaviors seemed to be taking place, such as near a scale-change station or interpretative label, and then [they] stood as unobtrusively as possible on the side of the Trail away from the Canyon” in order to conduct their observations. The evaluators used paper and pencil to record their observations; though they recorded overall times, they focused their observations more on the level of engagement and less on the individual timing or track. According to the researcher, visitors spent an average of 1-1.5 hours on the trail. The researchers triangulated their observational methods with depth interviews.

**Remedial Exhibit Evaluation**

As seen in Table 5, 14% (3) of the 22 tracking and timing projects were parts of remedial evaluation that helped provide actual data to display how certain exhibit components were not meeting their goals, and to provide suggestions for how to improve these areas. One of these evaluations was a thesis project to determine how broken exhibits were impacting the visitor experience, and another was a dissertation project to provide support and evidence that changing the interpretive approach of the exhibit helped increase stay time at the exhibit.
Case study: Tykes Peak at the Denver Museum of Nature and Science. One of the remedial evaluations that used tracking and timing was in the Expedition Health exhibit of the Denver Museum of Nature and Science. A section of this exhibition, Tykes Peak, is targeted for young children. The evaluation was intended to assess what elements in this section were the most utilized, and if parents were reading the “parent tips” labels placed in the exhibit. Evaluators observed 54 visitors over the period of 4 days; they used unobtrusive methods, used paper and pencil, and recorded total stay time (but did not include time spent at individual components). This observational study helped show that less than 4% of the adults observed were reading the “parent tips” labels. (Trainer 2010, 2011)

Summative Exhibit Evaluation

Of the 22 tracking and timing projects discussed, 55% (12) of them were used as parts of summative evaluations of exhibits. Of these summative types of evaluation, 50% were conducted for recently opened or remodeled gallery halls, and 50% were aimed at informing the overall understanding of visitor behavior within specific existing exhibit areas. All of these studies observed visitors within a finite section of a building (e.g. one gallery hall) and are primarily concerned with how thoroughly visitors are using the whole space and its individual exhibit components. Some of these spaces were small enough to view from one spot (and observers could remain in one fixed spot to observe), but most were big enough spaces that observers needed to follow visitors through the space.
Case study: Sharks: Myth and Mystery at the Monterey Bay Aquarium. One of these summative studies was conducted at the Monterey Bay Aquarium to understand how visitors were using the exhibit, what they were attending to the most, and their general impressions. 155 visitors were tracked and timed throughout the space; data was collected with the aid of Noldus Observer technology (to be discussed later); and exit interviews and web surveys were also used. The tracking and timing portion of the study was able to inform museum staff which exhibits were being attended to by the most people and for the longest periods of time. Because the researchers conducted tracked and timed individual stops of both children and adult audiences, they were also able to show significant differences between elements that were more popular with children and those with adults. The tracking and timing results were corroborated with other evaluation techniques to help staff and stakeholders understand the impacts of the exhibit and how visitors were engaging with it. (Yalowitz and Ferguson 2006)

Entire Spaces and Building Renovations

According to Table 5, 23% (5) of the 22 discussed tracking and timing studies were conducted to inform evaluations that aimed at understanding visitor behavior in entire museum spaces or large sections or wings of museums. 60% (3) of these 5 projects were related to renovation projects. The architect working on one of these renovation projects specifically requested a tracking evaluation of the entire space. Much of the emphasis of these studies relates to flow and wayfinding to understand how easily visitors are moving through the museum and navigating between different sections of the building.
**Case study: John G. Shedd Aquarium.** In the context of renovating the Aquarium’s Oceanarium, the evaluation department conducted a tracking and timing study throughout the entire building. Over the span of a couple seasons, 300 visitors were unobtrusively tracked and timed throughout their entire visits. This study, and other tracking and timing studies related to renovation projects, help their institutions and the architects understand how visitors are flowing through the building, which routes they take to get from one point to another, and where they are becoming disoriented.

**III. Traditional Tools: Paper, Pencil, and a Stopwatch**

In this paper, traditional tools for recording timing and tracking observations are considered to be paper, pencil, and (usually) stopwatches. In her book, *Paying Attention*, Beverly Serrell provides standards and procedures to help make these tools more easily accessible and useful to a wide array of museum staff (1998). Many of the evaluators interviewed for this thesis closely follow Serrell’s standards and use her recommended tools; almost all of the interviewers made at least some reference to her contributions to the field of tracking and timing. Of the 22 projects discussed, 73% (16) of them used these traditional tools. With these tools, the observer selects one visitor to observe and records their start and stop times at specific stops according to the total running time. Then the start time can be subtracted from the stop time to determine the total amount of time spent at each individual stop.

*Maps and Grids*
Most evaluators who use paper and pencil techniques record times and observations on maps of exhibit spaces. “It may take a while [for data collectors] to orient to a detailed overhead view map of the exhibition” (Yalowitz and Bronnenkant 2009, 52), so it is often useful to spend extra time training data collectors so that they are making consistent recordings and observations. By recording visitors’ tracks on a map, evaluators are easily able to see the routes that people travel.

However, some evaluators are not as concerned with recording tracks and focus more predominantly on time spent at individual exhibit stops. One independent evaluator believes that data collectors have an easier time interpreting and recording information in the form of a grid rather than on a map because some people have trouble constantly orienting themselves and visitors on maps. With a grid system, data collectors identify exhibit components by name, and instead of writing codes for behaviors on a map (e.g. B=bend, S=sit, P=point), they simply place checkmarks in boxes that correspond to different behaviors for individual stops. (Anonymous respondent 2011)

Case study: The Oakland Museum of California. Randi Korn and Associates conducted a summative evaluation of the Art Gallery of the new Oakland Museum of California with the goals of understanding how to create a welcoming and comfortable exhibition that is engaging for individuals, intergenerational groups, and ethnically diverse communities. The summative evaluation included tracking and timing studies as well as exit interviews. Researchers unobtrusively tracked and timed 93 adults in the Art Gallery, and used traditional tools to record their observations: paper (a grid), pencil, and a stopwatch. The data collectors selected the first eligible person (18 years or older) to
enter the gallery, and then began continuously timing and tracking their stops. Data was collected over the span of about two months. The study helped show the museum that the inclusion of comfortable seating and hands-on activities helped extend the total stay time of visitors who engaged with these elements, and that these elements helped visitors engage more with the artworks. Because this was the first of a few galleries to open in the Museum, staff could take the positive findings of this study and apply them to the development of their other gallery halls. (Randi Korn & Assoc. 2010).

IV. Technological Tools Used in Tracking and Timing

Though the traditional tools of paper, pencil, and stopwatches have some good advantages (cheap and pretty easy for anyone to learn), they do come with some challenges. Yalowitz and Bronnenkant offer a critique of these traditional tools:

Using the paper-and-pencil method is the most common form of timing and tracking in museums today, probably because it is more simple and affordable than other options. While cost and ease of use are compelling reasons, we have found some limitations to using paper-and-pencil methods for timing and tracking: (1) Lack of specificity—Many studies don’t include times at each element because it is difficult for data collectors to accurately record this information. Typically you record only whether a stop occurred or not for each exhibit. (2) Being obvious to visitors—Writing on clipboards is noticeable. (3) Use of resources—Transferring the paper to a database can take some time, especially when the sample is large. (4) Forced to choose—It is almost impossible to accurately record time for different phenomena that occur simultaneously in the exhibition… (Yalowitz and Bronnenkant 2009, 52-53)

Some evaluators have utilized different types of technologies in order to counteract some of the types of concerns expressed above, especially the issues related to accuracy and time. The main types of technologies that have been used include overhead video, visitor-held digital cameras, and handheld computers that researchers use to code in their observations.
Overhead video at the Exploratorium Mind Exhibit

Some evaluators have used overhead video cameras (security cameras or specially installed webcams) as tools for tracking and timing studies. 9% (2) of the 22 tracking and timing projects used overhead video to capture information about visitors’ movements. Yalowitz and Bronnenkant again offer a perspective about the pros and cons of this technique:

While video is an excellent tool for this kind of focused study of visitor behavior [within a single exhibit or gallery], it is not feasible for most exhibitions. Attempting to patch together multiple videos to accurately record visitor behavior over a larger area can be extremely frustrating. (Yalowitz and Bronnenkant 2009, 49)

In addition to limitations of how much area video cameras can capture from their limited angles, they still require human beings to watch the videos (which takes time) and record the data that can be extracted from them (McNamara 2011).

As part of a formative evaluation of the Mind exhibit at the Exploratorium, Joyce Ma developed a system at the Exploratorium to collect video with overhead cameras and help automate the process of entering tracking and timing information from the captured video. She constructed a system that used three pieces of technology: an overhead webcam, a FileMaker file for data entry, and a visualization software application called Trail Mapper. Recordings from the overhead webcam allowed researchers to play back videos, and clickable buttons in the Filemaker file allowed researchers to easily enter visitors’ movements as they observed the videos, and the Trail Mapper application helped translate the data from FileMaker into calculations and visualizations of the tracking and timing data. (Ma 2007)

A total of 175 people were tracked and timed using this system. The data visualizations helped exhibits teams understand how certain entrances and exits were
being used in unexpected ways and how some visitors were walking through the space without ever stopping; they were able to reconfigure the space to accommodate for these unanticipated patterns of flow.

The technology that was specially developed to help with this in-house evaluation was a success in that it produced a lot of data quite quickly and that these data were acted upon in order to increase visitors’ time spent in the exhibit collection. The main challenges were that it took a lot of time for in-house staff to build and configure the software system, it still took a lot of time for evaluators to watch the videos, and the system was not as automated (i.e., there was no automatic video tracking) as the system designer had hoped it would be.

**Digital Cameras Used By Visitors at the Plains Indian Museum in the Buffalo Bill Historic Center**

Out of the 22 tracking and timing projects discussed in the interviews, 9% (2) of them placed digital cameras in the hands of visitors and asked visitors to use the cameras to document their visits. Rob Jakubowski first tried out this method at the Plains Indian Museum as a way to let visitors record their own museum visits. In this model, inexpensive digital cameras were loaned to random visitors who were willing to participate in the study. These visitors were asked to take pictures of whatever they found interesting. This process allowed researchers to look at the visitor experience through the viewfinder of the actual visitors. The goal was that visitors would photographically record their paths through the museum and then researchers would look through the photos to analyze the paths traveled. Though the theory presented interesting
potentials, this initial study presented some technical challenges that obscured the usefulness of the data produced. The photos turned out dark and/or blurry, and it was sometimes difficult for researchers to see which exhibits were in the photographs.

**Noldus Observer in Expedition Health at the Denver Museum of Nature and Science**

Another technology mentioned in the interviews was the Noldus Observer software that can be used on handheld computing devices; 9% (2) of the 22 tracking and timing studies used this technology to aid in the collection and entry of tracking and timing data. In this model, researchers carry the technology around with them and are able to record simultaneous observations with a couple taps of the screen. Steve Yalowitz used the Noldus Observer software in a summative evaluation at the Monterey Bay Aquarium for the *Ocean’s Edge* exhibition. Yalowitz and Bronnenkant believe that:

> The most compelling reason to consider using software such as Noldus Observer is that it results in more accurate data…. The equipment is relatively expensive (approximately US $1,000* for one license and a handheld computer) but saves considerable time in data entry and provides a more sophisticated level of data collection and analysis than is possible with paper-and-pencil techniques.…. (2009, 54)

*Yalowitz noted in 2011 that prices have more than doubled since 2009.*

Patty McNamara led the summative evaluation for *Expedition Health* at the Denver Museum of Nature and Science. In this evaluation, she and other data collectors used Noldus Observer technology to conduct their tracking and timing studies of 74 visitors. McNamara, like Yalowitz, appreciated the technology for the quality and volume of data that it allowed researchers to capture. Though there is a definite learning curve, and it takes a while to configure the technology (the map of the exhibit space and which behaviors to include), the technology was overall very helpful (McNamara 2011). The ability to just tap the screen (instead of looking at a stopwatch and writing down a
time) allows researchers to more accurately time individual stops. The ability to automatically download data from the device to a computer greatly expedites the process of data entry.

**Summary**

Most of the technology-aided projects allowed evaluators to obtain more accurate data and more data points for each visitor they observed. However, the number of people observed using technology-aided methods was actually quite lower than those observed using traditional methods. As shown in Table 5, the mean number of visitors observed using technology-aided methods was 85, and the mean number of visitors observed using traditional methods was 174. The technology-aided methods described by the respondents were useful in terms of automating the process of data entry and collecting more accurate data, but it is not clear that the tools discussed are superior to traditional methods of using paper, pencil, and a stopwatch.

**V. Personal Studies**

The researcher of this thesis had not previously conducted any tracking and timing studies, and felt that it would be useful to conduct some of her own tracking and timing observations in order to develop some firsthand understanding of what these types of evaluation require. After receiving approval from the Institutional Review Board, she conducted approximately 17 total hours of observational studies in two different locations: (1) a new gallery hall in the University of Colorado Museum of Modern Life (CUMNH), *Modern Life: Exploration, Innovation, Pollination*, and (2) a section of a
food court in the University of Colorado Center for Community (C4C). As an employee of CUMNH, she had a personal interest in understand how visitors use this space, but was also concerned that there might not be enough visitors using this space to provide many insightful experiences. She chose the C4C as a secondary location to conduct observations because there were elements in the room at which to stop, and there was sure to be a higher volume of traffic. Though a food court clearly has some fundamental differences from museums, people move through the space in social groups and stop at certain elements. In these particular ways, the researcher believed that this location could be loosely likened to the experience of observing visitors in a museum space.

Observing in the food court of the Center for Community (C4C)

For her observations at the C4C, the researcher tracking and timed visitors from a fixed location—she stayed in one spot where she could view the most activity. It would have been impractical to follow people through this space because of how quickly people move through the area. On a map of the observable space (see Appendix C), she systematically marked and timed visitors’ stops at individual stations. She would randomly select a person who entered the space and would observe that one person until they left the viewing area. In Many individuals were simply walking through the space, and after this pattern became apparent, the researcher would simply record that a visitor “walked through” whenever this behavior occurred. Even for the people who were stopping at stations within the space, people moved through the space pretty quickly—5 minutes would be a long stay in this space. After 7.5 hours in the space (about 6.5
dedicated hours to observing), the researcher had collected tracking and timing information for 96 people.

The researcher also spent about 2 hours conducting “scan sampling” at the C4C. For this method, she would visually scan the area every one or two minutes to count how many people were at five different areas or were walking through the space. Challenges of conducting these observations will be addressed in the next section.

Modern Life at the University of Colorado Museum of Natural History (CUMNH)

For her observations in the Modern Life gallery in the CUMNH, the researcher tracked museum visitors throughout the gallery. Again, she stayed in a fixed spot in which she could see almost the entire gallery hall. She would select every first person that entered the gallery and would track them until they exited the gallery. For these observations, she kept a record of their total time spent in the gallery, the order of elements at which visitors stopped (a map of their tracks), and observable coded behaviors (e.g. sitting, pointing, bending, talking about content, talking about other things, using hands-on elements). Notes were again marked on a map of the gallery space (see Appendix D). If she could overhear conversations, she would take note of comments and subject matter. In these observations, she did not record the times spent at individual elements.

After spending about 8 hours in this space (spread out among weekends and weekdays), the researcher had collected observational data for 8 people. This was not because they were staying an average of an hour each, but rather because there were often long periods where no one came into the gallery hall at all. The time that these 8 visitors
spent in the gallery hall ranged from 3 minutes to 20 minutes, with an average of 9.5 total minutes spent in the gallery.

**Purposes**

The purposes of these observations were not to actually conduct evaluation of these spaces, but rather to develop some firsthand understanding of some of the challenges presented by human observations. The author of this thesis emulated just a couple parts of what most timing and tracking studies involve; she acknowledges that she did not conduct an actual timing and tracking study, and certainly did not conduct a summative evaluation—these were not her goals with this project. In the process of conducting observations, some challenges became more apparent than would have been possible from simply reading evaluation literature and talking to evaluators. The challenges noted in these personal observations are addressed along with challenges other evaluators discussed in the next section of this chapter.

**VI. Challenges With Tracking and Timing**

Though tracking and timing studies can be very useful indicators of how visitors are attending to different elements within museums, they pose some challenges that are ubiquitous regardless of method, and also present some challenges for specific tools and methods.

**Defining “Stops” and “Elements”**
In order to assess how much time visitors are spending stopping at exhibits, evaluators must define what is a “stop.” Beverly Serrell states that “a stop at an element is defined as a visitor’s stopping with both feet planted on the floor and head or eyes pointing in the direction of the element for 2 to 3 seconds or more” (1998). This definition provided a standard for evaluators to which to orient their efforts and develop some systematic standards in the field. However, for certain types of spaces, this definition of a stop may not be the best solution:

The “planted feet” criterion can be problematic when specific components are large enough that a physical stop is not required to engage it. For example, aquariums and zoos often have large tanks or enclosures that typically involve strolling by while engaged in viewing them. In art museums, visitors can engage with very large paintings or installations without physically planting their feet. (Yalowitz and Bronnenkant 2009, 50-51)

Defining an element is also essential. Not only must an evaluator know how to consistently categorize and record different nuances of visitors’ human behaviors, but they must also have a consistent way to define what exactly is being attended to. Serrell gives the definition:

Elements are all the physical spaces where there is something for self-guiding visitors to do, conceptually and physically. For example, elements include places to stop to look more closely at an object or phenomenon, read a label, interact with a device, or watch an audio-visual program. (1998)

Yalowitz and Bronnenkant provide their own context and experiences to the issue of defining elements:

Defining what constitutes an “element” is often driven by how accurately you can determine what visitors are attending to. For example, if the exhibit components are spaced far apart and each requires a physical stop in order to engage with it, then what is recorded as the “element” is rather simple. However, if there is not clear delineation between experiences (e.g. a “wall” containing labels, pictures, hands-on exhibits and videos), then it may be necessary to group these together. If you cannot accurately tell what someone is attending to by the movement of their body and particularly their head, then you need to group exhibit elements together. The distance between the observer and the visitor also depends on the layout of the exhibition. (Yalowitz and Bronnenkant 2009, 51)

One of the interview respondents noted that depending on the space that she is observing, she sometimes defines an element by one object, sometimes by a wall, or a “bay” of four
walls. Another respondent sometimes divides a space up into “zones.” Because each exhibit space is unique, every project will likely portray some differences. Evaluators must ensure that they understand the conceptual objectives of exhibitions before they can determine how it is best to define elements and stops.

**Unique Spaces**

While each exhibition has unique content and exhibit elements, the actual physical layout of spaces can also present challenges. For example, at least four of the eighteen interview respondents commented on the challenges of multiple entrances and exits. In one recently rebuilt museum, the architect designed the space so that visitors can always see outside. Exhibitions spaces kind of flow and blend together in this space, which creates some challenges for separating sections of the museum into obviously discernable and separate units.

In personal observations at the food court of the C4C, the area being observed had three different entry/exit points, though two of the actual entry points were more visible than the third one. At first, the observer would select every second visitor that entered from entrance “A”, and then would choose every second visitor that entered from entrance “B”. But it quickly became apparent that individuals entering from side B were typically just walking through the space, so the observer changed the selection technique to observe every first person that entered from entrance “A” only. While this created more manageable conditions, anyone entering from entrance “B” or “C” was automatically not considered as a potential person to observe. Spaces with multiple entrances not only force evaluators to choose which entrance(s) to focus on, but also lend
themselves to more complicated traffic patterns. In a busy space where visitors are
ebbing and flowing in multiple directions, it may be more difficult for evaluators to keep
track of the individual visitors they are observing while maintaining an appropriate
distance to remain unobtrusive.

**Time Consuming**

Almost all of the 18 interview respondents mentioned that tracking and timing
studies tend to be very time consuming and time intensive, especially if a museum is
trying to track and time visitors throughout entire museum spaces (Jakubowski 2011,
Loomis 2011, Trainer 2011). The average stay time of visitors will affect how long
collectors must spend conducting the observations in order to record the visitors’
behaviors. Not only can data collection be very time-consuming, but entering all of the
data into computers, and then making sense out of computer analyses also takes
significant amounts of time. One independent evaluator reported that actually collecting
the data was not the most time-consuming part for her (she hires data collectors for this);
her time is mostly spent on preparing protocols, defining “stops” and “elements,”
analyzing data, ensuring that the evaluation techniques match the goals, and
communicating evaluation findings in a meaningful way (McNamara 2011).

The evaluators who participated in interviews expressed a wide range of time they
take to collect tracking and timing information. For a visitor center where people tend to
only stay for a few minutes and front desk staff can make observations, the data can
probably be collected very quickly. For comprehensive studies of spaces where visitors
spend their entire days visiting the institutions, data collectors must then follow these
visitors around all day long in order to maintain the validity of the study. Of the 22
timing and tracking studies discussed, a couple of them only took a couple days to collect
their data, a couple took a few seasons, and most studies collected data over the period of
a couple weeks.

Accuracy

Another issue with tracking and timing studies is their accuracy. With traditional
tools of paper, pencil, and stopwatches, there is a lot of potential for error with human
observers. For each observer, he/she may be inconsistent about how to record data, and
physically unable to accurately visually switch back and forth between observing a
visitor, looking at a stopwatch, writing down a time, and then going back to observing the
visitor. Furthermore, when using multiple people to collect data and conduct
observations, their will likely be a lot of variation between how each person records
behaviors, and training should be implemented to ensure a greater degree of reliability
among how different people record information.

Also, human observers are only to record so many activities at a time. Trying to
simultaneously keep track of the route visitors are traveling, their individual times spent
at each element, and other behaviors is too much for most people to be able to accurately
record all at once.

VII. Statistical Analyses for Tracking and Timing

There are many different useful comparisons that evaluators can make when analyzing
tracking and timing data. These statistical comparisons can be used to analyze data
regardless of how it was collected, so long as the method of collection has yielded valid and reliable data. These data sets and comparisons are primarily derived from Beverly Serrell (1998), Steve Yalowitz and Kerry Bronnenkant (2006), Patty McNamara (2011), and Marcella Wells (2011).

**Data Points**

There are some fundamental sets of data points that need to be collected in order to make use of these different comparisons. Below are types of data that can be collected in order to make use of the comparisons that follow.

- **Data that relates to each observed visitor:**
  - **Total stay time** in the observed space.
  - **Total number of stops** (i.e. how many elements did the visitor “stop” at).
  - Stay time at individual stops (i.e. separate recorded times for each stop).
  - Other behaviors identified ahead of time (e.g. interacting with hands-on elements, sitting, interacting with group members, interacting with docents, interacting with strangers). (Optional)
  - Demographic information about the visitor. Either the researcher guesses demographics based on observations (age, gender, ethnicity), or can intercept visitors at the end of their visit to ask them. (Optional)

- **Data that relates to the space and the elements:**
  - **Size of the space in square feet.**
  - **Number of elements in the space** that could be possibly stopped at (as defined by the project).
  - Total time needed to be spent. (Use a group of 6 or more people to read everything in the space as if they were going to be tested on it. Average their times to arrive at the amount of time “needed to be spent” in order to read or interact with element.)
• Time needed to be spent for each element (average time “needed to be spent” for each individual element).
  o *Situational variables* (optional)
    • Crowding
    • Time of day, week, season
    • Other events or programs happening in the space
    • If docents, tour guides, or live interpreters are present in the space.

**Mean, Median, and Range**

The mean, median, and range can be applied to total time in the space, total number of components stopped at, and time spent at each individual component. Database software like Microsoft Excel can help create frequency distribution histograms and scattergrams. Some evaluators mostly like at measures of mean, median, and range and do not really use many other quantitative comparison measures.

**Sweep Rate Index (SRI)**

Beverly Serrell presented the Sweep Rate Index (SRI) as a tool to understand how quickly visitors are moving through spaces (1998). This index measures visitors’ average time spent per square foot of an exhibition. It should be noted that some evaluators choose to take the median time instead of the mean time spent. Part of Serrell’s intention was to create a way that exhibitions of different sizes could be compared against one another. For example, if visitors spent an average time of 10 minutes in a gallery hall of 4,000 square feet, the SRI would be 400. The lower the SRI, the more slowly visitors are moving through the space (this is good). Yalowitz and Bronnenkant report their criticism of SRI:
While Sweep Rate Index has provided a much-needed measure, it is not without its critics. Some say that the size of the institution and crowd levels would affect time in the exhibition to a great degree and need to be factored in… to determine the success of an exhibition SRI should be used in conjunction with other measures. (2009, 57)

% Diligent Visitors

The other key index that Serrell presented in *Paying Attention* was the Percentage of Diligent Visitors (%DV) index. “This index is obtained by calculating the percentage of visitors who stopped at more than half of the elements. The percentage of diligent visitors is a gauge of how thoroughly an exhibition was used” (1998). A high %DV index is a sign of a thoroughly used exhibition.

Holding Power

One measure that can prove very useful to museums is that of holding power (Wells 2011). Holding power compares the amount of time that visitors need to spend to read and interact with everything that is presented to them against the amount of time they actually spend. For example, a newly opened exhibit about Florida alligators (with an adult target audience) could ask a focus group of 10 graduate students who had never seen the gallery before to read and interact with everything in the space as if they were going to be tested on it. Researchers would time the members of the focus group as they interacted with each element, and would then create average times spent for each element and for the whole gallery. Then, researchers could unobtrusively observe other visitors and compare their actual times against those of the focus group. A scatterplot could be created in which every dot represents an element in the gallery. If actual visitors were
spending as much time at each element as they “needed” to, then one would see a positive correlation among the data.

**Other measures**

The list below refers to other commonly used comparisons of tracking and timing data. Depending on what visitors are doing in spaces, certain types of comparisons may help visualize trends better than others.

- Percentage of exhibits stopped at (or attended to)
- Percentage of total time stopped at exhibits (compared to time spent in the gallery not attending to exhibits)
- Percent of total time stopped at each type of element (e.g. interactive elements, objects, etc.)
- Percent of visitors interacting with interactive exhibits compared to the percent of people simply stopping at them
- Median time spent at each element compared to the percent of visitors stopping at the element
- Number of components visitors stopped at compared to the total time spent in the given space.

**Summary**

Tracking and timing studies allow evaluators to understand how visitors are spending their time and what they are doing in exhibit spaces. These quantifiable measures can then be best used when supported with other evaluation techniques. Evaluators most often use human data collectors to observe visitors, and these data collectors record their observations using paper, pencil, and stopwatches. However, some evaluators have used some technologies to help increase accuracy and to expedite
the process of collecting and entering this data. Some of the technologies used include overhead video cameras, digital cameras placed in the hands of the visitor, and handheld technology (e.g. Noldus Observer) in the hands of the researcher. Researchers may collect a range of types of data related to visitors’ stays in specific areas. These types of data can then be compared using a variety of methods in order to understand trends and relationships between the information.

VIII. Considerations for the Proposed Technology

In the 22 examples of tracking and timing projects, the 18 interview respondents discussed issues of valid and reliable data, the intensive time that it takes to conduct these types of studies, different ways the results are used (for different phases of evaluation for exhibition, and also to inform architectural renovations), and different methods used to collect data. The challenges and successes of these projects helped illuminate some potential challenges and benefits of the proposed technology.

No Human Time Needed for Data Collection or Entry or Analysis

The proposed technology system intends to collect tracking and timing data about visitors simultaneously as they use the technology within museum spaces, and will then automatically analyze that data. This power to automatically collect and analyze data is arguably one of the biggest benefits of the proposed technology in terms of its ability to aid in evaluation. As visitors use the technology to explore content and interactions that pique their interest, the system will automatically collect information about where they are physically within the museum, feedback they provide, and information about how
they are using the museum app. Instead of relying on human observers to spend their hours observing visitors, recording behaviors, entering data into a computer, and then analyzing the data, all of this can happen automatically with the proposed technology. Also, despite efforts for evaluators to remain unobtrusive and invisible to the visitors they observe, “[nobody] can ever be completely unobtrusive as a human observer;” they will alter the experience for visitors, even if it is subtle and they are not consciously aware of it (Diamond 2011). This system takes that question out of the equation.

**Multiple Visitors All the Time**

While human researchers are physically able to observe only one visitor at a time, the proposed technology can collect data about any number of visitors all at the same time, continuously. This feature would allow the proposed technology to collect more data than would ever be humanly practical. By collecting data about multiple visitors at the same time, patterns of flow and crowding could more easily emerge. By collecting data over long spans of time would allow museums to compare different trends across seasons and days of the week. Having a system in place that would continuously collect tracking and timing information, museums could more easily compare their exhibitions over time and quantifiably identify underused areas more quickly and easily.

**Visualizing Data**

In interviews with professionals, it became quickly apparent that the tools used to visualize this data in the proposed technology system need to be well-designed and easy to use. Yalowitz and Bronnenkant believe that “using a map to report [the analyses of]
timing and tracking data is much more effective than lists of exhibits and numbers” (2009, 58). They use exhibit maps to visualize “hot and cold areas of usage” in terms of the percentage of observed visitors who attend to elements, as well as the average amount of time spent at these elements (Yalowitz and Bronnenkant 2009, 58-60). Joyce Ma produced visualizations of visitor behavior using a map of the exhibit space to visually emphasize the most used entrances, exits, and exhibit components (Ma 2007). The proposed technology should be designed to not only show visualizations of average usages on maps of spaces, but could also be designed to show visualizations of trends according to time of day, or by demographics. Time-lapse videos of tracks on maps could help museum staff visualize flow and crowding patterns within the spaces.

The proposed technology would be able to automatically and easily produce visualizations of all of the statistical comparisons mentioned in the previous section. As tracking and timing data is automatically collected throughout a day, these statistics would be continuously updated through internal algorithms in the software and compared across any given period of time.

Questions of Accuracy

One of the main concerns identified by multiple interview respondents related to questions of accuracy of the technology. Particular questions included: How close to visitors need to be to be detected? On how many exhibit stops will sensors be placed? What happens if someone turns off their phone, or closes the app, will they still be tracked? Confident answers to these questions will not be possible until the actual technology has been developed and is then able to be tested. However, these questions
will have to be answered in order to develop a clear picture of the precise abilities of the technology after it is actually working. It will be essential that visitors can be detected within a range of at least 5 feet. Ideally, the sensors would be able to be modified to different physical ranges in order to detect visitors depending on what should be defined as “an element” within a given space. Testing of the actual technology and smartphones will be demanded to determine what exactly happens with different models of phones when visitors turn their screens off or close out of the museum app.

Some respondents also commented on the technology’s inability to determine when someone within range of a sensor is not actually “attending to” or “stopping” at an exhibit—they are not looking at the exhibit. This is true; the technology will not be able to see where people are turning their heads. However, introducing museum interpretation on smartphones introduces another complication for observing in and of itself—visitors may be attending to exhibit-related content on their phones, but whether they are looking at a museum app or some other feature on their phone will be impossible to detect from an unobtrusive viewpoint. Discussions in the last two chapters will address some potential ways to deal with this challenges.

**Concerns About a Self-Selection Bias**

Multiple respondents also expressed concerns and questions related to a self-selection bias. The tracking and timing evaluation within the system will only register those people who are using smartphone tours. The most apparent example of self-selecting will be the users who use their own phones to experience a multimedia museum app tour. These visitors reflect a specific demographic of users who are comfortable
using smartphones and can afford to own their own. Museums could provide devices for visitors to use during their visit (either for free or for a small rental fee), and this would help alleviate some of the self-selecting sample bias (Meluch 2011). However, the individuals who would be willing to use a museum device (even for free) would likely be those who were most comfortable with the technology, so there would still be a sampling bias based on people’s inclinations to use the technology. These may not be significant problems, so long as the claims match what is actually being collected and demonstrated through the data.

**Pair Qualitative Feedback with Tracking and Timing**

In their article, “Timing and Tracking: Unlocking Visitor Behavior,” Yalowitz and Bronnenkant support a mixed-methods approach:

> We advocate using timing and tracking in conjunction with other methods, particularly interviews, since timing and tracking on its own sheds little light on why people are behaving the way they do. Using both allows us to study the relationship between what a visitor does and the intended outcomes of the exhibition. (1996, 49)

Many of the respondents discussed their mixed-methods approaches of pairing observational studies with surveys or interviews. For any qualitative evaluation method that a museum wished to conduct through the medium of smartphones, this information could be automatically paired with visitors’ tracking and timing in the proposed technology system.

If a museum was conducting some quick formative evaluation, they could have prototypes of the elements on display in a gallery hall, and a friendly staff person could invite people to engage with the prototypes and then encourage them to answer a couple questions that would pop up on their smartphone screen right there. For example, a
history museum might be developing an exhibit about the evolution of jazz and they want to evaluate the graphical and linguistic approach of two different label styles. They might create prototypes of two different introductory panels, one that features colorful, flat illustrations of instruments and two short sentences that use playful language; the other panel uses black and white photography of famous musicians and four sentences that use simple, elegant language. A staff person could invite participants to respond to a few questions on their phones:

- How did the graphics of each panel make you feel?
- How did the language of each panel make you feel?
- Rate how much each one caught your attention.
- Rate how much each one inspires you to learn more about jazz.

Responses submitted could also be compared with the visitors’ self-reported demographic information, and their tracking and timing patterns to assess if there were correlative trends between the comments and the commentators’ demographics and tracks. For example, people who generally tended to have longer stay times at individual elements throughout the museum might prefer to read a longer label, but people who tend to quickly browse through exhibits prefer shorter labels. Or people traveling with children prefer the colorful graphics, but groups of adults prefer the black and white photography. Or visitors who spent a lot of time in an exhibit about racecars preferred the colorful graphics, but visitors who spent time in an exhibit about the Gold Rush preferred the black and white photographic approach.

**Summary**
The proposed technology has abilities to collect larger volumes of tracking and timing data than would be ever be humanly possible. Visualization tools could make statistical analyses of this data available quickly and easily. While these capabilities offer great potential for museums to learn about more of their visitors in a more in-depth way, special attention must be paid to ensure the accuracy and reliability of the collected data, and to understand what factors of self-selecting biases are at play.

Provided that the system can be designed to ensure a sufficient level of reliability, the tracking and timing components of the proposed technology will ideally be paired with other evaluation techniques to paint a more in-depth picture of museum visitors. By being able to collect large volumes of tracking and timing data about visitors and visualize this data, museums should develop more informed ideas about their visitors which can then lead them to conduct more meaningful evaluation in other forms (like interviews) and create more engaging programs and exhibits.
8. Professional Perspectives on the Proposed Technology

I. Positive Interest
II. Concerns
III. Recommendations

Though other sections have addressed some of the concerns and praise that the interview respondents expressed for the proposed technology, this chapter serves to comprehensively address the perspectives of museum professionals: their enthusiasm for the proposed technology, their reservations, and their recommendations. Respondents were provided with a brief description of the proposed technology, asked if they had any questions about the proposed technology, and were asked to discuss their general feelings and concerns about the technology, and if they believed that it would be better suited for certain types of institutions more than others.

I. Positive Interest

Respondents expressed a lot of overall positivity and enthusiasm for the proposed technology in terms of both its abilities for visitors and evaluators. Part of this positivity is likely the result of feeling that museums today need to make an effort to keep up with the technologies that visitors are becoming increasingly reliant upon. Below are some of the general statements that reflect the respondents’ overall sentiments towards the proposed technology:

• “[What you’re proposing] is an interesting and timely issue… I hope it gets to the point where you’re actually testing it.” (McNamara 2011)

• “By itself it could be really useful in a narrow way [with timing and tracking], but in combination with other techniques, it could be really really powerful. […]Being able to do large scale timing and tracking] would be a huge advantage for really big spaces. Even just by itself, you could learn a lot.” (Meluch 2011)
• “I think it’s awesome what you’re trying to do… As an evaluator, I can see the value of what you’re trying to do.” (Wells 2011)

• “Everything you have outlined here is fantastic. All of these things are possibilities--- input demographics, leave feedback, and see how many people engage with this exhibit stop. I feel like the smartphone technology you want to use is something that people have made very personal... it can become these very personal extensions of ourselves. How can [museums] take advantage of that when people are in our space? The personal connection seems very achievable with what you are proposing.” (Bowell 2011)

• “My gut reaction is that is has a lot of real good potential, [especially with tracking and timing.] … I mean, I think you’ve got something that [will offer] a variety of ways that museums could take advantage of it. I think it’s got potential. I will look forward to hearing more as it develops along.” (Anonymous respondent 2011)

• “If you can get to the level of detail that you’re talking about, I think it would be really useful as a tool to understand where people are going and spending their time.” (Anonymous respondent 2011)

**Flexibility for Interpretation and Evaluation**

Some respondents expressed enthusiasm for how institutions could use the technology in a flexible way to achieve different evaluation and interpretation goals depending on the space and their current projects. One respondent was quick to understand the flexible nature of the system with particular regards to the tracking and timing capabilities,

What I see is the potential for this really being used in two different ways. There’s a lot of potential for using it in the enhance-the-visitor-experience mode and getting a little bit of data on the side. I think evaluators would be perhaps more apt to use it in strictly the data collection mode and maybe with many more stops tagged, but not necessarily things that the visitor can get more information about, but just that they’re stopping there. Just to register that track because it could be done more unobtrusively. I could almost see it being used differently by two groups within an institution. (Anonymous respondent 2011)

She went on to explain her ideas of how the system could address types of issues within different space of the same museum,

I can see this being used while a gallery space is being developed—“Well we want to incorporate videos that people can watch on their own devices and so we’re going to use this as a permanent element of the exhibition”—that element will be a set piece of the experience. Then when you get to a point of summative evaluation, doing a track through there [to determine] if they’re using that additional content, and if so, for how long, would be vital. [The technology you’re proposing could be used to] update and supplement existing galleries. I can see it being used in a gallery where none of that extra content is there, but you want to strictly do evaluation of how it’s set up. (Anonymous respondent 2011)
Another respondent mentioned the need to present content differently at different institutions; for example, keep text minimal for an app at a children’s museum. Allowing museums to fill in their own content into a well-designed template would enable flexibility for each institution.

In the contexts of flexibility for visitors, Judy Diamond mentioned that the multilingual abilities of the technology could be hugely helpful for museum interpretation, especially in certain locations. Another respondent echoed New York Times critic Ed Rothstein’s sentiments when she mentioned how beneficial it would be to have content pop up on the phone depending on what people are standing near.

**Follow-up Interactions**

A benefit that multiple respondents expressed is the ability for visitors to extend the museum experience on their own personal device after they leave the museum. “It would be interesting to explore how the experiences will end up as a keepsake after their visit” (Loomis 2011). More specifically, another respondent suggested using museum apps as a way to keep in touch with visitors via email, “I think what would be a neat element to add to something like is the opportunity for a visitor to leave an email address or something to be contacted a little bit later so that they get that follow-up… [and] get that time for reflection as well” (Anonymous respondent 2011).

**Good for Facilitating Interaction and Soliciting Feedback**

A few of the respondents addressed the fact that opening pathways between visitors and museums through a more networked medium, like smartphones, is likely to
alter the landscape of museums. “Collecting visitor-constructed content gives museums new potentials and opportunities to allow visitors to construct new meanings. Do museums know how to accommodate for this?” (Wells 2011) Katie Bowell discussed how different forms of technology can either encourage isolation or participation, and supported how the proposed technology could facilitate increased interactions:

My fear of technology is that it’s isolating. I like very much what you have proposed here because the examples that you’re giving aren’t completely isolated. Dialing in and listening to a cell phone is a very person-to-technology interaction. You listen individually and miss the group dynamic. But doing things on Facebook, leaving comments, or reading other people’s discussions adds another level of dimension that I find very intriguing. And it opens it up to create that idea of communication. In an ideal world, there would always be somebody there who you wanted to talk to, who would be happy to talk to you about whatever you wanted: answering questions, responding to your comments, listening to your criticism… I think that you are perfectly set up to open that door.” (Bowell 2011)

**Demographics**

A few respondents mentioned how helpful the collected demographics could be, “[It] would be exciting to be able to sort easily by demographic info” (Jakubowski 2011). Some of them emphasized that when collecting demographic information, it is especially important to ask individuals if they are first-time or repeat visitors, if they are in a group, and if they are with children.

**Implications for Marketing**

Since the technology presents potentials for increased accuracy of timing visitors in museum spaces, paired with demographic information and qualitative feedback, the area seems ripe with benefits for marketing departments. About one-third of the respondents mentioned how much marketing departments would like this technology; some of their responses are presented below.
• “I know that immediacy of information would certainly appeal to a number of staff in our facility.” (Anonymous respondent 2011)

• “I could see marketing people salivating over this.”

• “The marketing piece of this may be larger and more important.” (Diamond 2011)

• “Marketing departments would love this” (Jakubowski 2011)

In Falk and Sheppard’s book *Thriving in the Knowledge Age*, they make a case for the value of using demographics for purposes of making the right kinds of connections with different audiences:

> Without a doubt there will be increasing competition [to attract] consumers, but the winners will not be the ones who get their message out to the *most* people, it will be the ones who get their message out to the *right* people. […Attracting these *right* people] involves creating complex combinations of demographic and psycho-graphic categories in order to classify people into a finite set of categories (2006, 59).

II. Concerns

While respondents expressed a lot of enthusiasm and encouragement about the proposed technology, they also expressed concerns that were directed towards both visitors and museum staff. This section presents the concerns expressed by respondents, but responses to these concerns are largely addressed in the next chapter, Conclusions, rather than in this section.

**Informed Consent and Protection of Privacy**

One of the most commonly expressed concerns related broadly to informed consent and privacy protection for visitors (McNamara 2011, Diamond 2011, Trainer 2011, Wells 2011, Loomis 2011). Respondents wanted to know if individual people’s phone numbers could be collected and therefore individual identities tracked, if using the WiFi networks would present opportunities for identity theft, and if people had to pay for the time they spent playing on the smartphones. Once museums know what information
can and cannot be collected about their visitors, how will visitors know what information of theirs is protected? It’s important to give visitors the opportunity to opt out, but you “don’t want to make it too easy to opt out… [The point of informed consent to be tracked and timed] may be as simple as [the app] asking [users] “Allow to use your location?” (Anonymous respondent 2011).

**Changing the Experience for the Visitor**

Other commonly expressed questions related to how the technology could alter the visitor experience: How do you facilitate interactions with the “real stuff” in museums rather than the screen and sounds of the phone? How do these devices change the ways in which people interact with each other and the physical exhibits in museums? (McNamara 2011, Trainer 2011, Wells 2011)

**Accuracy**

Other concerns expressed an apprehension about the accuracy and reliability of the tracking and timing data collected on the phones. One aspect questioned was the distance range of the RFID sensors placed on exhibits; how close to visitors need to be to be tracked and timed?

Another variable that some researchers were concerned about was people sharing and swapping phones during their museum visit; what happens to the quality of the data if visitors carry a phone through part of their visit, but then pass it off to a friend?
Another issue related to accuracy is that of visitors turning phones on and off: how will this affect the collection of consistent data? What happens if they turn off the screen, close out of the app, or completely turn off their phone?

While human observers can see when a person is looking at an exhibit element, a phone cannot determine where visitors might be directing their attention. In terms of protocols and methodologies for human observers using paper, pencil and a stopwatch, the human researcher watches the visitor to determine the start time of “stopping” or “engagement.” With the proposed technology,

**Accessibility and Self-selecting Bias**

A couple respondents expressed their concerns about how a limited number of people have the technology, a limited number of people are comfortable with the technology, and a limited number of these will want to use the technology in museum spaces. However, many respondents acknowledged the increasing prevalence of smartphones and believed that museums likely have a high portion of visitors who are coming in their doors. “Among museum visitors, we’re not looking at people in a subway or park or mall… we have a highly educated, more wealthy population in general” (Anonymous respondent 2011). Also, the Baby Boomer generation is one of the biggest growing markets for smartphones (Carracher 2011), and Falk and Sheppard believe that “the key to a business’s success may very well hinge on appealing to two large population cohorts, the Baby Boom and the Echo Boom generation, [the children of the Baby Boomers]” (Falk and Sheppard 60). According the NielsenWire, Hispanic...
populations create a large percentage of the smartphone-user population (Kellogg 2011, Pardo 2011).

Related to issues of accessibility, came concerns for how the proposed technology presents a sampling bias towards those who have self-selectively identified themselves as someone willing to use this technology and possibly someone who owns the technology themselves. If museums offer devices for rental or free checkout, this will reduce the sampling bias a bit, but it will still be biased towards people who are willing to use the technology.

For feedback questions that visitors must seek out on their own within the app, this situation is biased towards people who self-selectively wish to leave a comment. Like comment cards that sit passively on a front desk at a museum, the feedback provided in this situation may reflect people who either have strongly positive or negative feelings.

**IT Departments and Reception**

Three respondents expressed their concerns that IT departments will have to be intricately involved in helping set up the system, create firewalls, and maintain the system (Jakubowski 2011, Trainer 2011). Usually these departments are overburdened with other tasks and are especially hesitant to allow systems to access the museums’ WiFi networks. Only two respondents mentioned that their institutions have very poor cell phone reception; how will that affect the reliability of the system? Aquariums have so much concrete and water that these physical elements are typically the culprit of poor
Screen Size and External Hardware

One respondent suggested using devices with bigger screens than smartphones, such as iPads or Kindles. Another two respondents were concerned about asking visitors to plug in an external hardware piece (the RFID scanner). Requiring this piece presents a variety of logistical challenges: How do you ensure that people don’t walk out with them? Will people be willing to leave a driver’s license to check one out? Who would distribute them? Will people feel like the device is taking personal information from their phones?

III. Recommendations

A number of respondents provided similar recommendations on what they believe the proposed technology needs in order to be as successful and useful as possible. Some of their recommendations had already been considered, and others were newer ideas. All of them seem like valid and useful suggestions.

Conduct Comparative Studies

Multiple evaluators recommended that after the actual technology is developed, a comparison should evaluate the abilities of the proposed technology against traditional methods in order to better understand the limitations and abilities of the proposed technology to collect accurate tracking and timing data (McNamara 2011, Anonymous respondents 2011). A comparative observational study could also be conducted to
evaluate differences in how smartphone owners use their own devices in the museum compared to visitors who borrow or rent devices from the museum (McNamara 2011).

**Develop Pilot Studies to Prove Success**

In order to develop successful and intuitive user-interfaces for the apps and software included in the proposed technology system, it will be important to conduct series of pilot-tests with real users: visitors for the apps and museum staff for the software that will be used to build the apps and for evaluation (Loomis 2011). Once the technology has actually been developed, it will be important to develop some pilot studies to demonstrate the technology’s abilities and prove that as an evaluation tool, the technology collects accurate and reliable data (McNamara 2011). This will help institutions feel that this is a worthwhile tool and will be more inclined to consider purchasing the technology. After successful pilot studies can show that the system is reliable and produces accurate evaluation data, then the system should be framed in the context of best practices (Jakubowski 2011).

I think it would be a welcomed addition [in the museum community]. If the technology was introduced in a focused way and in a way that allows practitioners to know that you’ve done your homework…. [You should] integrate yourself into the field and become a technology person…. do some pilot studies using the technology to build your credibility in terms of using [and selling] the technology. I think it’s needed for museums to stay relevant, we need to incorporate [these kinds of] technologies. (Jakubowski 2011)

After proving that the technology is reliable and will help museums understand visitors in more meaningful ways that previously possible, then it must be proven that the proposed technology can do this in a cost effective way. Museums might be willing to invest large
amounts of money in a technology system like this, but they need to be assured that it will be worth the investment and that the system will pay off over time.

**Partner with Other Institutions to Get Written Into Grants**

At least four of the 18 respondents suggested that it would be worthwhile to try to get grant funding to help develop this technology system (McNamara 2011, Diamond 2011). These respondents suggested that it would be worthwhile to get written into other organizations’ grants as part of their evaluation fulfillments. Pairing with organizations and people who already have a strong track record of receiving federal grants increases the likelihood that grants will be fulfilled.

**Match Automated Tracking and Timing with Other Qualitative Information**

One respondent suggested how beneficial it would be to have the proposed technology automatically collect tracking and timing information about users, but also be able to have human researchers observe their behaviors, and then match the two sets of data for individual people (Warren 2011). Another respondent suggested triangulating the automatic evaluation with human interviews. She thought it would be particularly interesting to print out an individual’s tracks, and then interview them (and show them their map) in order to get a better idea of how people budget their time and make decisions (Meluch 2011).

**Provide Remote Updates and Tech Support**
Some respondents expressed how much it can help or hinder their experiences with technology depending on tech support. The proposed technology should provide remote updates and tech support in order to help museum staff solve any problems with the technology. Not only will this help the technology to continue to function at its optimal state, but will also help to maintain good relationships between the technology providers and the museum clients.

**Types of Museums**

Because every museum is unique, as are their exhibitions, spaces, and missions, it will be important that the proposed technology responds to the unique qualities of every museum. Technology providers should work closely with museum staff when implementing the technology so that the technology is best serving the needs of the museum and that the museum is extracting as many benefits as possible from the technology.

Respondents were asked if they believed the technology would be better suited for any particular size or type of institution. The types of museums referenced in their responses generally fell into two divisions (size and type) and were comprised of two categories within each of them (big/small; collection-based/hands-on interactive). Below are summary statements of the pros and cons mentioned for each example.

- **Collection-Based Museums**: Types of text, images, audio, and video on the app might be better suited for these types of content. Museums in this category could include natural history, art, and history.
- **Children’s Museums and Science and Technology Centers**: At science centers and children’s museums, people’s hands are often occupied with hands-on activities (Trainer 2011). However, they sometimes seem to change more quickly that art
and natural history museums, so they might be able to implement the technology more quickly and successfully.

- **Large Museums**: Often have more financial resources to invest in technology and receive more grant-funded projects. They would also benefit from being able to do large-scale tracking and timing studies that they normally are not able to do because they are too big. Larger institutions have so many people and departments to coordinate with, it would probably get more complicated really quickly. Also, they often already have staff working on different pieces of this. (Trainer 2011)

- **Smaller Museums**: Might be too scared at first to invest in a big project like this (Trainer 2011), but they might be better for developing the system in the beginning and scaling it up from there (Jakubowski 2011).
9. Conclusions

I. Ideal Applications
II. Further Considerations and Next Steps
III. Possible Impacts for Museology

I. Ideal Applications and Impacts

After discussing the proposed technology in terms of technology in museums, evaluation in museums, and professional perspectives about the proposed technology, the main intentions of the technology are clearly to (1) serve as a platform for new kinds of engagement between museums and their visitors, and (2) to simultaneously act as an evaluation tool to provide museums with deeper understandings of their visitors.

Technology: Platform for Visitor Engagement

In a day when technology is evolving very quickly, museums are struggling to keep up. Increasingly, it looks like smartphone devices will continue to become more pervasive in the daily lives of many museum visitors, and museums could likely benefit from finding meaningful ways to use such technologies to create deeper connections with their visitors.

In the end of the day, if [museums] don't use relevant technology, we're fools…Progress doesn't stop and if our biggest goal is to remain relevant to our communities... We want repeat visitation we want people who care about us and support us so that we can continue to do what we’re doing. For us not to take advantage of everything that people are integrating so permanently and importantly into their lives... We need to take advantage of as much of this as possible… This type of technology could be really cool and appropriate for discussions of deeper engagement that everyone is struggling with in museums. (Bowell 2011)

Technology: Platform for Evaluation
While the proposed technology system serves as a platform to promote new layers of engagement with audiences, it simultaneously will serve as an evaluation tool for museums. It aims to provide museums with an affordable and long-lasting platform on which to create mobile experiences and evaluate their visitors in a variety of ways including tracking and timing, voluntary visitor feedback, mobile surveys, ratings of specific exhibits, analytics of the mobile platform.

By offering a built-in system to automatically collect tracking and timing information, the proposed technology aims to make tracking and timing a more accessible evaluation tool so that more museums can more easily understand what their visitors are doing. Rob Jakubowski reports, “I would say 90% of museums don’t do tracking and timing. There needs to be a match of personal interest in it, and the administrators making it a priority. Your technology would break down some of those barriers” (2011). Kate Bowell offers a perspective on the benefits of conducting evaluation via a system to which visitors are already personally connected:

I think that in terms of evaluation potential… museums are almost reaching a point where the basic information that we have gathered for so long with evaluation doesn’t matter as much… What I am really interested in is evaluating those much deeper more meta complex questions of visitor dynamics and interactions with each other, with the exhibits, with objects within the museum… I think more and more we are trying to do deeper and deeper things and our evaluation tools just aren’t set up to get information that measures what we’re trying to do… We are repositories of humanity. We are what we have created and what we have deemed is important, what we think is important now. We are asking [visitors] to explore it with us, and I think we can use these [technology] tools that everybody is already using to tap into that larger humanity and their reactions to what we’re trying to accomplish… What you are suggesting in terms of a tool here feels really interesting and really [presents] valuable possibilities as an evaluation tool for those much bigger questions. I think that we need to create systems that go into systems that people are already using and already finding a voice in… Once we ask them to come into our system—our survey, our scale of -5—I think we lose that opportunity, or I think it’s very easy to lose that opportunity. (2011)
The proposed technology system inherently spills into many departments of a museum. As an interpretation tool for visitors, the technology applies to departments like exhibits and education. As an evaluation tool that collects multiple layers of data, the technology system can help marketing, exhibits, and education teams better understand their audiences. In these ways, the proposed technology has the potential to create new bridges of interaction between different sectors within the museum. One respondent speaks to the tendency of museum technology to only serve single departments:

I think we’re still as a [museum] field floundering around a little bit frankly. If we’re talking about technology, certainly we’ve done a better job incorporating technology into the exhibits themselves, but not a great job. We’re still trying to figure out how to push things on mobile devices [but] to what end? Where is the mobile device that is doing something that no other approach can? What’s the added value? What’s the individual contribution that can be made there? Museums are doing our best to keep up, but we’re behind … We’re hesitant about technology… We’re tackling some of the individual pieces, but we still don’t do a very good job of how it all fits together. How museums should fit into this picture is by constantly thinking about it and being critical of our approaches… but really I don’t think we’re doing a very good job because it’s split up into different departments… how does it all fit together? I think we’re really sometimes missing the big picture. (Anonymous respondent 2011)

The proposed technology hopes to do what only a mobile device can do: provide personalized engaging experiences to visitors on a device they are already connected to while simultaneously and completely unobtrusively collecting useful evaluative data about each smartphone user to help museums better understand and serve their audiences.

II. Next Steps and Further Considerations

This thesis has served to create an understanding of how this technology could benefit museums, particularly in the context of evaluation tools. Through the course of 16 interviews, 18 museum professionals offered their experiences, ideas, and opinions to help create a more solid foundation and understanding of the challenges and potentials of the proposed technology. These views and ideas will help inform the development of this
proposed technology so that when it is actually created, it will be able to deliver better quality experiences to both visitors and museum staff.

Next Steps

Based on responses of museum evaluators, the following are the proposed next steps in order to make the proposed technology an actual usable tool.

1. *Create the technology.* Before this project can move much farther forward, the location-sensing hardware components must be built, and preliminary software systems must be designed. At this point, it should be possible to create rough estimates of how much the system might cost for different sizes of institutions.

2. *Continue talking with museum professionals.* Now that museum evaluators have been consulted to help inform the overall design of the system, it would be helpful to talk to other museum professionals as well, especially museum directors since they would likely be the people to sign off on an investment in the proposed technology. Due to the nature of the system, it would also be of great value to talk to other museum departments that could be affected by the proposed technology: exhibits, education, marketing, development, visitor services, and IT departments.

3. *Partner with an institution, possibly through a grant.* The technology developers should find a museum to partner with so that they can further develop the technology. In this setting, the technology team can test iterative designs of user-interfaces for the app with visitors and test interfaces of the app templates and evaluation software with museum staff. After the software is designed, create an app and implement the whole technology system in a museum. Test it with users (both visitors and museum staff) until it is working smoothly in the ways intended.
4. *Conduct comparative studies.* After implementing the technology system in a museum, conduct comparative studies between the technology system and traditional methods of timing and tracking to determine how reliable the system is at collecting accurate tracking and timing data. Determine a measure of potential error for the technology system. Conduct comparative studies between visitors using their own devices and visitors who are using a borrowed device.

5. *Fine-tune.* Determine what the problem areas are, and how to fix them so that the system meets its goals. Fine-tune the system to better understand exactly what it needs. Maybe reevaluate the cost models. Develop a realistic projection of how much the system will cost over the period of five years and how much quality evaluation data it can collect and analyze in that time frame.

6. *Present at conferences.* Address the system in terms of best practices for technology and evaluation, and present it at conferences.

**Additional Considerations**

In order to address more of the concerns presented by the interview respondents, the following considerations should be carefully reviewed.

- *Address privacy and informed consent.* The proposed technology has never had any intentions of collecting visitors’ personal phone numbers or information actually stored on their phones. However, it is obvious that there needs to be a clear statement that addresses how the proposed technology will deal with informed consent and how it will assuage concerns related to privacy.

- *RFID maybe not the best.* With the RFID model, an external hardware piece must plug into the smartphone. This presents a variety of logistical challenges, as well as a slew of manufacturing challenges. It is possible that there is a better solution
that would enable the phone to still detect the desired distance ranges without requiring an additional hardware component.

• *Develop measures of minimum requirements.* In order to be realistic about which types of spaces will best benefit from this system, a set of minimum requirements should be developed. Issues addressed in these requirements would definitely relate to cell phone receptions and WiFi capabilities, but might also correlate with factors like “what percentage of your visitors come in with children under the age of 5?”

• *Design evaluation modules.* In the interviews with 18 museum evaluators, it became apparent that the proposed technology could address a number of separate issues and questions: wayfinding and flow, summative evaluation of exhibitions, formative evaluation of exhibit components, marketing tools. The evaluation software might be best designed to feature different modules that would address data through the different lenses of individual exhibitions, marketing, visitor services, development, education, and the entire building.

• *Focus on resources for usability.* In order to most successfully implement this technology system in museums, the museum staff will need to understand how to best make use of it. Training sessions and manuals should be developed to guide staff members on how to best use the evaluation modules, how to best construct content for their smartphone app, how to best integrate the system to address their goals and missions.

**III. Possible Impacts for Museology**

While the goals of the proposed technology are most directly applicable to single institutions, if this technology becomes implemented in many sites, it is possible that it could have some far-reaching impacts on the field of museology, particularly evaluation. The ability of the technology to make noticeable impacts relies on two key qualities: affordability and reliability. The issue of reliability relates both to how reliable is the technology as an engaging multimedia tour for visitors, and how reliable is the
technology at collecting accurate data about visitors. These two qualities cannot be assessed at this time because the actual development of the technology is still in a state of infancy. However, as long as the technology proves to be affordable and reliable, it may result in the following impacts:

- **Standardization of tracking and timing evaluation methodologies.** So long as the proposed technology produces accurate data, this system could be implemented to ensure a standardization of methods for tracking and timing.

- **Exponentially wider pools of data.** The proposed technology has the ability to collect more data about visitors than would ever be humanly possible. This large data sets can be used to look at trends in a museum throughout the year. With many institutions using the system, large, standardized sets of data could be compared across institutions. While each institution would be able to gain a more in-depth understanding of their own visitors, the field of museums in general would be able to create a deeper understanding of museum visitors at large and could better understand differences between museums.

- **More widely implemented evaluation tools.** So long as the technology is affordable and yields accurate data, it will allow institutions to implement a system that automatically collects evaluation data. By automatically collecting and running statistical analyses of the data, the technology could alleviate the human burden of time that is usually associated with these tasks. In this way, it could make the task of evaluation a more achievable one for many more institutions.

- **Broader and deeper connections with visitors.** So long as the technology system can be designed to be a affordable and reliable source of accurate evaluation data, the proposed technology offers opportunities for museums to create broader and deeper connections with their visitors. By serving as a platform for individual visitor engagement and as a platform for evaluation of visitors, the technology presents possibilities for museums to have connections with more people, and to deepen those connections. Offsite users can access museum apps remotely and
have a surface-level connection with the museum’s content, and visitors at the museum can engage in participatory experiences facilitated by the technology.

Overall, this proposed technology aims to keep museums relevant in the lives of its communities by serving as a platform for personalized experiences and facilitated social engagement. Simultaneously, it allows museums to harness a more in-depth understanding of their populations more easily than has previously been possible.
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Appendix A: Informed Consent Form

Principal Investigator: Rebecca Wahlberg

PARTICIPANT INFORMED CONSENT FORM
Interviews with Museum Professionals
March 8, 2011

Please read the following material that explains this research study. Signing this form will indicate that you have been informed about the study and that you want to participate. We want you to understand what you are being asked to do and what risks and benefits are associated with the study. This should help you decide whether or not you want to participate in the study.

CONTACT INFORMATION

You are being asked to take part in a research project conducted by Rebecca Wahlberg, a graduate student in the University of Colorado at Boulder’s Department of Museum and Field Studies, 218 UCB, Boulder, CO 80309. This project is being done under the direction of Professor J. Patrick Kociolek, Department of Museum and Field Studies, 218 UCB, Boulder, CO 80309. Rebecca Wahlberg can be reached on her cell at 512-791-7726. Professor Patrick Kociolek can be reached at 303-492-8464.

PROJECT DESCRIPTION

The purpose of this research is to understand how emerging Smartphone technologies could be integrated with existing evaluation practices and methodologies to provide museums with more insightful data to assess their visitors’ experiences. Particular areas of focus within the scope of museum evaluation include collecting visitor feedback, and timing and tracking visitors’ movements through museums. This research aims to address the following questions:

• What are the best practices and methods for museum evaluation related to collection of visitor feedback, and timing and tracking of visitor movement through museum exhibitions?
• How can such data best be used to enhance the museum experience?
• How can Smartphone technology best be used to aid in museum evaluation of visitors?

You are being asked to be in this study because of your evaluation experience related to tracking and timing and/or utilizing visitor feedback. I have either identified you by a personal referral from another museum professional, or through publications and websites that list professional museum evaluators.
10-25 participants will be invited to participate in this research study, which will last for 2-5 months.

**PROCEDURES**

Taking part in this study is completely **voluntary**. You do not have to participate if you don't want to. You may also leave the study at any time. If you leave the study before it is finished, there will be no penalty to you.

**Description of Procedures**
If you agree to take part in this study, you will be asked to participate in an interview that will be **audio-recorded**.

**Description of Interview Questions**
There will be five sections of questions related to your experiences, opinions, and attitudes about existing evaluation methods and my proposed technology.
1. Your evaluation background
2. Your experience with timing, tracking, and observational evaluation techniques
3. Your experience with evaluation techniques that rely on visitor feedback
4. Your views on general technology in museums
5. Your views on my proposed Smartphone technology as collector of evaluation data

**Time Commitment to Complete Research Procedures**
Participating should take 60-90 minutes of your time.

**Research Location**
If possible, I will conduct these interviews in person in your place of work, or a public place of your choosing. If it is not possible to conduct these interviews in person, I will conduct them over the phone.

**Audio Recordings**
Participation in this research includes **audio recording**. These recordings will be used to reference the exact interview responses of the participants in order to categorize and report on the responses. The recordings will be retained for up to one year after completion of the study.

Those individuals who will have access to these tapes will be Rebecca Wahlberg (P.I.), Patrick Kociolek (academic advisor), Robert Guralnick (academic committee member), and Barbara Monday (academic committee member).

**RISKS AND DISCOMFORTS**
The interview process will in no direct way pose harm to the subjects. However, there is a potential future scenario that could be considered a risk: the proposed technology could potentially impact the field of museum evaluation in a way that would reduce the need for human involvement in the collection of certain kinds of data. This could impact the participant’s line of work by reducing their involvement in collecting data about visitors. The probability, magnitude, and duration of these risks are unknown. The interviews are, in part, a way to include evaluators in the process of developing this technology in a way that helps museums, visitors, and evaluators.

To avoid any social or legal risks related to divulging negative information about certain institutions, projects, or individuals, participants may choose to omit details, change names, or go off the record at any point so that I may understand the essence of their sentiments, but keep the details completely confidential.

**BENEFITS**

The intention of this proposed technology is to help museums better understand their audiences so that they can in turn better serve those audiences. This research aims to guide the development of the proposed technology to create the most effective product possible, for both the visitors’ sake and the museums’ sake. Participants will be more in the know about a proposed technology that could potentially alter their field. If they choose to be referenced in the bibliography or directly quoted, this could potentially be beneficial to them if my thesis is published.

Participants that complete interviews will be mailed a $10.00 gift card as a token of appreciation within a week after they participate.

**COST TO PARTICIPANT**

For in-person interviews, the only cost is the participant’s time. For phone interviews, there may be some cost to the participant depending on how they pay for their phone services.

**SUBJECT PAYMENT**

Participants who complete interviews will be given a $10.00 gift card as a token of appreciation for their time. This will be mailed to the participant within a week after their participation.

If you choose to completely withdraw from the study, you will not be sent a gift card.

**ENDING YOUR PARTICIPATION**
You have the right to withdraw your consent or stop participating at any time. You have the right to refuse to answer any question(s) or refuse to participate in any procedure for any reason. Refusing to participate in this study will not result in any penalty or loss of benefits to which you are otherwise entitled.

CONFIDENTIALITY

We will make every effort to maintain the privacy of your data. You may choose the degree of confidentiality of your responses. You may choose whether or not:

- Direct quotes may be used;
  - If these quotes can be attributed with your name;
  - If you would like to have final edits on quotes before written work is submitted;
- Your name may be cited in the bibliography of the written findings;
- You would like to remain completely anonymous.

If you wish to remain completely anonymous, I will categorize your responses in the context with other participants’ responses, but will not quote you directly, cite you in the bibliography, or include detailed names related with any of your responses.

After the completion of the interviews, audio recordings will be transferred from the recorder to the researcher’s personal computer, and deleted from the audio recorder. Written notes will be kept in a binder at the home of the researcher. All audio recordings and personally identifiable data will be erased within a year of completion of the study.

Other than the researchers, only regulatory agencies such as the Office of Human Research Protections and the University of Colorado at Boulder Institutional Review Board may see your individual data as part of routine audits.

There are three exceptions to this promise of confidentiality:

1) If we see or are told information that makes us reasonably suspect that a child or at-risk adult is being or has been abused, mistreated, or neglected, we will immediately report that information to the county department of social services or a local law enforcement agency.

2) If we learn of a serious threat of imminent physical violence against a person, we will report that information to the appropriate legal authorities and make reasonable and timely efforts to notify the potential victim.

3) This promise of confidentiality does not include information we may learn about future criminal conduct.

QUESTIONS?

If you have any questions regarding your participation in this research, you should ask the investigator before signing this form. If you should have questions or concerns during
or after your participation, please contact Rebecca Wahlberg at 512-791-7726 or rebecca.wahlberg@gmail.com.

If you have questions regarding your rights as a participant, any concerns regarding this project or any dissatisfaction with any aspect of this study, you may report them -- confidentially, if you wish -- to the Institutional Review Board, 3100 Marine Street, Rm A15, 563 UCB, (303) 735-3702.

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<th>AUTHORIZATION</th>
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<tr>
<td>I have read this paper about the study or it was read to me. I know the possible risks and benefits. I know that being in this study is voluntary. I choose to be in this study. I understand I will be audio-recorded. I know that I can choose not to answer any question, omit details, go off the record, or withdraw at any time. I have received, on the date signed, a copy of this document containing 5 pages.</td>
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<td>By initialing on the following lines, I express my desired degree of anonymity.</td>
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<td>_____ I authorize the researcher to use direct quotes from my interview.</td>
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<td>_____ I would like to remain completely anonymous. Neither my name nor the names of any institutions or people that I mention may be included in the body of written work or the bibliography.</td>
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Name of Participant (printed) __________________________________________

Signature of Participant ____________________ Date ________________.
(Also initial all pages of the consent form.)
Appendix B: Interview Questions for Museum Evaluators

Section I: Evaluation Background
1) How long have you practiced museum evaluation?
2) Do you work as staff at a museum or as an independent evaluation consultant?
3) For museum staff: What type of museum do you work in? Approximately how many visitors do you serve annually?
4) For independent evaluators: What types of museums do you most often work with? How would you describe the size of these institutions?
5) What do you think is the most important role of a museum evaluator?

Section II: Experiences with Timing, Tracking, and Observational Evaluation Techniques
1) Describe an experience with a timing/tracking project that was a great success.
   • What size and type of institution was this for?
   • What was the scope and purpose of the project?
   • What methodologies were used?
   • What kinds of staffing and technologies were required to conduct the study?
   • How many people were timed/tracked?
   • What was the duration of the study?
   • Can you give an estimated cost for this project?
   • Briefly describe the results of this study.
   • How did the museum use these results?
   • What made this project a success? What were the strengths & challenges of it?
   • Any other memorable elements related to this project?

2) Describe an experience with a timing/tracking project that was not particularly successful.
   • What size and type of institution was this for?
   • What was the scope and purpose of the project?
   • What methodologies were used?
   • What kinds of staffing and technologies were required to conduct the study?
   • How many people were timed/tracked?
   • What was the duration of the study?
   • Can you give an estimated cost for this project?
   • Briefly describe the results of this study.
   • How did the museum use these results?
   • What made this project a success? What were the strengths & challenges of it?
   • Any other memorable elements related to this project?

Section III: Experiences with Evaluation Techniques Relying on Visitor Feedback
1) Describe an experience with a successful project that relied on visitor feedback (responses to open-ended questions).
   • What size and type of institution was this for?
   • What was the scope and purpose of the project?
   • What methodologies were used?
   • What kinds of staffing and technologies were required to conduct the study?
   • How many people were evaluated?
   • What was the duration of the study?
   • Can you give an estimated cost for this project?
   • Briefly describe the results of this study.
   • How did the museum use these results?
   • What made this project a success? What were the strengths & challenges of it?
   • Any other memorable elements related to this project?
2) Describe an experience with a less-than-successful project that relied on visitor feedback.
   • What size and type of institution was this for?
   • What was the scope and purpose of the project?
   • What methodologies were used?
   • What kinds of staffing and technologies were required to conduct the study?
   • How many people were evaluated?
   • What was the duration of the study?
   • Can you give an estimated cost for this project?
   • Briefly describe the results of this study.
   • How did the museum use these results?
   • What made this project a success? What were the strengths & challenges of it?
   • Any other memorable elements related to this project?

Section IV: Views on General Technology in Museums
1) What technologies do you rely on when conducting evaluations of various types?
2) What are some of your favorite examples of effective use of technology in museums to aid in the visitor experience? Successful examples of technology that primarily benefit museum staff?
3) What are some examples of ineffective technology, or ineffective use of technology that you think hinder the visitor experience? Examples that hinder museum staff?
4) Have you used any of the available Apps for museum tours? If so, what did you like and dislike about them?
5) It is hard to deny that technology is becoming more prevalent in almost all aspects of our daily lives. How do you think museums should fit into this picture?

Section V: Proposed Smartphone technology as collector of evaluation data
The technology that I am proposing would use Smartphones and a location-sensing technology that would serve two main purposes: to provide visitors with multi-modal information about exhibits, and serve as an instrument to collect evaluative data about visitors.

For the visitors:
After visitors open the museum’s Smartphone app, the technology would detect when they are near exhibit stops. As visitors approach a stop, information about that stop would immediately appear on their phones. Visitors could then choose to explore more information though text, audio, images, video, games, or web links. They could also leave feedback on specific exhibit stops, read others’ comments, and share information via email/Facebook/Twitter. Feedback could be solicited by a general invitation (“Leave a comment”), or by specific question prompts (e.g. “What do the colors in this painting remind you of?”).

For the museum:
The location-sensing technology that would allow visitors to automatically access information would also allow the museums to track and time visitors as they move through exhibits. This tracking and timing information would be automatically collected and then stored on a museum server. Potentially, visitors could choose to input their demographic information when they open the Smartphone app, then allowing museum staff to sort tracking and timing data by demographic information. Feedback left by visitors about specific stops would also be automatically collected and stored on a museum server. Ideally, the technology would also collect information about how visitors are using the different features of the Smartphone app at each stop. An evaluation software program would be developed to allow museum staff to easily sort the quantitative data about tracking/timing and Smartphone usage, as well as the qualitative feedback. This technology would allow museum staff to quickly develop statistics about tracking/timing, but humans would still need to determine how this information should most effectively be used.
Overall Model and Intentions
The intentions of this technology are to use increasingly prevalent Smartphone technologies in museums in a way that can enhance the visitor experience and give museums useful information about their visitors. The model of this project involves a company that creates the technology and consults with museums to install and implement the hardware and software involved. If a museum hires the company, the company would then install the hardware and software and lead training sessions about the technology for museum staff. Museums would have the ability to develop and input content for the apps on their own, or they could hire the company to develop the content for them. In order to make the best use of collected evaluation data, museums that lack in-house evaluation staff would be strongly encouraged to consult with professional evaluators. The company might hold training sessions for external museum evaluators too, so that if museums hire external evaluators, they will be able to make the best use of the technology and the collected data in order to develop meaningful conclusions about museum visitors.

This section may become more of a dialogue discussion depending on the responses.

1) Do you have questions for me about the proposed technology?
2) What are your general feelings about this proposed technology?
3) What are your biggest concerns?
4) Do you feel that this technology would be useful for museums? Do you think certain types of museums, sizes of museums, or museums in certain geographic regions would be able to use this technology more effectively than others? How so?
5) What types of museum staff do you think would be able to most effectively use the feedback and timing/tracking data gathered through the technology? (Educators, exhibit designers, exhibit developers, architects, directors, marketers, etc.)
6) What seems like a reasonable price for this technology?
7) My hope with this technology is that it could facilitate problem solving among many sections of staff members and stakeholders to better assess how to best serve museum audiences, both in the physical space and through the Smartphone Apps. I do not think that this technology would by any means replace museum evaluators, but rather would serve as an instrumental tool for evaluators to more easily gather large volumes of data. Because fewer human hours would be required to collect data through in-person observation, museum evaluators could devote more energy to analyzing data and transforming it into useful information for the museum.
   • Do you think this is a reasonable outlook?
   • What other ideas do you have about the implications of this proposed technology on the role of museum evaluators?
8) Any other thoughts about how this technology could be integrated with existing methods of evaluation? Thoughts about this technology could help, hinder, or alter museum evaluation and museology in general?
Appendix C: Map of Center for Community, Site of Personal Observations

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Appendix D: Map of *Modern Life* Gallery, Site of Personal Observations