ELECTRONIC GUIDEBOOK FORUM

January 13–14, 2005

San Francisco, California

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This unpublished document is intended to be a faithful synthesis of the discussions that took place at the Electronic Guidebook Forum held at the Exploratorium, San Francisco, January 13–14, 2005. It is meant to serve as a resource for those who attended as well as others in the field; it does not necessarily reflect the views of the Exploratorium or of individual symposium participants.

Participant comments have been paraphrased. The content and meaning of the ideas presented have been preserved.

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A Note from the Organizer

In 2001, the Exploratorium convened a meeting to discuss findings from researchers and developers working with handheld computers in exhibition spaces. Since then, new mobile, low-powered technologies and wireless communication networks have expanded these devices' capabilities and reach. What have we learned so far about the user experience and use of wireless technologies and mobile computing devices in exhibition spaces and beyond? The Exploratorium hosted a two-day forum bringing together researchers, museum educators, and developers to discuss the latest findings and challenges on designing mobile devices, handheld computers, and wireless networks in informal learning environments.

During our workshop, we also discussed interrelated aspects of mobile devices, handheld computers, and wireless network applications for museums and other informal learning environments:

- Audience goals
- User experience, interaction, and adoption
- Content development and instructional design
- Staffing, sustainability, and operational issues
- Technology infrastructure
- Research and evaluation

Our goal in hosting this forum was to identify key issues to inform further work in informal learning environments including museum visits, after-school and outdoor settings, and other out-of-school uses. During the forum, we addressed ongoing questions and challenges raised by participants in the field, such as:

- What is known about social interaction and learning in museums that can inform the design of these technologies?
- When do mobile devices enhance a visitor's experience and when do they detract?
- What combination of network and location technologies are currently in use? What are the strengths and limitations of each system? How sustainable are these technologies?
- How might a design meet different audiences with different needs?
- What research has been done on mobile inquiry? What methodologies are useful and appropriate for doing user studies?
- How can we leverage new partnerships with industry and community stakeholders?

Participants shared different implementations and compared approaches and observations (both disappointing and inspiring) based on their experiences working with handheld technologies. During the workshop, a transcriber, graphic facilitator, and photographer were on hand to capture and share critical insights for this report. We have enjoyed hearing the conversations and hope you will too from reading about the rich discussions that took place.

Sherry Hsi, Ph.D.
Center for Learning and Teaching
Director of Research and Evaluation
January 13 and 14, 2005
Exploratorium, San Francisco

Electronic Guidebook Forum 2005:
Issues and Questions about Wireless Learning Technologies and Handheld Computers in and beyond Museums

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A Welcome from Goéry Delacôte
Executive Director of the Exploratorium

Hello and welcome.

As executive director of the Exploratorium, I'm very interested in this forum and its results. What you will discuss here is part of a bigger agenda. What we have in mind is to look for what I call a "mobile user"; this mobile user could be the next generation of what we're doing here.

This museum is a place where you interact with physical artifacts but also have conversations.

We need to develop a more interactive process, to create technology that allows users to interact with more than just their hands.

A parallel track to the mobile user concept is to explore developing smaller-scale exhibits that are also mobile, ones you could put on your tabletop or in the trunk of your car. We also want to extend exhibit access so that it becomes a community-based organization, accessible at a college, a school, or other public places, even at home.

For this to happen, there needs to be an electronic guidebook. But we suspect it will not be an easy task to complete the work. At the end of the process, we'll see a modified system of people trying to understand the many aspects of the technical world, using a network of small, electronic devices. But we must first start small: We must have a modest agenda and spread our knowledge gradually. Later, by creating partnerships around the country and the world, this learning technology will be disseminated on a grand scale.

Again, welcome to the Exploratorium. I'm happy to see so many friends here in this room. Have a great forum.

Sincerely,
Goéry Delacôte
Executive Director
Exploratorium

Welcome. I'm happy you're here at our Electronic Guidebook Forum! In 2001, the Explor-
atorium held a similar event to bring together museum partners, technologists, artists,
researchers, and developers to talk about designing technology for exhibition spaces.
Several of you were at that meeting and presented your work.

This meeting is to check in and find out what has happened since then. Since the 2001
meeting, we've broadened our view to include extensions beyond the spaces of the mu-
seum and to discuss questions about using handheld devices, user experiences, and the
challenges we're facing.

With a show of hands, how many people here are from science museums? How many are
researchers? Evaluators? Educators? Developers? From the technology industry? Of the
educators, who teaches K through 12? Who works in higher education? It looks like we
have a great representation from multiple communities, a broad range of expertise to help
us discuss the issues.

At the end of two days, we'll have met new people, formed new collaborations, and moved
forward. I hope you'll make use of this forum to reflect upon your own practices and shape
your work.

I began working on an electronic guidebook project here at the Exploratorium starting in
2002. Because of my prior experience working with handheld computers, I had a healthy
skepticism about the role of technology in supporting deep interactions and learning:
Does it really help expand the user experience? Today, we have many compelling applica-
tions you will hear about, as well as how these were evaluated.

I'd like to formally thank the National Science Foundation's Information Technology Re-
search grant for supporting this workshop.

Sherry Hsi
Director of Research and Evaluation
Center for Learning and Teaching
Exploratorium

A Welcome from Sherry Hsi
Forum Organizer

A Welcome from Rob Semper
Executive Associate Director of the Exploratorium

It's great to see you all, both old and new friends. This is the second of these meetings for discussing using electronic guidebooks in museums. Reflecting back upon 1999 when our project started, I realized that we didn't have WiFi; we didn't have Bluetooth or RFID. We had smart phones, but those were more along the lines of the shoe phone from the TV show *Get Smart*. Technology has moved forward, but we've gathered together today for the same reasons we gathered together then—to discuss the opportunity and challenges to using electronic guidebooks in the museum setting. It was courageous of Barry Van Deman from the National Science Foundation's Division of Elementary, Secondary, and Informal Education to fund this project, which allowed our community to come together and discuss these questions, key issues, and the use of these technologies within museum settings.

This project has at its roots a fundamental issue: How do we make use of the museum environment to support learning? How do we extract more of the ideas around the physicality of the experience? We've been thinking about these kinds of issues at the Exploratorium since 1975. Back then, we used paper-based materials to connect exhibits to each other and to abstract ideas. We had IBM punch cards to cross-referenced exhibits. These cards produced a cross-index that related exhibitry to phenomena. For example, the exhibits "Color Contrast" and "Gray Step" both relate to relative color vision. But the paper lists were lost, cumbersome to use at exhibits, and difficult to maintain. Obviously, technology has changed in the last thirty years, but many of the issues have not.

So, the question before us is, where do we need to go in the next four or five, or thirty, years? We look forward to the discussions, ideas, and answers this forum will generate.

Rob Semper
Executive Associate Director
Exploratorium

The GettyGuide™ wireless is launching February 1, 2005. It is an interpretative tool for visitors with three interfaces: a handheld device that provides primarily audio interpretation, wayfinding, realtime events information, and bookmarking; stationary kiosks, where visitors "dock" the handheld and access bookmarks; and the Web, where you can do pre-visit planning and post-visit extensions. The handheld devices will be available in the entrance hall in the museum at the information booth. There will be 450 devices available, leased for free when you leave your ID.

We had a dry run of the system to help staff get comfortable with the devices. A visitor can get the GettyGuide™ at the information desk. We want to centralize all the things that visitors do. I am focusing more on the handheld interface, given the topic today.

Home Screen of Handheld

1) Watch Demo
2) Daily Events
3) My Bookmarks
4) Audio Tours
5) Cafe and Restaurants
6) Coat Check and Restrooms

Daily Events

This gives a text description of an event. It also shows where the event is with a map with locationing. Nine of the top ten questions from visitors relate to locations, such as where is the exhibit, lecture, or event, and so on.

Audio Tours

Find out about audio tours you can use GettyGuide™ to access. These are designed around permanent collections. We also developed a site tour for families. The Getty has a big site with complex architecture, views, garden, and other things. Clicking on a tour gives you a brief description and a brief audio blurb.

We Want to Drive People to the Experience

The handheld first gives you the object on the tour. You can't access the audio until you are at the object. It was designed so you cannot access the audio while sitting in the cafe, for instance. (Single and double earphones available.) While outside the gallery, you can preview the tour visually, but cannot access the audio. We decided to use text more than graphics to get visitors to the site.

Show Map

This feature gives you directions to the start of the tour. The maps update as you get closer. When you're outside we don't bring content to you. When inside, the screen automatically updates.

Featured Attractions

GettyGuide shows visitors what they might be interested in.

Resources

Anything we want to make people aware of. The visitor can scroll through a list of thumbnails of works in that gallery. An overview of the gallery is provided in audio format.

The GettyGuide™

Christina Olsen

J. Paul Getty Museum [now at the Getty Foundation]

My Bookmarks

- Use bookmarks for exploring later.
- Touch the screen to bookmark the work of art.
- Recall a list of bookmarked items.
- Bookmark up to 50 items.
- Touch bookmarks to get a description.
- Get a screen for the item bookmarked and a map back to the item.

Location of Kiosks

We placed kiosks in transitional areas between galleries. There are both standing and sitting workstations available.

Online via the Web

- E-mail your bookmarks or set up access to an account.
- Follow up on your bookmarks while online.
- Continue on the Web to make bookmarks following or preceding a visit.
- If you bookmark at a kiosk, you transfer information via infrared.
- Transfers your bookmarks into your account on the Web.
- Explore those bookmarks in-depth at home.

Lessons Learned

- Support Many Levels of Immersion
  - We designed this for people who will never use a handheld, only the Web/kiosk.
- Keep the Information on Handheld Limited
  - We have eight years' worth of maintenance and content on items available, so there is lots of information available on the Web: biography of artist, videos, links to other works, etc.
- Keep Text to a Minimum
  - For the outdoors and screen glare, high-contrast graphics seem to work.

Questions and Comments from Forum Participants about GettyGuide™

Why did you decide to use mainly a text interface? Was this visitor-research driven?

We did usability studies and will be evaluating the effectiveness in the future. We did test glare in the plaza: We tested screens outside and they worked.

How many languages are available on the GettyGuide™?

Multiple languages are available, eight languages in addition to English. When there is a Spanish version available, you'll see a button above. You can walk up to the artwork and enter the number, like the older version of tours with random access. Captioning is also available for audio-impaired visitors.

How long was it from the time of idea to inception?

Many years! Our timeline:

- ArtAccess: Launched 1997
- GettyGuide™ design: Summer–January 2002
- GettyGuide™ kiosk pilot: June 2002
- GettyGuide™ handheld pilot: August 2002
- Kiosk launch: Summer 2003
- Handheld launch: February 1, 2005

You can start pre-visit planning on February 1, 2005.

When the visitor is done with the device, what happens to the bookmarks?

The visitor needs to save his/her bookmarks in an account or they will be lost—the device is cleared when it is returned. (Bookmarks from a handheld are synched to a kiosk for viewing while at the museum. You enter in your e-mail and they are sent to you.)

How much time do you estimate people will spend in the gallery vs. the transition area?

It will probably vary tremendously. Based on our visitor studies, we found that after 45 minutes people need a break.

What is the commitment of your organization in supporting this technology?

The archiving piece has taken the largest amount of effort, time, and cost. There is a huge amount of information on collections.

What user needs/problems are you addressing?

We conducted many evaluations early on of audio-guide Art Access. One was wayfinding and locating content in segregated places. The GettyGuide™ push was to get those resources out into the path of visitors and to bring relevant resources to visitors.

Our goals are:
- Supporting deeper, longer looking at works of art
- Wayfinding
- Limiting technology in galleries
- Supporting multiple levels of immersion
- Repurposing all existing art access/audioguide content
- Maintaining all content as data, updatable, and "migrate-able"
- Providing framework for personalization
- Providing framework for visit planning

I suspect your first goal of wanting visitors to look longer and deeper at works—they want to get more out of them—it must be hard for visitors to articulate.

Can people use their own handhelds?

Not yet. We're planning many tweaks in working with teachers.

Are you talking with gallery teachers who work with schoolteachers? Are you setting up bookmarks for certain topic areas?

Yes, that is all in the thinking.

Are you using devices to track activities?

Yes. There is lots of back-end data-tracking and creating reports

How long are they spending? Are they listening to the entire tour?

We are launching next month and we will find out.

Do you have a specific type of visitor in mind?

We talked with a lot of stakeholders to design a prototype visitor and came up with three

different prototypes. For example, one is a prototypical family of three living in San Diego: a professional, a homemaker, and a child.

ScienceAlive: Wireless, Location-based, Multimedia PDA Tour Guide

Jason Teo

Singapore Science Centre

Problem Context

Before showing ScienceAlive, I want to provide an introduction to our setting. Singapore is a nation with a population of four million. The Singapore Science Centre is a nonformal educational institution for the promotion of science and technology among students and members of the public. It has the country's largest collection of educational and exhibit materials devoted to science and has been acclaimed as one of the top ten science centers in the world today. The mission of the Singapore Science Centre:

> *To promote interest, learning and creativity in science and technology, through imaginative and enjoyable experience and contribute to the nation's development of its human resource.*

We Have

- 3 buildings
- 14 exhibition galleries
- 750 exhibits
- 10,000 square meters of exhibit space
- 650,000 visitors a year
- 40% visitors from schools

Cell Phone Adoption

- 80%–90% of Singapore citizens have mobile phones, color, camera
- Many cells phones are Bluetooth-enabled

Resulting in Happy Problems Such As

- Difficult to update printed content
- Getting lost in the Science Centre
- Too many events
- Too many shows
- Lack of human tour guides
- Too many panels to read
- Too much content to absorb

Earlier Solution: Pocket Geographic Solution

You buy a smart keychain for US$6. Using the keychain, you beam your keychain ID via IR (infrared) to a receiver, which Bluetooth(s) the information to the server. When you get home, you can log on to the Web and get more information on the exhibit.

This program lasted slightly longer than one year.
Problems:
- There was no instant gratification.
- The battery life was short and you couldn't turn off the device.

Our Wireless Solution: ScienceAlive

ScienceAlive is a location-tracked, multimedia, PDA-based tour guide. The guide is user-focused and user-driven by asking:
- What are you interested in?
- How much time do you have?
- Do you want a tour recommended?

For example, if you have one hour and are interested in physics, it will recommend a tour for you and a timeframe.

Why ScienceAlive?

- Reduce printing
- Visitors always know where they are
- Less staff required
- Instant update of exhibit content
- Low cost of updating information
- Easier and more customer feedback
- Revolutionize information delivery
- Continuation of tour even from home

Components of the System

- WiFi Pocket PC PDAs
- Server with positioning engine and ScienceAlive content engine with these features: Data Collection, Main Menu, Multimedia Tour, Exhibit Videos, What's On, Messaging, Feedback
- The system is currently set up for 802.11b and will expand to 802.11g in the future

Location of Visitor Is Tracked By

- Signal strength from three wireless access points (minimum) using 802.11b
- Positioning engine triangulates and calculates signal strength
- The system supports PDAs, laptop PCs, and WiFi tags. Using a positioning engine (Ekahau), ScienceAlive shows the visitors their location within the Centre. A minimum of 3 access points is required to triangulate the position with an accuracy of 1m. Initially, with 30 wireless access points, our original system had an eight-second delay in tracking the visitor's location. However, after upgrading to 45 access points, the delay is now down to two to three seconds. We are currently using the Dell Axim X30.
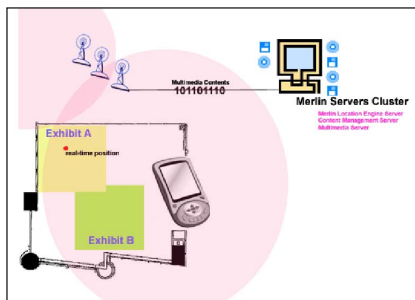
Walkthrough of ScienceAlive Screens

1. Data Collection

This collects a basic profile of the visitor, such as e-mail, interest, and age group.

2. Main Menu

Only four selections are available to make the system as simple as possible.
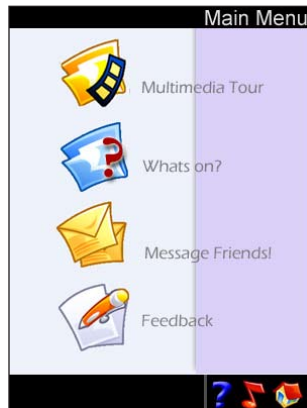
3. Multimedia Tour

This is the main feature, where visitors will be able to see themselves as a green dot, "walking" around the Centre.

4. Exhibit Videos

Upon clicking on the red dots representing the key exhibits, visitors will be shown a 20- to 30-second video of the science behind the exhibit.
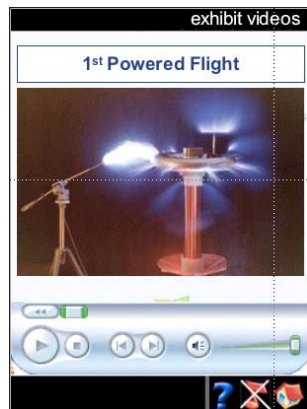
5. What's On
This feature shows a listing of events happening and allows visitors to request for a reminder of the event. When reminded, the system even shows the visitor how to get there.

6. Messaging
Don't enjoy ScienceAlive by yourself. Chat with other visitors and make friends through instant messaging.

7. Feedback
ScienceAlive also collects feedback after the tour is completed.

Questions and Comments from Forum Participants about ScienceAlive

What has been the reliability of the hardware?
- Relatively ok—we are currently testing five sets.
- We reduced bandwidth to 1mbps to simulate more users.
- We have funding from a government agency—money for experimenting, but not for implementation .
- In February 2005 we're going to do a trial.
- Official launch is in March 2005.

How does the "Remind Me" feature work?
- It comes up five minutes before a museum event starts.
- A line is drawn on the map that shows the visitor how to get to the event.
- It's just like GPS on the Pocket PC.

Does this work on the visitor's own PDA?

Currently, visitors will not able to install it on a personal Pocket PC, but at Macworld, I saw technology that will make it possible in the future. The setup sent the application via Bluetooth or IR to six different platforms (Palm, Pocket PC, Nokia, Sony Ericsson phones, etc.)

What about support for new PDAs and platforms?

Ekahau currently does release upgrades to support next-generation players.

Can children be contacted in the messaging feature?

Currently, yes, everybody sees everybody else. It may be a problem if anyone could contact your children. Any suggestions? Let's discuss it.

What's the processor speed on devices?

300–400 megahertz

Will you be charging for the devices?

Approximately US$3 to rent devices for the first two hours. Entry to the museum is about US$4.

■ **Research partners and team**
  • Robert Semper, Exploratorium, San Francisco
  • Mirjana Spasojevic, HP Labs, Palo Alto
  • Gaetano Borriello, University of Washington, Seattle

■ **Nomadic inquiry**
  • This area of research addresses how people integrate knowledge learned across different settings.
  • In the future from any point in the world, you'll be able to access anyone and any information online.
  • Controlled ubiquity is created within a specific space.
  • Moving through the physical landscape, the learner makes inscriptions.

■ **Instructional challenge**
  • How do we promote and sustain nomadic inquiry across formal and informal learning environments?

■ **Background research**
  • Network paradigm—Our original view: a visitor has an experience online, comes to the museum to play with exhibits, then goes home to do more activities.
  • Our evaluation found that those who would take time to download and use the Web before coming to the museum were mostly educators.
  • The majority of visitors just show up at the museum without preparation. So, our new paradigm became "Can we capture their interest while they're here and encourage them to continue their inquiry at home?" We are currently testing this hypothesis.
  • The idea is that we capture their interest at the museum and encourage them to continue their learning after they leave the museum. At home online, visitors can access more online content, interactives, and digital libraries.

■ **Wireless setup**
  • 802.11b
  • "Point-of-Information Station" to capture photos and hold IR beacons
  • Mobile Web content built for HP Jornada
  • Wanted to avoid heads down, visitors isolating themselves
  • Wanted to promote interactivity
  • Did research with visitors, teachers, and students
  • Guidebook transcript analysis from interviews

■ **Differences across uses**
  • Teachers saw this as an extension device.
  • Teachers would have conversations and put devices into a pocket.
  • Explainers could multitask and switch back and forth.
  • Mixed results with visitors: Prompted new interactions with exhibits, but also was socially and physically isolating.

■ **Isolation felt by users**
  • "Tips and Tricks" content
  • Isolating socially and physically
  • Tried using both single- and two-earred headphones
  • Need two hands for some exhibits here—once handheld goes into pocket, doesn't come out

■ **Bottom line**
  • The handheld motivated play with the exhibit, but switching modes was difficult between playing with exhibit, reading text, and watching media on handheld.
  • Isolation was an issue.

Wireless Technology and Handhelds Research at the Exploratorium

Sherry Hsi

Exploratorium

■ **Looking at post-visit experience**
  • Successful—many people wanted to go back online for more information.

■ **Learner interaction in informal settings**
  • Using it for
    - Exploring
    - Requesting information/Asking a question
    - Documenting/Remembering
    - Reflecting
  • Not using it for
    - Playing a game
    - Collecting, measuring, or monitoring
    - Assessing and evaluating
    - Communicating and collaborating
    - Seeking expert advice or recommending
    - Creating, building, or modeling

■ **In our redesign, we considered freeing visitors' hands and designing for nomadic inquiry**
  • Visitor application
    - eXspot RFID system (Radio Frequency Identification) for use by the general public, school field trip, and educators
  • Explainer application
    - Wireless handheld (iPaq) designed for museum docents who work at the Exploratorium

■ **Visitor application goals**
  • Extend museum experience
  • Link physical experience to later activity and reflection
  • Provide online, persistent space for inquiries across multiple settings
  • Study nomadic inquiries over time

■ **RFID token designs**

  Card, yoyo, necklace, watch, coaster

■ **Paper prototype evaluation**
  • Developed paper mock-ups to get feedback on what might be a good post-museum experience or set of activities

■ **Visitor application eXspot**
  • Visitor gets card
  • Goes up to an eXspot exhibit
  • eXspot reads card and links to user's online account
  • Wireless and low-powered
  • Speaks to server
  • Takes photo at exhibit and stores it on server
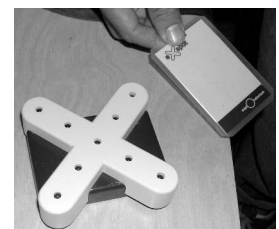
■ **Explainer application eXspot**
  • Guidebook
  • Search interface
  • Mobile inquiry tool

■ **No conclusive results but a lot of research has been done**
  • Will be doing lots of data collection in the next few months

Questions and Comments from Participants

Do you have partners?

- We know of other places like the Tech Museum in San Jose that have RFID within the gallery and are thinking about how to synergize around the same technology
- Where and who hosts the content and the branding around it? We haven't worked it out.

Do you have more recent data about follow-up on the Web? From studies of other systems in museums, the data was very low—are you seeing more follow-up?

- Our data is not significant, but it's hovering around 35% of visitors who are following up on the Web.
- I heard that wristbands with RFID are keeping cost down. Nice bracelets can lead to follow-up—we can e-mail/buzz them as reminder—but bracelets cost more.
- There is a museum that has a vigorous bookmarking program that is getting low follow-up—5%. We hope to see increases as customers become more used to the technology.

Why can't this be designed like a Gameboy? It seems there is already a user group of Gameboys.

Since participants are interacting, can you capture them doing something, such as taking a photograph that goes back to them, a photograph of themselves interacting with an exhibit?

- Visitors like the personalization and they like high-quality images.
- You can trigger that kind of picture-taking at an exhibit and have time to put yourself in the scene.
- It would not necessarily have to be a picture of themselves; it could be a picture of what they created at the exhibit.

Handheld users are simultaneously immersed in virtual and real worlds. What are technology issues? Have you done any wearable computing?

- No

One goal of our Exploratorium research: develop an instructional design framework for handhelds

- If someone is going to design a handheld, what would s/he need to do to foster learning?
- What are the affordances of these small devices? We need to articulate all of these.
- What are we doing here at the Exploratorium? This is an open exploration.
- There are communication affordances of these devices—allowing both visitors and staff to exchange text messages or use handhelds as walkie-talkies. If we introduce new capabilities, this will necessarily change the nature of the museum and how people behave in the Exploratorium.
- This is a fertile jumping-off point for brainstorming.
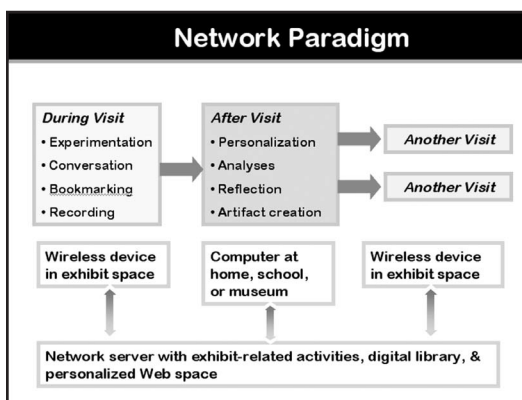
What expectations do visitors bring when they come?

- Visitors including teachers with kids on field trips bring many different goals, including leisure, entertainment, and learning.
- Visitors may expect Explainers to help provide answers about exhibits, so we don't want to replace the role of Explainers with a handheld, but support Explainer training and preparation.

The Ubiquitous Camera: An In-depth Study of Camera Phone Use

Mirjana Spasojevic

HP Labs

I have been working with folks here at the Exploratorium for the last couple of years. Sherry gave a great overview of the past couple of projects over the past four years of research, including some pictures from early prototypes using old Jornadas. How can you provide context-aware applications? How can devices know where you are? We are supporting the delivery of information through wireless infrastructure. We identified various kinds of applications—informing, suggesting, communicating, and remembering (via bookmarking.) I'm glad to see that some of these applications are being rolled out. In 2002, we had the "Rememberer" to:

- capture your experience in the museum
- use different kinds of tokens
- bookmark
- insert a link or take a photo of the exhibit
- annotate and see these pages later at home

Camera Phone Study: Motivation and Questions

Let's fast-forward to 2005. There are new kinds of handheld devices: mobile phones and camera phones. Looking down the line at new technologies, the spread of camera-phone technologies and cell phones is growing exponentially. There were more camera phones sold last year than regular phones.

- Range and diversity of use: What do they actually do with these devices? We know people have these devices. What do they do with them if they're not sending messages over the Internet?
- Characteristics and context of use: What are people doing with camera phones? People were not using multimedia messaging. Why the low rate of capture-and-send?
- Who are they? Where are they? Why do they capture? Do they try to store it? Send it? Annotate it?
- Where are there opportunities for new devices/services?

Our goal was to investigate emerging behaviors of camera phone users and understand opportunities. In the summer of 2004, users were recruited to participate in a study. Users were various, ages from 13 to 50+, in the US and the UK. We worked with a variety of camera phones and service providers. We did an analysis of 320 images (randomly selected) and captured information about where, why, who, and what they did with the image after it was taken.

Key Findings

- These are first-class imaging devices; people use them a lot.
- A new genre of casual, spontaneous images was created.
- The taxonomy of image use was social/personal and functional/affective.
- Implications for design arose.

Content of Images

- 50% have people in the image
- 50% have different spontaneous image subjects
- Food
- Presents
- Books
- Flowers
- Indoor/outdoor scenes
- Specific information—capture something to remember

Our findings are consistent with anecdotal reports about what people choose to photograph.

Taxonomy of Reasons for Capture

Taxonomy of Reasons for Capture

294 captured images: 278 photos, 16 videos
Coded 1-2 intended uses (& 0-2 additional uses, not shown)

	Social*		Individual
	co-present	absent	
Affective	Mutual experience 103 (35%)	Absent friends/family 63 (21%)	Personal reflection 120 (41%)
Functional	Mutual task 12 (4%)	Remote task 22 (8%)	Personal task 29 (10%)

*Sharing with people co-present or absent at the time of capture

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- ■ **Taxonomy of Reasons for Capture**
  - Social vs. individual—to be shared or for personal use
  - Mutual experience—people are co-present
  - Sharing experiences with people who are absent
  - Affecting vs. functional—emotional connection to subject/occasion vs. task/information/reminder
    - People do use these devices because they are always with them.

- ■ **Some Examples of Mutual Experiences**
  - Enhancing the moment
    - A shared memento
    - Most images are of people—some show a relevant object
  - Public social
  - Many captured on phone and stored later on computer
  - Absent friends and family
  - Specific things
    - Images not obvious to someone other than the sender/receiver—context is important
    - Evidence of house projects, new car bought, flowers sent
  - "Look where I am" images captured and instantly sent
  - Teasing the recipient

Questions and Comments from Participants

Can people send an image while they are talking on the phone?

- Multimedia messaging works independently. You can send messages but don't necessarily receive responses. The users aren't talking at the same time.
- It can be perceived as SPAM because it looks like an e-mail attachment.
- The photo exists out of context, unless you were on the phone at the time. Then it would have been in context.
- People complain that it takes effort to both talk and send images simultaneously. A higher threshold of technology awareness is necessary to send images while talking.
- If it's not simple, they forget it.

What phones were used in the study?

- We used a whole range of phones—just about all of them.
- Almost all of them are just VGA quality.

- Higher-quality phones are just now arriving in the US market.
- Some people are more into taking camera-phone pictures and putting them into their BLOGs.

Did you track how much people shared their images by passing their phones?

- The most predominant way of sharing images was to pass the phone around.
- This was more prevalent in the UK market.

Did you see people using the phone as a digital camera?

- We did for some people.
- Quite a few did send photos.
- Its presence in daily life makes it different from a digital camera.
- Images about spontaneity—there were examples of people taking images inside of museums.

I didn't see any images from museums in your presentation. Can you say more about this?

- I did see images from amusement parks.
- I [forum participant] was at massive change exhibit—most of the exhibit is about words—I saw a guy whip out his camera phone to take a picture of some of the information.
    - We've been wondering about the prevalence of the images of things and have been experimenting with these devices. Cameras are good at taking images of stationary objects, but not good at taking images of movement.
- Users expressed disappointment with some of the features.
- New phones will have better components.

What else would you do if technology was not an obstacle?

- General Likes and Dislikes
    - Likes
        - › Presence in their daily life
    - Dislikes
        - › Image quality
        - › Poor lighting
    - Mixed opinions on sending
        - › Too slow
        - › No immediate feedback
- Wishes in Relation to Images Discussed
    - Want to print the images but not high-quality
- Overall Observations
    - First-class imaging device
    - Substantial use
        - › Affective, personal, and social, but also functional
        - › "Carry it everywhere" is a typically mentioned advantage
        - › Spontaneous capture
    - Implications for design, products, and services
        - › Design to recognize diversity of activities
        - › New and compelling genre of communication
        - › Need to remove obstacles
        - › Allow users to explore environment
        - › Showing in the moment on appliances
        - › Giving in the moment
        - › Strongest moment for sharing is at the moment of taking
        - › How to facilitate the sharing
        - › Connecting in the moment
        - › Tools for mementos and records
        - › How can we make it easy to transfer images to nearby devices?

Sound Bites from Participants

The following are responses given by participants to the question, "What are you puzzling about?"

- The sense of place is really important.

- The question of the form factor and the hardware: PDAs seem to be on the downswing, and the Apple iPod is not a communication tool. Cell phones seem to be taking on the role of the PDA in terms of visual functions. How do they fit into art museums where cell phones are not allowed in the gallery?

- In the future, it's going to be cell phones: They'll be networked, they'll have a camera, everything. It's not a question of what platform we're moving toward, but rather how do we work with the platforms we currently have and link them? How do we cost effectively develop content that will not be lost as technology develops?

- I'm interested in transcoding services: If something is designed for one aspect ratio, how do you get it to be readable for other devices?

- Why does learning come second? John Seely Brown, the former Director of Xerox PARC, commented that overhead projectors were used first in bowling alleys! The concept of "worldware" at the time raised the question, "Could word processors be used in education along with information technologies?" Unless information technology is designed into pedagogical experiences, it won't be used.

- Devices are converging upon cell phones, whereas the Ipod is an example of a device made for one purpose. Apple went down the road of NOT making one device that fits all purposes.

- As far as the form factor is concerned, it is probably the case that with phone/PDA devices, we are heading toward one device. There will still be a proliferation of "horizontal" devices. Other devices, such as a graphing calculator, are single-purpose devices. Where do you need a vertical versus a horizontal device?

- There's the issue of PDAs being something that takes you out of interaction. How can we design it to throw you back into interaction with an exhibit or other people? In education, there was a study of PDAs in 100 classrooms. PDAs could provide a private practice space and quickly be shared. Both dimensions were valued by teachers and students.

- When talking about integrating mobile technology in classrooms, we have to look at the realities. For example, a friend teaches in a fifth-grade classroom. She can't give tests because students are taking pictures of tests and passing them to others with their camera phones.

- As these technologies start merging and many people are walking around using his or her own device, not everyone will have Pocket PCs. How do we address that in museum settings?

- People will have different preferences for different devices. Not everybody will want to use the screen size you select, so whatever is designed needs to be portable to all types of screens.

What Are You Puzzling About?

■   If 40% of people are students, why aren't we taking the teachers to the Web site and having them select their topics? Let the teachers select their topics, then set up specific exhibit tours for students with embedded activities. Interact with other people around that exhibit. Provide a report for teachers about how students interacted with the exhibit. Did they "get it" or do they need more teaching time around the topic?

■   I walked out on the museum floor on the break and noticed an incongruity. This is not an art museum. People explore this museum with their entire bodies. Visualizing people using PDAs to explore this museum is a challenge. In 1997, I was an artist in residence at the Exploratorium working on an exhibit looking at what people carry with them. I'm interested in what people carry. In the old days we wondered what devices we might hand to them to get them to leave their backpacks and bags behind. No one was wiling to leave their stuff behind. Unless you have a mandatory coat and bag check, they take their stuff with them. You want to have that stuff with you; you won't leave it behind unless you have to. Everybody carries weird and idiosyncratic stuff. I'm curious about what Exploratorium visitors are bringing with them. Is there a way, other than handing them something new, to get them to use what they already have?

■   Visitors are coming to see a work of art. If we can't come up with something that makes it easier to do that, we're not doing our job. It speaks to the part of this that's an art not a science. The platform will change. And we have to address the digital divide: Not everyone will carry these devices. It's not about technology, it's about the aesthetics. The technology needs to work with all the visitors.

■   I'm interested in the difference between a museum-based, informal/ad hoc learning experience versus an outdoor learning experience.

■   We need to consider how we are going to sustain use of mobile technologies for learning and digital content delivery.

■   There's a gap between the museum stakeholders, content providers, and users, and how they want to use mobile devices. Users don't want to have a deep interaction with these devices. How are we going to bridge this gap?

Overview of Demonstrations

Carolyn Staudt—The Concord Consortium

■ This was a demonstration of probeware: sensors and probes that work with handhelds. Probes (or sensors) are used with a computer to measure physical aspects of the world around us, such as temperature, light intensity, velocity, air pressure, and pH.
■ Some of this technology we've been using for nine years.
■ It works on cross-platform applications.

> **http://www.concord.org/teemss**
>
> **http://teemss2.concord.org/**
>
> **http://probesight.concord.org/**

Holly Fait—Exploratorium

I showed two prototype applications that use wireless technologies.
■ eXspot
  • This uses RFID (Radio Frequency Identification) and wirelesss readers to extend a visitor's museum experience to home.
  • It bookmarks a visitor experience and, in some cases, triggers a camera to capture a photo for later viewing.
■ Iguide
  • This is a Flash-based application for Explainers, our museum docents, that runs on an iPaq, co-developed by Digihound. Information is organized into three types of exhibit-based information: learn, try, and reflect. The user can search for information by phenomena, exhibit name, and if we had positioning system in place, by floor location too.

> **http://exspot.exploratorium.edu**
>
> **http://www.exploratorium.edu/guidebook**

Chris Tellis, Mandy Smith, Jodi Burke—Antenna Audio

■ We demonstrated a multimedia guide that was designed for the Van Gogh Museum with British Sign Language (BSL).
■ The application provides definitions of terms not in BSL.
■ Terms are added to the BSL dictionary.

> **http://www.antennaaudio.com**

Anita Wilhelm, Erick Herrarte—Caterpillar Mobile

■ We showed an application on a mobile phone called Zooke—a scavenger hunt in which players take on a challenge (e.g., find the ugliest handbag), annotate photos in the context of the museum situation, and aggregate experiences. Users then log onto the Web when they get home and view their photos, as well as others.

> **http:// www.caterpillarmobile.com**

Kiyo Kubo, Philip Hawthorne—Spotlight Mobile

■ We developed two tours in partnership with a team at Cornell University.
  • The first application, Imprints, is targeted at third-grade students going to an art museum.
    - Visitors can leave their mark by creating a digital stamp for the traveling Byrdcliffe exhibition that is automatically put onto each exhibit visited. They can leave a trail and follow other people's trails. A photomosaic is then created of all the stamps

Demonstrations

at one of the objects. Visitors can see his or her stamp as part of the art in the museum.

- The second application, Museum Detectives, is also for third graders in an art museum.
  - Students got a list of questions on paper then walked into the museum.
  - They went through the tour and answered the questions.
  - All the groups came together and shared what they had studied.
  - When the questions were replaced in a PDA tour that engaged students more significantly, they took real ownership of the object. The retention was very high compared to the paper tour.
  - The PDA tour was also engaging for kids with learning disabilities.
  - Researchers at Cornell University are reviewing the hours and hours of videotape data.

http://www.spotlightmobile.com
http://www.hci.cornell.edu/projects.php?id=3

David Bell, Janet Green—Digihound

■ We demonstrated two applications for science museums that we helped to develop.
- Chabot Space and Science Center Application for Explainers
  - A Web beacon sends URLs into a PocketPC—a PDA would retrieve multimedia applications from a server.
- The Iguide for museum docents at the Exploratorium
  - For iPaqs, we co-developed iGuide with the Exploratorium. In this Flash-based, cold-fusion application, the other applications and keys are disabled.

http://mydigihound.com/index.cfm?fuseaction=guide

■ It's very noisy in the Exploratorium!

■ Sense of place is so important. Looking at the demos in the Exploratorium with everything going on was difficult. It was difficult to see the demos out of context. There was so much I didn't get from the demo because I was not at the museum.

■ Visitors go to museums and say, "Wow! That's famous. That's worth a lot of money." These devices give people the opportunity to go deeper, but there needs to be a balance. Interactive museums like the Exploratorium enrich interaction with these highly kinetic exhibits.

■ Antenna Audio is doing a lot more with memory on-board. As memory prices come down, we at Antenna are doing more.

■ There is a project at Intel Labs on personal servers: You can hold your life's data and personal information on a tiny server. This may change the way we think about information and mobility.

■ Transfer rates for streaming are also going up so it may not be an issue in a couple of years.

■ Content from the Discovery Channel can be repurposed.

■ There are multiple modes of sensory possibilities. Can we use media to broaden accessibility to people with disabilities?

■ It was interesting to see in Kiyo's demo of the Cornell MUSE work that allowed kids to construct a virtual tower while they were viewing the actual tower in the museum.

■ Looking at Kiyo's exhibit reminds me of a Smithsonian exhibit: lots of video, high-performance. The weakest link is positioning. Performance takes a back seat to the god of positioning (streaming). They have content on board, so it's a rich experience.

■ This technology allows people to have their own experiences in a personal way; it gives them a gift to take home with them. I saw someone taking a video of an Exploratorium exhibit to take home. How do we use these devices in ways that we touch people a little bit and allow them to approach the exhibits in a different way?

■ This place (the Exploratorium) is way too busy. Allowing visitors to explore deeply could be a distraction.

■ We talked earlier about the low rate of follow-up. What about the idea that the value is not in the keepsake but rather in the act of making it? The act of bookmarking can be useful whether or not visitors go back to it. It gives them something to take with them if they're looking for it.

■ It's a circus out there. We're thinking of the handheld as the solution for all environments. There are environments of distraction and of contemplation. These devices are not going to be used in the same way in both environments. We cannot make them complementary. It just may not work.

■ Some people go to the Louvre and say, "I just want to see the Mona Lisa. What's the fastest way to get there?" The issue is wayfinding quickly.

Comments on Demonstrations

■   The Getty's experience with location was valuable. We wanted to give people content interpretation. Stationary devices were unsuccessful.

■   There is the issue of the appropriate depth of immersion. Depth is not always what we want in all settings.

■   What we want to create for all environments won't be the same. What we create for all users will not be the same. There is no one-size-fits-all solution.

■   Are we giving people options with the tools to individualize their experience? In terms of reflections, what are the different ways the tools can mediate and enrich an experience in a museum or anywhere?

■   There is research in science learning that shows that when students look at physics exhibits without expert counsel they don't learn as much. This speaks to the need for continued presence of Explainers.
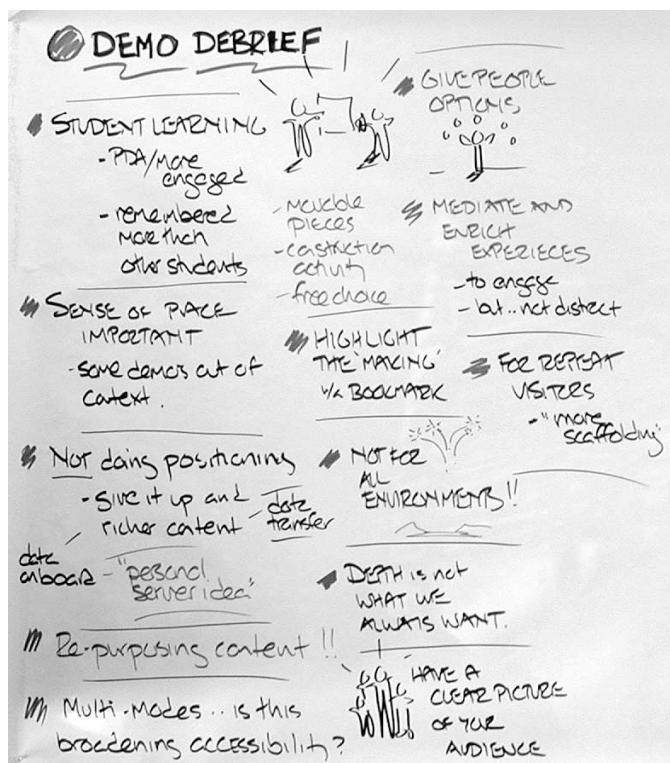
I'm going to talk about what we've been doing at the Field Museum in building up our wireless infrastructure. In 2001, we tested with handhelds called Stanley. The results of the visitor experience research led us to question the PDA model and think of other mobile devices such as cell phones. We had an interest in public handheld applications and a trustee vision of "the next generation of audio tours." We identified strengths and weaknesses of Palm Pilots, participating in the CILT program (www.cilt.org) and in Cornell/Intel CIMI Handscape Initiative. Our goal was to push the next generation of audio tours, identifying three possible trajectories: public learning, zero-interface exhibits, and staff applications (including Citizen Scientists doing fieldwork).

With little momentum from applications testing, we pursued laying the infrastructure groundwork for future applications. We started with anecdotal understanding that we had cell phone "dead zones." We then undertook a dead zone survey and developed a business model.

We identified the variety of services the infrastructure could provide.

- Cell phone—public and staff services, public safety justification

- WiFi—staff, public, and emergency services applications

- Radio—security, emergency services, and staff applications

Business Model Findings

- We were in a significant city dead zone.

- There was a possibility for cell phone revenues to fund capital cost.

- We could also bundle a WiFi and radio (emergency services) infrastructure.

- Wireless infrastructure buildouts were moving to internal facilities.

- A company conducted a dead zone survey, testing all five wireless carriers by exploring around the entire Museum with cell phones to identify dead zones.

- In the beginning, we wanted the infrastructure to be cell phone and wireless and did not consider radio, but have since come to a realization about the personal/public safety issues.

- We asked for all services, cell/data/radio to be built out.
  - We didn't care about programming that would come later.
  - We focused instead on an infrastructure model envisioning converging technologies.
  - Because we were in a city [Chicago] dead zone, the site gave us an opportunity for cell phone revenues.

Strategy for Pursuing the Initiative

- We followed up on this promising information by laying groundwork with current and potential partners.
  - We developed RFI for responses from neutral host providers: They partner with carriers to cover capital cost of building towers and then share profits.
  - We invited other Museum Campus institutions (Shedd Aquarium, Adler Planetarium) to participate.
  - We invited Soldier Field to participate.
  - We invited the park district/city to participate/sign off.
  - We invited OEMC (Office of Emergency Management and Communications, City of Chicago) to participate.

Mobile Phone Partnerships: Case 1

William Barnett

The Field Museum

- ■ We provided a bigger community of tenants.
  - • We made a wireless real estate proposition.
  - • We have more people to collaborate in selling to the cell phone providers.

Resulting Infrastructure Program

- ■ The negotiations resulted in the following infrastructure program:
  - • In-building antenna system for 100% internal coverage. This system would cover 800 MHz to 1,900 MHz for all cell phone systems and radio.
  - • External cell phone antenna system: Also from 800 MHz to 1,900 MHz, it would cover the Museum campus, Lake Shore Drive, and local harbors.
  - • Internal WiFi antenna for 100% coverage will be installed, with an external "halo" of 100 meters for outside applications.
  - • Construction impact: 1,500 square feet "carrier hotel" space requirement within the Museum
    - › We would secure Museum LAN integration requirement for staff WiFi applications

Takeaways

- ■ The nature of the opportunity depends on the local cell phone buildout.
- ■ Neutral host providers can operate the infrastructure and handle carrier negotiations.
- ■ Partner early and often, particularly with local government. Broader partnerships elicit more carrier interest.
- ■ Don't be afraid to ask for the things you want.

Field Museum Wireless Infrastructure SWOT Analysis Summary

Strengths
Will improve visitor service and life safety by eliminating Museum cell phone dead zones
Will improve visitor service and life safety by reducing Campus cell phone dead zones
Will improve life safety by improving radio service throughout Museum
Provides wireless data access throughout entire building and to Campus near Museum
Ongoing revenue stream to Museum
Builds out part of Museum's infrastructure at no cost
Reduces networking costs of CRC and East Entrance
Enables new wireless data applications

Weaknesses
Cell phone calls in public halls may be a nuisance
Possible hidden installation costs such as asbestos removal
Requires commitment of 1500 sq. ft. space for carrier hotel

Opportunities
Provides capability to develop wireless exhibit and educational applications
Fundraising opportunities for public spaces that use wireless technologies
Establishes Museum's leadership as a technologically progressive institution
Opens relationship with cell phone carriers (Verizon, Sprint, US Cellular, Cingular, T-Mobile, AT&T Wireless), cell phone manufacturers (Motorola, Ericsson, Nokia), and wireless infrastructure companies (Cisco, Intel)
Wireless access will be a value add for marketing corporate events
Carrier hotel on site allows us to better leverage carrier business relationships
Collaboration with OEMC for emergency situations and high-profile events
Potential site for the testing new technologies
Possible increased appeal to families and teenage attendees

Threats
WiFi security risk to Museum's network if connected for internal applications or staff use
Possible revenue impact if noise affects attendance

Questions and Comments from Forum Participants

Media focus right now appears to be on the cell phone nuisance angle. Can you comment upon that?

- "Make dinner plans while perusing the personal effects of Jackie O! Argue with your spouse while pondering the world's largest T-Rex skeleton! And—by all means—let that Ozzy Osbourne ring tone rip through the Hall of Jades!" (Jeremy Mullman, *Crain's Chicago Business*, January 3, 2005) Yes, this is the media angle.

Beyond this cellular infrastructure capability, what are your plans for using these spectrums?

- We hope to develop staff applications—some of our galleries have not been wired—we can use WiFi. So, we got it done for free. Collections managers can work with their exhibits using WiFi.
- Cell phones in the museum is a policy issue.

Do you own your building?

- We have a lease and control everything within our footprint.
- When we tried to do it here—at the Exploratorium—the city said they owned the airspace. And, because the Palace of Fine Arts is a historical landmark, we are not able to put up a cell phone tower.
- If we want to have staff applications, these are on our land, and we can do any of our applications for free.
- We don't control public access. Cell phone providers profit from any public access charges.

Was the Art Institute of Chicago involved in this?

- They're more interested in getting the cell phone revenues than about getting cell phone access inside.

There are costs because the public won't have free access to it. We've gone to the dark side. The city put up WiFi points with free public access. You make a choice between giving service away for free and ensuring a sustainable and well-managed and secured service. We chose the latter, partly because we had no option to pursue the former.

What about support for the WiFi network? Does support follow under your staff? What about the secure integration piece?

- We build and maintain the gateway between their network and our network. They maintain and update the network.

What was the motivation for wanting internal cell phone and WiFi coverage?

- We envisioned in the next five years the convergence of wireless/data phone. We didn't want to design something that would be obsolete in five years.

Mobile Phone Partnerships: Case 2

Wayne La Bar and Denise Bressler

Liberty Science Center

Liberty Science Center is in the middle of $104 million expansion and will close in September 2005. We are located in Jersey City across from lower Manhattan—less than a mile from the former World Trade Center—and immersed in the radio emergency infrastructure of the area. We are moving staff off-site to a train terminal in Liberty State Park, which is being converted into office space, and opening a 3,000-square-feet exhibition space. We are striving for a different type of exhibits, especially something innovative, and different audiences.

What Is SNSE?

Science Now Science Everywhere (SNSE): Similar to a sensei ("teacher" in Japanese), SNSE, we hope, will be a "guide," providing science content and experience whenever and wherever you want it—both inside and outside the museum.

Key Aspects

■ People bring and use their own devices
  · Cell phones
  · Wireless devices
  · PDAs
  · MP3 players

■ Provides a variety of ways to access this network. Content is accessible both at the museum as well as outside the museum via cell phone, WiFi, or land-based networks.

Reasons

■ Frees us from buying the infrastructure
■ Like the idea of impacting our visitors at any time in their lives
■ We're impacting our non-visitors
■ Users can interact with content in ways that are familiar
■ Doing this in ways that are pervasive and "sweet"

Project Components

■ Proof-of-concept phase: January 2005—December 2006
■ Two-year process
■ Four applications being tested in conjunction with new permanent exhibit "Eat and Be Eaten" at temporary location during building expansion
■ Simultaneous research about how learning occurs with mobile devices
■ Broad-based dissemination of findings through Web and meetings

Applications: The applications we envision are based on how people already use their mobile devices.

■ Keep data—MP3, PDA, etc.
■ Customization—ring tones, skins, etc.
■ File sharing—sending photos
■ Interactive experiences
■ Communicating

Therefore, we first test applications.

■ Tour of Eat and Be Eaten
  · Can go on own device
  · Take device with you
  · Share with friends
  · Permits outdoor use (park is right outside the terminal building)

- Include tour of river walk and virtual wildlife
    - Animal calls of birds and frogs
    - Download calls onto device—use as ring tones on phone
- Social networking that goes on via mobile devices
- User takes care of an animal that was downloaded on his/her own device
- User can see predator-prey relationship when s/he meet someone with another animal on his/her device

■ Be a field reporter

- Might be a collaboration with Caterpillar
- Take photos of animals in exhibits/park/vacation and send photos to us
- Get people to look at photos
- Cluster the animals into categories

Partners

■ Dr. Ricki Goldman, New Jersey Institute of Technology (NJIT)
- Research on how people learn
■ Verizon and Verizon Wireless
- Grant and technology infrastructure
- President is on museum board
■ Lucent Technologies
- Helping with infrastructure
- Lucent has been great; Verizon has been a bit more difficult.
■ Liberty State Park

Learning Research

■ How are mobile devices changing the way we learn?
- Conducted by Dr. Ricki Goldman of NJIT
- It's clear that they do change the way we learn. Why?
- Trying to gain insight into how they change the way we learn
- Have two middle school classes that will participate in the research
- See cell phone and mobile devices increasing in that age range
- Methodology: ethnography—Goldman will observe children using SNSE onsite and during follow-up meetings. Research will be recorded in a blog and on videotape.

Visitor Evaluation

■ Institute for Learning Innovation will do M-learning (i.e., mobile learning) evaluation to look at public visitors in "Eat and Be Eaten"
■ Methodology: semi-structured interviews onsite with follow-up phone interviews, comparison of SNSE users vs. non-SNSE users

Dissemination

■ Web resources
- www.lsc.org/snse/snse.html
■ Three blogs
■ Two planned ASTC (Association of Science-Technology Centers) "rap sessions" conferences: ASTC, MLEARN

Questions and Comments from Participants

Industries tend to tack on features because it's easy to do, and they can charge more for the phone.

- There is a play among technology features.
- Service costs are also a factor: It's all about the minutes.
- Think of it in terms of watching soccer games on the phones.

I am curious about how this US application compares to Singapore. Do people pay by the minute in Singapore?

- Incoming calls are free, but we do pay by the minute for outgoing calls.
- Mobile calls are much cheaper in Singapore.
- We do pay for WiFi—monthly subscriptions for US$20.
- Minutes from different subscribers work together.
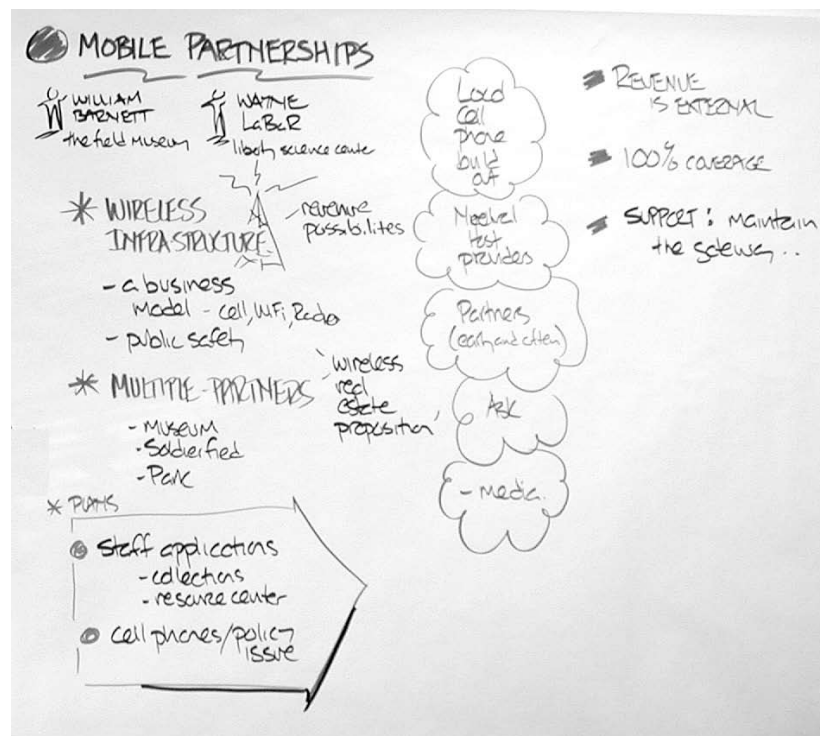
We're going to form small groups to discuss puzzling issues. What's important for the group to discuss?
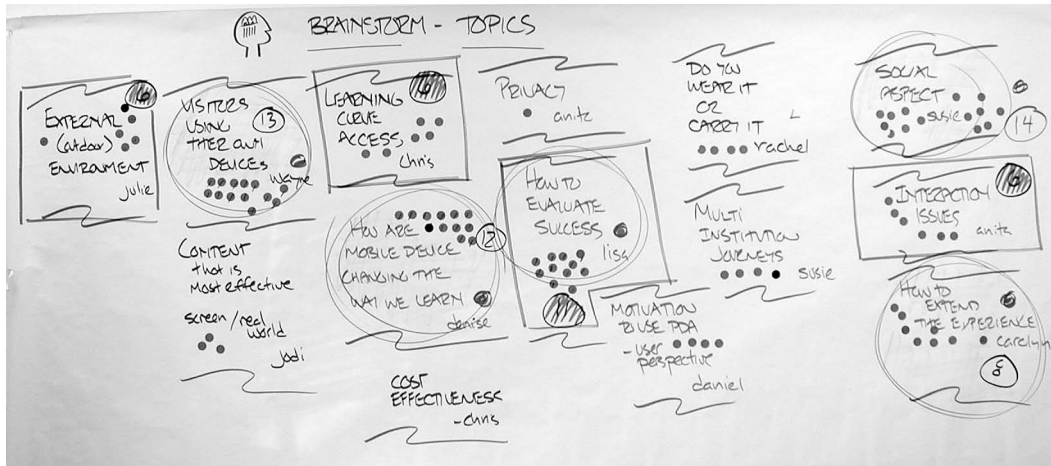
- What are the larger social aspects?
- Do you wear the device or carry it?
- What are the interaction and privacy issues?
- Learning-curve access: How do visitors become comfortable?
- Are visitors using their own mobile devices?
- How do we evaluate the success of these programs?
- Multi-institution journeys: How do you foster experiences across institutions?
- External environments: How can we use the outdoors/urban spaces?
- How are mobile devices changing the way we learn?
- What is the motivation to use a mobile device from a user perspective?
- What types of content are most effective? What is the balance between screen-based and exhibit content?
- How can you extend a visitor experience?
- How do you design a cost-effective solution?

[Participants voted on their top three choices using stickers.]

And the winners are . . .

Group 1: Social Aspects
Group 2: How to Extend the Visitor Experience
Group 3: How Mobile Devices Are Changing the Way We Learn
Group 4: Visitors Using Their Own Devices

Group Reports

Group 1: Social Aspects
- How do you create the tools and the experience? There is a tension between social interaction (too many people) and a single device.
- How do we become savvy about keeping it customizable/personal/special while also addressing the social needs?

First Day
Breakout Groups

■ Our models for good social interaction may not meet the needs of existing museum space.
   • There are a pervasive set of social norms.
   • For example, IM (Instant Messaging) is a technology tool and it is social, but it may not be appropriate for a museum space.
■ Question for the group: Did you make connections between social stuff in museums and social stuff on the Web?
   - Online gaming
   - Open-content models
   - Visitors providing and rating content
   - Models would have to be adapted for museum environment

Group 2: How to Extend the Visitor Experience

■ Does not include Web-only visitors
■ Goals
   • Making learning more meaningful
     - No Child Left Behind–driven
     - Allowing focus on key topics
     - Teaching experience in museum—teacher takes certain experiences back to classroom.
   • Increasing repeat visits
     - More repeat visits mean more money—when visitors view Web extensions, it may motivate them to come back to the museum.
     - Advances lifelong learning.
   • Web site is current extending-the-experience model
     - Requires intelligence and identification.
     - There are privacy issues (COPPA—Children's Online Privacy Protection Act of 1998).
     - Look at mementos you bring back with you.
     - Postcards at *The Americas* exhibit at the Field Museum: Visitors could e-mail an online postcard to people.
     - Pre-visit and post-visit experiences—there is a standard model that we use for formal education.
   • Tie in to educational standards and/or visitor expectations
     - People have expectations that are formed before they come to the museum.
     - They're going to have the experience they predict they're going to have before they come.
   • Requires intelligence to deliver the information you want
   • Need to identify the group—gives data about the group
   • Needs to be educator- or participant-defined
     - Extension of the visit is something they control.
     - Our role is to help them do it in the way they want to do it.
     - We need to understand user beliefs about our institutions (e.g., natural history museums viewed as the dead zoo).
   • Needs a first step to define goals—understand visitor cycle—to define a framework
   • Exploratorium's great Web site
     - How do you get people to go to the Web site after they visit?
     - When you walk around the Exploratorium, you don't see their Web site advertised.
     - Visitors don't know there is a follow-up option.
     - More people come to the Web site than to the museum.
   • Multi-institute journey
     - We need to think beyond our own institution and extend by going to multiple museums.
     - For example, we could go from the "dead zoo" to the "live zoo."

- Bookmarking
  - I'm not sure I want to go to multiple Web sites to visit my bookmarks.
  - Create cross-institute bookmarks.
  - Bookmarking is a lot like collecting crushed pennies, national park stamps, etc. from various institutions.

Group 3: How Mobile Devices Are Changing the Way We Learn

■ Mobile device—users are probably not going to dive into a whole lot of content.

■ They want information in short snippets.

■ Why?
- Low bandwidth
- Inner life, lots of time to kill
- Impulse learning bit: sitting on a park bench and want to know what that bird is or what the specials are in the restaurant across the street
- Usually doing something else when you're on the cell phone
- Mobile devices have a more social component
  - They get information from other people.
  - Quality of information depends on reliability of source.
- Is context now more or less meaningful with the addition of an information appliance?
- Allows access to more information, but the device is getting smaller—address this problem via add-ons. The screen is not as high-fidelity (resolution) as a computer.

■ IM and gaming are two learning applications.
- Games encourage working toward mastery.
- Kids are progressing on their own toward a goal.
- Gives mobile access to the Internet; people learning every day of their life, all the time.
- Importance of mobile devices
  - They give visitors more control over the experience.
  - Personalization the key to changing the way we learn.
- People learn in different ways.
- Ties into free-choice learning
- The mobile devices are pull learning, not push learning: They gather the information you want.

■ Context is more or less meaningful.
- One explanation of context: You've got your PDA and you want to learn about a painting. That's your context. But you can also take your PDA anywhere, so is context really that important?

■ Blog entries aren't necessarily a solo activity.
- In a gamer's blog, the Halo game expert went on vacation for two weeks. The community went into a frenzy.

■ The phone is a social device.
- I hope the FAA does not allow cell phones on planes. It seems to be the most antisocial device I know of.
- Our group was thinking of the text-messaging aspect of phones as being social.
- The winner of the Center for Innovative Learning Technologies Palm Awards back in 2000 was someone who used IR technology to communicate with others in the area—they exchanged fish in virtual ponds to study genetic mutations.
- What do we mean by social? What are the boundaries? How do we break the boundaries?

Group 4: Visitors Using Their Own Devices

■ Research: who does and who does not have wireless access

■ Soon, everyone will have a cell phone—great starting point

■ Hurdles
  • Different platforms, phones, carriers, and operating systems
  • Complicated fee structures

■ Overcome hurdles
  • Start simple
  • Voice system
  • Have carriers provide calls for free within the museum—some minutes provided
  • Skip the carrier completely —use Bluetooth or IR devices
  • Download Java from cell network
  • Carriers can sell science minutes as part of a cellular plan—could give certain number of free minutes for science questions or for audio downloads, such as animal calls, for ring tones

■ Rich content
  • Not all phones support video and images.
  • Most support some level of text messaging.

■ Real world
  • Audio help
  • Identifying bird calls
  • Virtual animal: can exist in its own cyberspace—cell carrier can call you to remind you your pet needs feeding.

■ Cell carrier can make science minutes a donation to museum.
  • Museum membership includes minutes with cell carrier.

■ If you're going to spend education dollars with the assumption that everyone has cell phones, don't you have to also have giveaway programs in place?

■ My 11-year-old son has a cell phone—he's become the school "switchboard." NOT everyone has cell phones.

After some brainstorming, the groups decided to not focus on a particular topics or issues, but each focus on the same two questions: What do we already know? What don't we know?

Group 1

- We had a stimulating, wide-ranging discussion.
- We started talking about the issue of what interactions we want to support with technology designs and a bit about how to design for learning. We briefly discussed separation of data from the device.
- The device is not as important as the experience.
- Improving the visitor's experience should be the anchor for designing technology.
- The landscape of technology: Handheld and other technology needs to be taken into account.
- The handheld is in the service of creating experience in context.
- We should think of the audience as a heterogeneous market segment with different demographics.
- Tension exists between institutional perspectives and goals and the goals and aims of individual users. We should allow users to have some choice but also meet our own goals.
- We need to think about what the affordances are of certain technology. What does a smart device afford? If we want to improve user experience, what are the capacities of devices to contribute to this?
- We should aim for personalization and customization and enhancing the user's visit.
- Communication, interaction, and data transfer are afforded by networked devices.
- Funding question: How do you design for improving the visitor experience?
  - This is difficult because we can't ask the visitors.
  - We don't know what all the affordances are of the technology.
- We drew the beginning of a matrix of the dimensions of technology.
- We should identify design practices that allow for iterations of change—we should strive for a completed design that allows for the process of iteration.
- There should be practices on the institutional side that allow for design iteration.
- When do we stop tweaking features and start being transformative with the technology?
  - Doing gaming activities in the museum could be transformative within the context.
- Transforming the visitor's experience depends on context.
  - Visitors have an impact on the process. What do they bring? How do they link across institutions?
- Funding is really important.
- Devices are always in development—they're a moving target and are never fixed.
  - There is a convergence of devices; they're all tending toward mobility and connectivity.
  - A looming issue is the convergence of technology for the devices vs. the divergence of uses for these devices.
  - The capabilities of these devices are converging, but the uses are also diverging.

Second Day
Breakout Groups

Group 2

- ■ Who or what are the potential drivers?
  - Technology
  - Institutional research
  - Audience
  - Board vision
  - Budget
  - Logistics: How do we actually do it?
  - Museum vision statement: What do we want to accomplish?
  - Cultural trends: How are people using new technology outside the museum?

- ■ What is the process now for developing new technology?
  - There needs to be a front-end evaluation: What would the visitors like to see and what are they interested in?

- ■ How do we take all these drivers and come up with a way to move forward?
  - Use the same market research that industry is using.
  - Create think tanks between museums and manufacturers—these institutions have different goals but share common threads.
  - A museum would be the testing ground and primary audience for some of these technologies—a museum could come up with applications for the technology.
  - Come up with solutions: What is the visitor actually going to use?

- ■ The big solution
  - Visitors don't know how to articulate what types of tools will help them.
  - We should provide more freedom for prototyping. Google employees have 20% of their time for personal exploration.
  - The best ideas can come from play/exploring time.
  - If you're looking to create innovative technologies, consider partnering with industry leaders such as Gartner Group to look at trends.
  - Educate museum audiences on new technologies.
  - Create a consortium among museums in the country to create more clout with the technology industry.

- ■ Market research—does industry play this role?
  - That's what they would bring to the table. We would provide the research to give back to them.
  - There must be commercial-application potential to entice industry. They don't care what's going on in the museum; they're interested in what's in it for them.
  - Industry would bring in money. They don't care about our goals. Our museum audience is a focus group for industry.
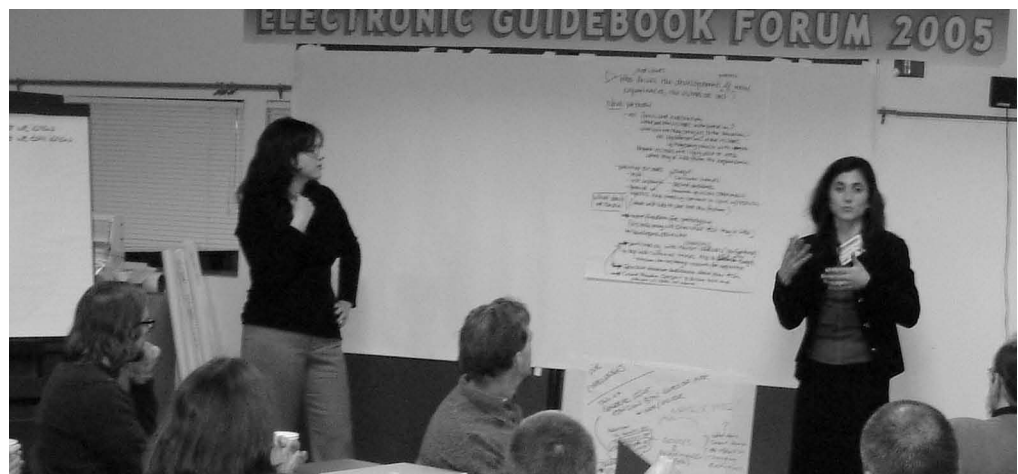
- If we acknowledge that they are interested in things that are going to enhance their business models to promote their technology, they'll work with us. If not, they're not going to work with us.
- If we formed a large consortium of museums working with a large consultancy, we could do market research on what technology might attract industry interest.
- The Museum of Science in Boston wants to do an exhibit on measurement devices. Industry may get involved to gather data based on their business goals.
- Most industry is not going to find funding opportunities in museums. Prototype work within museums can inform industry trends. Microsoft PocketPC and Flash applications in a museum setting informed an upgrade for Microsoft.

Group 3

■ We started brainstorming and then focused on looking at what we don't know.

■ Visitors have a hard time getting acquainted with new technology; the learning curve will be reduced over time as users become more comfortable with the technology.

■ No consistent standards exist. Proprietary technology—there's a problem with institutions asking visitors to bring their own devices because there are different protocols for each device.

■ Young visitors are more comfortable with technology than older visitors.

■ At Liberty Science Center, visitors are interested in bringing their own devices to museums and using them within museums.

■ What don't we know?
  - Do we separate data from technology?
    - This is a no-brainer.
    - We need to consolidate media over cross-platform databases.
  - How do we design the learning context?
    - What do we want visitors to experience? We need to work back to what content we're going to use then work back to the platform we're going to put it on.
  - It's very important that there be evaluations of all of these programs.
  - "Electronic guide" is a euphemism for "digital docent." Do we want to exclude certain experiences? We do not want to restrict other learning opportunities, do we?
  - Museums want to give visitors choices, i.e., electronic guides, audio guides, handhelds, and docents.
  - What interactions are supported?
    - Restrict text you can put on player devices—complete free will vs. museum's desire to channel the experience—where is the dividing line between channeling and free will / full access to unlimited information?
    - A random visit vs. a tour determines the amount of information provided.
  - What are the goals of the institution?
    - Acknowledge the subversive quality of the device.
    - Visitors may do anything they want with the devices, i.e., bring reprints of art on handhelds into museums.
    - Google allows the search of real stores and online stores.
    - Certain museums want to channel visitors to the museum's unique content. They don't want visitors to branch out. We need to balance the goals of the museum vs. those of the users.
    - Users could customize their experience.
    - If the museum is going to spend money on a program, they'll want to direct the experience.

- Boundaries break down with these devices.
  - If you have a handheld in Muir Woods, you can be at the Exploratorium.
  - Devices are going to be everywhere.
  - There are no boundaries.
  - Handhelds will be used beyond ways we can ever imagine.

- Museums are competing with other organizations for leisure-time capturing.

- Money to support this electronic guidebook consortium:
  - These programs are more expensive to produce than traditional audio guides.
  - Copyright is an issue. We need to develop a uniform rights clearing house and guidelines for nonprofit use.
  - Obsolete gizmos: Many of these things will be obsolete before they're amortized.

  - Revenue models:
    › Museums make money on audio programs.
    › Museums will be reluctant to give up a revenue stream to people with their own devices.
    › People will have to pay for content even if they bring their own devices.

- Multi-institutional partnerships
  - "Museum that never closes."
  - There is a certain amount of "turf" between institutions.
  - Look for ways museums can combine resources to leverage grants and common learning.

Group 4

■ After hearing the other groups, it's clear we're all thinking about the same things.

■ Concept of content—what we know and what we don't know.
  - There are many practical matters to consider.
  - Higher learning is full of concepts rich in learning development.
  - Static vs. dynamic content must be considered.
  - Where does this dynamic content come from?
    - It's difficult to tie down where we want this content to come from.
    - It's coming from staff and other places—people who want to learn.
    - It all boils down to a chicken and egg question: Everybody has great ideas, but nobody knows what works; nobody knows what the visitor wants because they haven't been exposed to these technologies.

  - A lot of new technologies have come of age. We've seen many failures and successes:
    - Amazon as an example of success—doing Barnes and Noble online more efficiently and more easily— not doing something radically different.
    - What can we learn? What parallels can we draw?

  - We're probably all going to try these things and we'll probably fail a few times.

  - Lots of companies/industries are invested in this and they don't want to fail. By watching their successes and failures, we can inform our efforts.

■ Cross-group issues

  - Some of these experiences are readily available and don't need to be driven by museums.
    - If we look at what people are already doing and target museum content toward what people are already trying to access, we don't have to invent the entire system.
    - Emergent systems are based on ethnographies.

- Alison Billings is doing an ethnography of the Explainer youth program that is helping us see the potential roles of the technology. [Alison and Dan Winokur provided the insights below.]
  - We're addressing these technologies from an ethnographic perspective.
  - We need to deal with it from an inductive way: Look at what the Explainers want, not what we want to use them for.
  - Looking at the Explainer programs, we're more interested in community-building applications than data-gathering applications.
  - Mobile devices are fostering the creation of mobile learning communities.
  - What do the Explainers want? They want the tools to create informal knowledge communities.
  - What does that mean to those people?
  - Explainers are docents. They do demos, walk the floor, show visitors different exhibits, and also learn in conjunction with the visitors. They approach the museum from a culture of exploration.

  - On a practical level, the program can help us be able to find lost kids or help us know if someone goes home sick.

  - Some Explainers have been at the Exploratorium a long time, and they want to share their tricks with others.
    › They can share their tricks via the handhelds.
    › They can share their unique skills/expertise.

  - In our observations, Explainers had various reactions when trying to interact with guidebooks.
    › There were many negative reactions
    › Any attempt to replicate content already on the floor makes no sense.
    › We were trying to create extended content, and the Explainers felt it was a replication of what was already there and could be seen.
    › Parallel content would be more of a burden. They would have to carry the content around and know how to find it.
    › One potential promising area is the use of handhelds for communication between Explainers
    › The majority of Explainers said the most rewarding aspect is teaching. They're looking for a tool that would enable them to learn with a visitor: "I don't know the answer. Let's find it together using this device."
    › Compared to other institutions we're based on mediation of learning. Keep in mind that these objects can extend but not replace what is already available.

Pleasure Seekers and Social Butterflies: Using Early Stage Focus Groups to Define a Mobile Cultural Content Application

Julie Zilber

7th Floor Media, Simon Fraser University

■ We used focus groups during the early stages of defining a cultural-content application.

■ The context—mobile MUSE research network.

■ The MUSE research network involves the use of rich multimedia content.

■ We have government, private, and public sector funding.

■ Three prototyping teams were established:
  • memory
  • ambience
  • and amusement

■ Leora Kornfeld and Lars Meyer of UbiquityInteractive.com were involved in the early stages.

■ We are working with a short timeframe and rapid prototyping: By the end of March 2005, we must have a prototype ready for testing in the real world.

■ The project is named "Re:call."

■ Memory domain
  • We needed to define the culture.
  • We did "streeters" with this demographic of digital natives.
  • Content—consumption and creation—was of more general interest than gaming.
  • Meaning of memory—Create an application that would address different types of memory:
    - Personal
    - Professional
    - Private
    - Public
    - Individual
    - Collective
    - Historic
    - Current
  • Content—Create location-based caches
    - Create an application that would enhance and deepen a person's experience with a specific locale.
    - Create and explore cultural content on the go.
    - Create a time- and location-stamped journal.
    - Contain links to rich media content associated with the locale.
    - We were aware that many of the features had been tried in other circumstances. We wanted to create an application that made sense as an experience and that would be greater than the sum of its parts.
  • Focus groups—Define the audience
    - Demographic = digital native
    - Focus groups cannot generate the following information:
      › They cannot provide statistically valid information.
      › They cannot provide reliable information on application design for something that does not exist.
      › Participants will fit what you're telling them into a model that already exists.
    - Focus groups are useful for the following reasons:
      › They allow you to identify attitudes.
      › They determine personality types.
      › They identify features that will address the needs of different groups of people.

- What did we learn?
  › Receptivity to applications such as ours would be governed by two axes:
    ◊ Technology is a tool—Technology is for fun
    ◊ User is fully booked—User has lots of spare time

- We identified four personality types
  › The indifferent conservative
    ◊ Sees technology as a tool
    ◊ Has lots of spare time
    ◊ Doesn't find much interesting
    ◊ Will use technology if it makes something easy

  › The practical minimalist
    ◊ Is busy with work
    ◊ Doesn't want distractions
    ◊ Will use technology to get tasks done more efficiently and for less cost
    ◊ Uses a cell phone for emergencies, a PDA for appointments

  › The pleasure seeker
    ◊ Has lots of time
    ◊ Is looking for interesting and amusing things to fill up that time
    ◊ Is receptive to anything that will fill up that time

  › The social butterfly
    ◊ Is busy with friends and family
    ◊ Is receptive to anything that will enhance his/her shared experience
    ◊ Wants to expand his/her social network

- Identified two personality types that would be interested in Re:call
  › The pleasure seeker
  › The social butterfly

- Identified two personality types that would not be interested in Re:call
  › The indifferent conservative
  › The practical minimalist

- Discovering the interested personality type informs us about what does and does not go into the application

Questions and Comments from Forum Participants

How many people were in the focus groups?
- Small focus groups
- 15 members

What was the age range? There have been lots of transitions and lifestyle changes. How does that affect the personality types?
- Only people between the ages of 20–35 were represented in the study.
- In the focus groups, age did not seem to be a factor.
- Having identified the personalities using the focus groups, we could now conduct a statistical study to determine what percentage of the population fell into each personality type, and in such a study we could do an age correlation.

Did you derive the personality types?
- Yes

Where are you now in the development of the application?
- We are in the process of development, in the heads-down phase.
- We will have a 0.1a version—technology functionality—by the end of January 2005.
- We will have a partially functional prototype by the end of February 2005.

- A prototype with some content will be available by the end of March 2005 in one location.
- Ultimately Re:call will be designed to run on visitors' devices.
- For the prototype, we will hand out devices.
- We'll conduct intercept interviews with users.

What will the content consist of?
- We were trying to incorporate content (e.g., rich media content) and functionality (picture-taking, opinion sharing, etc.) that would appeal to the personality types we had identified as most receptive to this kind of application.)
- Features will be targeted at specific groups. We are interested in testing to see whether the people who actually used and liked the prototype fell into the personality types we had identified as being most receptive to an application such as Re:call.

What is the appropriate level of granularity vs. a museum space?
- We don't want to require people to walk up to something the size of a building in order to discover something about it.
- The line of sight is our level of granularity. We need to match that with the capability of detection.
- We can narrow down where they are and can determine what they are able to see.
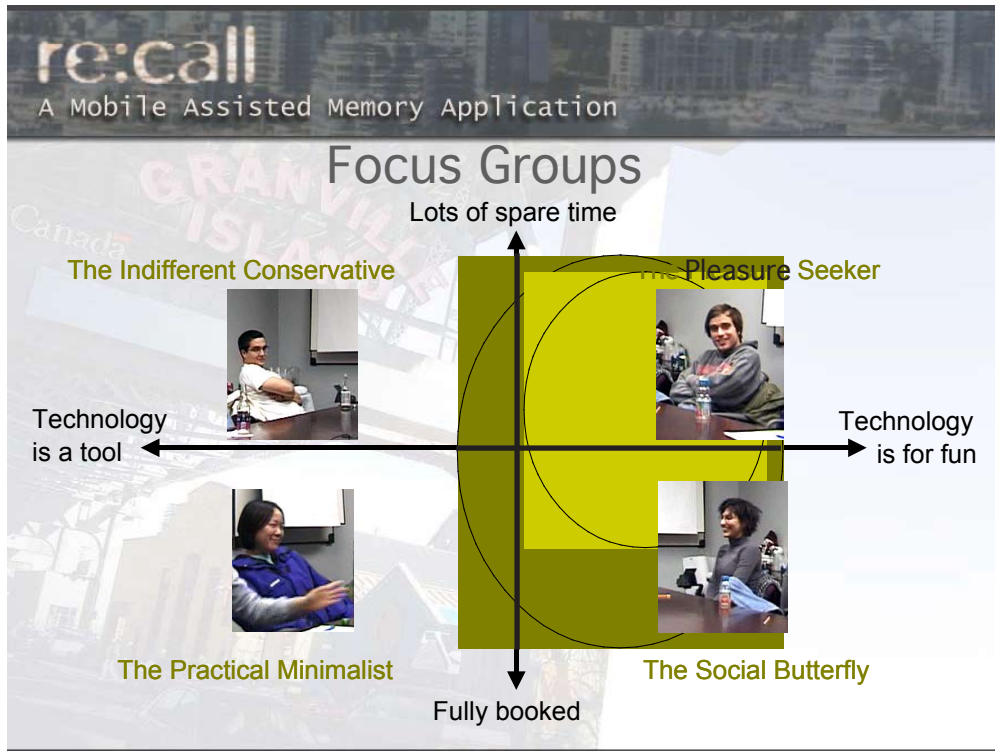
Pleasure Seekers have lots of free time and are looking for interesting and amusing diversions with which to fill it. They are receptive to trying anything that sounds as if it might fill their needs for interest and amusement.

Social Butterflies are engaged in a social whirl, busy with friends and acquaintances, whether making plans, sharing stories/gossip, or taking part in activities together with others. They're receptive to things that will enhance their shared experiences with their social circle, whether that's finding activities they can do or places they can go, or sharing their thoughts and impressions. They're interested in the opinions of other people and in expanding their social network.

Practical Minimalists are busy with work obligations. They are scheduled to the hilt and don't want any distractions. They are only interested in using a technology if it will help them achieve their tasks in a more efficient manner or save money—preferably, both. (Note: Practical Minimalists may become Pleasure Seekers or Social Butterflys when on vacation.)

Indifferent Conservatives are not busy, and this is because they find most activities uninteresting. They will use a piece of technology if it is the easiest way to do something they have to do.

The target market for Re:call is Pleasure Seekers and Social Butterflies. It can meet their needs for interesting diversions, information about social and cultural events, and information sharing.

Framework for Design and Evaluation of Mobile Applications in Informal Learning Contexts

Valerie Crawford

SRI International

Background about SRI International

- Founded by Stanford in 1946

- Independent since 1970

- Contract R&D nonprofit organization

- Headquarters in Menlo Park

- Center for Technology and Learning (CTL)
  - Mission: Achieve sustainable learning impact on K–12 education through innovation and research
  - Learning sciences research
  - Large- and small-scale evaluation of technology-supported education innovations and programs
  - Design and research of learning technologies
  - Strategic Learning Consulting Practice
    - Work with commercial firms as strategic partners
    - Create leading-edge, effective education technology

- Funded by the federal government, the National Science Foundation, public and private funders

- CTL's work in handhelds over ten years includes:
  - Evaluation of handhelds in schools
  - User experience in studies
  - Design principles of mobile learning
  - Design process for handhelds
  - Software development
  - Curriculum development

- Increasing focus on networked handhelds
  - Peer-to-peer, classroom networks, tuples architecture

- Informal learning
  - After-school learning: focus on underserved students and enhancing technology proficiency
  - Evaluation of after-school programs
    - Community Technology Centers (CTC) programs out of US Department of Education ($65M annual budget—now cut).
    - Intel's Learn Program

- Analytical framework for design and evaluation
  - Early phase design work in algebra classrooms
  - Design classroom of tomorrow
  - Still vaporware
  - Link tablets with rich electronic content to improve teaching and learning in the classroom
  - Ethnographic methods to define needs and experiences
  - Define workflow issues: teachers overworked and time-pressured—interested in efficiency
  - How do you know what students know?
  - Both latent and explicit needs of students and teachers
  - Leverage points for this technology, such as for assessment

- A holistic-systems/activity-space approach emerged.
  - Communicative density
  - Artifact density
  - Data density
  - Temporal data
  - All contribute to cognitive density
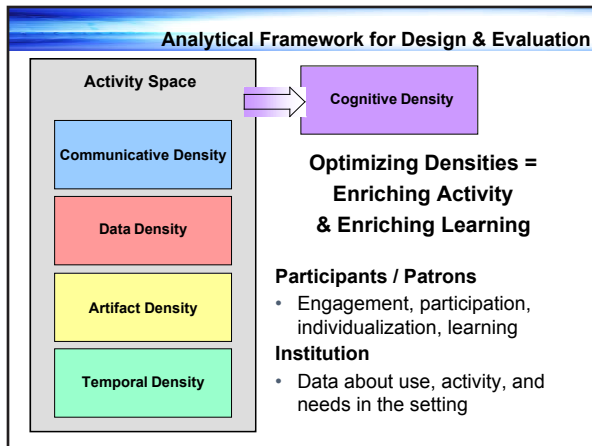
- The goal is to think about how technology can help configure these dimensions for optimal learning.

- We may want to optimize communication at some times and at other times constrain it.
  - Design principles are to allow a fluid, configurable space determined by the technology and how the activity is designed.

- Communicative density
  - Synchronous and asynchronous
  - Broadcast and point-to-group—Jerry Gray—eGraffiti—context aware-devices access publicly posted messages
  - Co-located vs. geographically dispersed
  - Extending the activity by messaging people who have shared an activity but are not with user

- Digital artifacts: Enriched engagement with context and exhibit
  - Static
    - Background information, document links
    - FAQs
    - Interactive guides to exhibits
    - Explanatoids
    - Pursue now or later

  - Dynamic
    - Visitors can create within the context of the space
    - Reed Stevens's tool—makes video tracings—take a visual representation, allows user to add annotation into the artifact
    - What are created dynamic artifacts the museum wants to keep vs. artifacts the user takes with them?

- Capturing data about communication and artifact use
  - Gather data about user experience.
  - Use this data for research into the relationship among context, communication, artifacts, and exhibits.
  - Enable experience-sampling methodology (ESM). (Examples of ESM are beeper studies and surveys of two to three questions, which are triggered by location/event/time.)
  - Collect what data for patrons?
  - Collect what data for administrators and researchers?
  - Enable software to support ESM.

- ■ Configuring time
  - • Dead time
    - - Engagement vs. nonengagement
    - - Wait time, down time
    - - How can dead time be eliminated by giving people other options and opportunities?
  - • Flexible time—options for "here and now" activity
    - - Asynchronous communication
      - › Follow-up communication via Web site, among visitors
      - › Buffered messages on site
    - - Availability of digital artifacts
    - - Explanatoids, tracings, etc.
    - - Salient in classroom
    - - Time on task—want to maximize it wherever possible
    - - Give options whenever possible

- ■ Cognitive density: Optimizing densities = enriching activity and enriching learning
  - • Participants/patrons
    - - Engagement, participation, individualization, and learning
  - • Institution
    - - Data about use, activity, and needs in the setting

- ■ Implementing as design framework
  - • Study current activity in setting: goals, processes, activities, formats, events
  - • Identify needs, both explicit and latent
  - • Characterize options and benefits of potential technological solutions
  - • Identify leverage points for technology solutions

- ■ Implementing as evaluation framework
  - • Develop a theory of change—good analytical purchase on how the analytical tools provided are contributing to the fulfillment of visitor goals for your visitors.
  - • Generate evaluation research questions.
  - • Can be basis for theory-based outcomes.

Questions and Comments from Forum Participants

Using this framework, an evaluator can come in and examine the things you picked—communication, data, artifact, time. What about other aspects like affect?

- • You can layer in the goals of the institution and the kinds of activities you're looking to support.

■ We're based in Vancouver and focused on handhelds.

■ We're developing interpretive media that moves with the visitor.

■ We're moving beyond the concept of sedentary media. As we do this, we can't help but think about our grounding in other media.

■ Handhelds provide a much stronger connection: location and context matter.

■ The here and now matters. This is the key to thinking about how we do what we do.

■ The program is based on a series of devices we used in several museums.

■ The mobile visitor experience
   • What it isn't:
     - The rearview mirror of technology, Marshall McLuhan—using the latest technologies but in old-fashioned ways
     - "The handheld is an audio guide plus X": This approach has failed us in the past.
   • Engages visitor in a more participatory role.
   • Handhelds are not kiosks in the palm of your hand.
   • We can create a resonance between the vistors' movements and what happens on the screen.
   • Mobile computing is not desktop computing.
     - Try not to think of a mobile device as a mini Web.
     - I like to think of the Web as accessible no matter where we are—what matters least is our physical space.
     - With handhelds, it's all about our physical space.
   • Handhelds are augmenting devices.

■ Web experience vs. mobile experience
   • Interface
     - We ignored the elephant in the living room syndrome—Web thinking—does not discriminate—equal opportunity.
     - In context, need focused information in handhelds. Information generated is specific to where you are and what you're looking at, visually reflecting your physical environment on the screen.
   • The mobile visitor's experience: What is it?
     - Mobility
     - Personalization: All the resources are modular and scalable.
     - Collaboration: People go to the museum in small groups—devices could distract from their interaction.
     - Baseline expectation is about communication: texting, screen sharing, etc.
     - Moment-to-moment meaning construction: What are the spaces between the objects, and how do we fill them with information?
     - Kurt Lewin said, "There is nothing so practical as a good theory."
     - Paul Dourish 2001—Embodied Interaction
       › The world is available for certain types of interaction.
       › Objects around us are augmented with computational capabilities.
       › Move from abstractions to something that is concrete.
     - Duckworth 1990—Minds-on Learning
       › What kind of activities can we create that engage the minds in addition to the hands of the visitors?
     - Loomis 1996—Control and Motivation
       › An art museum can be an environment of intimidation.
       › Give visitors a sense of control and motivation.

WYAIWIA— Where You Are Is Where It's At: Interface and Information Design Approaches for Museum Handhelds

Leora Kornfeld

UbiquityInteractive.com

- Elizabeth Ellsworth 2004—Knowledge in the Making
  › Give visitors tools with which to think.
- Museum of Anthropology in Vancouver
  - The exhibit is a large sculpture with little text.
  - Visitors want more information.
  - We wanted visitors to get into the object in a deeper way.
  - The museum artifact displayed in the handheld moves around the screen based on where they are.
  - The handheld allows the user to focus on specific aspects of the sculpture.
  - The iconography is difficult, especially on art pieces like *The Raven* and *The First Men,* a sculpture, which stands almost seven feet tall.
  - The handheld gives the visitor a way into the exhibit when they need it. Not on the Web or when they go home. Hard-to-view images of the sculpture appear on the handheld screen that rotates with visitors as they walk around the actual sculpture.
    › Audio provides information about the objects.
    › We saw people apply this knowledge later to different pieces with the same iconography.
    › Many visitors commented they wanted more of the closeness.
    › People want more of the closeness.
    › Artifact-centric and theme-centric
    › Linear audio tends to be artifact-centric.
    › Handhelds can be theme-centric.
- Collaboration features with other visitors holding a handheld
  - Consensual beaming
  - Texting
- Why does this matter?
  - Not just different technology—it provides different interactions.
  - The artifact resides on screen and in the real world: footsteps are now clicks.
  - Navigating on screen and in a physical space can lead to heads down. What we have to do is address this in the instructional design—we have to create activities that cause people to interact with others and objects.
- Different types of screens cue different interactions.
  - We need to think deeply that this is not video, TV, an audio guide, etc. And we need to think about different patterns inherent in these devices, things like factoring in the relationship to the screen and physical space.
  - The interface does shift depending on the context.
  - We tested many things to see what people would like. Users are comfortable with the online Web environment.

Questions and Comments from Forum Participants

How do you connect to the heads-down problem? In your graphical interfaces you have the image in the virtual space. Could you take the image out and force the person to look out into the world?

- We called it "back and forthing": When given a visual or conceptual tool, users would take it and look back often to replay the video.
- How do we get them to interact without forcing them?
- We observed that every single person would look at things (handheld and real sculpture) at the same time.

Did you explore camera devices to explore augmented overlay?

　We're looking at it now.

How did you get the tracking of the object rotation? How did you get the screen to rotate the object as the visitor is walking around the actual sculpture?

　IR beacons around the objects tracked where users were. Ubiquity Infrared (IR) Beacons, a location-sensing technology, were discreetly mounted on the display cases. The IR beacons communicate with the IR port on the handheld device when the visitor approaches the area. So, the content "finds" the visitor, as opposed to the visitor having to find the content related to the object or artwork in front of them.

How much content?

　45 minutes
　30 total objects
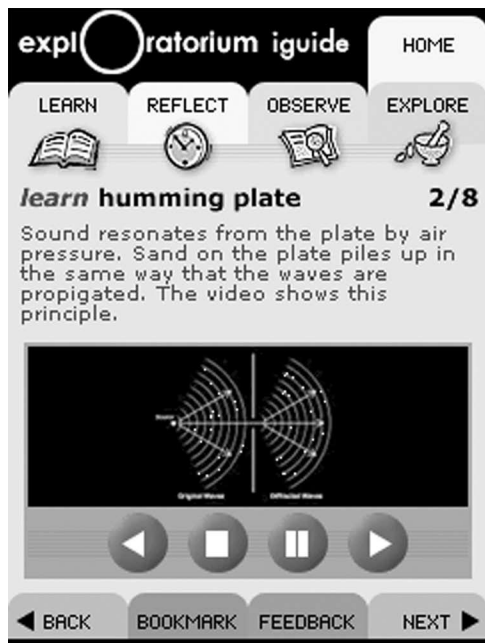
We're looking at ways to help the field with what we know and also synthesize what we've learned in the past two days at this forum.

We're going to blend these two agenda items together, hoping to arrive at what I call "extreme improvements." My question now is: What are our next steps to synergize what we've been doing and what are some ways to improve knowledge sharing?

Group Discussion

Facilitated by
Sherry Hsi and
Steve Christiano

### Questions and Comments from Forum Participants

- We might get far in identifying best practices in process-thinking evaluation, but we are far from identifying a single product device interface.

- I feel much better equipped about developing interfaces for an artifact museum and less equipped to do so for a science technology center.

- In designing experiences, social interaction is the key, whether it's within pairs or with a docent. There should not just be one device for one person; interaction is a key part of the design.

- How can we accelerate both our anecdotal and intuitive senses? Would it be useful to do a study of an audio program compared to a screen-based program?

- Beyond audio and screen-based programs, there should also be a paper version to study.

- We touched on the idea of audience—how close are we to coming up with one audience? We're targeting very specific groups within the larger audience of museum-goers. That conversation has just begun.

- In terms of the PDA audience —museum visitor, Explainer, collections management— how can the technology be used in each of those contexts?

- I'm stunned by the diverse range of partnerships. I'm also thinking about opportunities for sustainability. I've observed that there is a good mix of European and Asian descent here, but this group is not representative of the audience we're trying to draw in. I'm interested in community-based design. This concerns me.

- I'm struck by Jason Teo's Singapore Science Centre presentation that they have a management backend for their program. We have not dealt with the institutional changes necessary to sustain this. Changing institutional culture can be ugly and ultimately leads to the need for more dollars. What are the tools we're going to use to sell this? Prototyping, corporate partners, small pilots, or other situations? I don't see any solutions right now; this is a big challenge.

- These projects force organizational changes, and this can be a painful process. A lot of the research being done is not in the museum; much of it is being done in educational settings. It's a big challenge, being able to put the time, energy, and thought into the design.

- Might explain the lack of diversity—if we had K–12 educators here at the forum, we might get at these issues.

- These projects span the educational aspects and management aspects of the institution. We need to understand what the impact is of what we're doing. We need data to make decisions institutionally about programs.

- How much does the choice of the device inform what the museum can do? If it's the user's own device, the museum can be everywhere; if it's a specific device, it can only be in the museum.

- Multi-institution projects—I've heard a lot about this, but I haven't heard anything specific about linking experiences among museums and coming up with collaborative efforts.

- Perhaps you could use something that you purchased at one museum at other museums.

- Collaboration has been discussed here in terms of equipment manufacturers, but what about libraries, archivists, museums, and the broadcast industry? There are partners out there discovering that they need museums to be successful. Let's start reaching out to these potential partners.

- To what extent can we manipulate the context? Context matters. We need to provide an escape route because this is what visitors want to do—escape. For instance, I can't imagine being in eighteenth-century Spain. An eGuide is the portal into that.

- To what extent is this a supporting technology? An electronic guidebook can include multiple-language gestures; provides wayfinding; suggests tours for those with limited time—"I've only got an hour."

Comments—Suggestions—Actions

- This needs to be proposed as a knowledge community if we're going to have legs.

- We're not building on work done outside the US—should we pull that in?
  - G1:1 mobile computing initiative is an international group. They're thinking about how to get a computing device into the hands of every child—what would happen? How would you support their learning? They meet annually in conjunction with the Wireless Mobile Technologies Conference.
  - We could create an online area where people can submit examples of work they're doing. It would be a repository of information, part of which would be best practices and a section for informal learning.

- The Getty is creating a blog around the GettyGuide™ and will make available all documentations and evaluations.

- Both science and art museums have similar problems with evaluation. It would be strategic of this community to not reinvent the wheel; we should develop a central repository for evaluation resources where we can share findings.

- If you want papers, www.informalscience.org has a repository for evaluation, shared matrices, and processes.

- The Liberty Science Center has a blog on the Science Now Science Everywhere project.

- What is the interest in continuing together? Would you come to another meeting if the Exploratorium held one next year?
  - Yes

- A select group of museums is represented here. Could the Exploratorium convey what's happened here?
  - We'll make a guidebook from this and distribute it.

- Other conferences that would be good are the American Association of Museums (AAM) and the American Educational Researcher Association (AERA).

■   What other issues can lead to action items?

■   Neutral host providers: Is there a neutral museum data-sharing organization?
- This brings up the issue of data storage—we're dealing with all sorts of data: biological, anthropological, etc.
- OCLC: This is a library trade group that has an agreement with Google—you can click on books available in your area.
- We've been talking about Google. Can you click on museum objects that are available in your area?
- Your comment relates to the sharing of digital assets.
- When is it a good business model and when is it not to share digital assets?
- Should institutions share the metadata or the assets or both? This is something institutions will have to come to an agreement about.
- In response to your question about what is metadata, the metadata is the pointer to the actual data. The metadata and schema associated with it—there may be assets within the museum—descriptions of the objects.
- There should be a community-based back-end.
- For example, while airlines all share the same database, there are different services and interfaces to this data. How much interoperability is the museum community willing to create?

■   The issue of copyright could have a stifling effect on this work.
- Users and museums could subscribe to protocols that would set pricing and use guidelines for museums and nonprofits.

■   There doesn't seem to be a clear sense of what the drivers are to make these extreme improvements. In education, everyone is clear about the drivers. Having a clear sense may be a way of prioritizing
- Do we feel that we have drivers?
- Some drivers are museums being competitive—attracting visitors, funding, impacting the community, and improving learning.
- Museums are driven by an audience market: Audiences are decreasing rapidly— what to do about the museum? Is it an overbuilt enterprise? We're seeing the de-institutionalization of culture. These devices allow the museum to move outside of its physical place in the world. How can you utilize these resources in other ways? How do you make them more part of the culture? In the last twenty or thirty years, museums have made the case that they are educational rather than a place of collective culture.
- Is this de-institutionalization of education or is this leisure time? We're in a leisure market and losing to the malls. What if we put exhibits in malls?

■   How do we influence device managers?
- Device manufacturers don't have time to investigate these technologies.
- Museums can provide data on the uses.
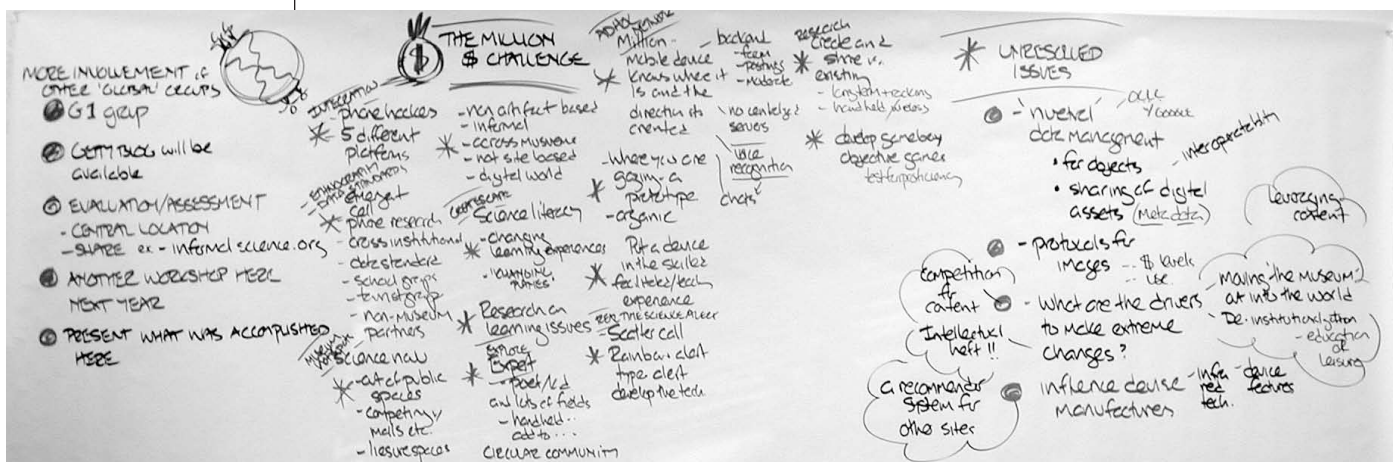
- There needs to be a mapping between device features and affordances.
- This document could influence what stays on the devices.
- Device manufacturers won't change a device based on what the museum says. The museum should function as a lab for figuring out what these applications can do. Features may be preserved as a result of this research.

■ Once people have access to information at any time, they no longer have to buy into your interpretation of content. For instance, visitors could carry Discovery Channel interpretation of STEM content. This situation provides an opportunity for competition of content interpretation.
- This type of competition came up in our discussion about what issues came up during the Exploratorium's testing of a handheld project involving the space outdoors. The visitor might have someone else's version.
- As a result of this competition, it becomes the institute's mission to build credibility for its interpretation of its content.

■ In art museums, the same exhibit travels from city to city. There must be some organization that interconnects museums. What is the existing mechanism that allows exhibits to be scheduled?

■ A big driver has been the idea of leveraging content. It is a physical space. How can we expand our audience? That's what's driving technology in general in museum settings. Where does that leave the object? What does that do to the meaning of the device?

■ What keeps you from more connectivity? What are ways to promote better connections?
- Institutional inertia
- The Exploratorium is an interesting case: We replicate exhibits and send them out in traveling exhibitions to create more connectivity.
- Do you archive the graphic, the blueprint, or the exhibit?
- You could send an exhibit to another museum and gather contextual overlays.
- There are fundamental differences between artifact and science museums.
- At the Exploratorium, supporting materials and biographical information is being gathered for traveling exhibits at the Center for Museum Partnerships: All the information is available on our internal Web site—if these institutions purchase an exhibition, they might not want it to be in the Exploratorium shell. How can we create content that is sharable and usable in many contexts ?
- There's no ego involved with Wikipedia; it's authoritative and changing culture. It raises the question: How much do you want to collaborate?
- It's like open-sourcing your work: Everyone can contribute and share it.
- There's the metaphor of recommender systems. I'm thinking of this as a mother and a teacher: Say my daughter gets excited about certain exhibits. If something online could recommend other sites in different geographical areas, we could travel to see them. We could create a shared database and knowledge-management system, an Indigo for museums.
- The database could work across varying institutions. If we came up with seven user scenarios and seven different models for seven users, we could use the same models at the Exploratorium and at the Field Museum. However, this scenario assumes that the personas would behave the same in different settings.
- With recommender systems, we could track the time visitors spent at certain exhibits. It's easy to recommend exhibits when you cross them with the persona. Amazon effect—it's not a virtual Barnes and Noble—understanding the collaboration and aggregation of group collaborative shopping. You could also leave your mark on the world.
- Are there lessons we could learn from Amazon about technology and the use of recommender systems?
- Google is a sociotechnical concept: It has the ability to capture human activity and aggregate it across collections of information. . . .
- Is it a benefit to the museum community to create a knowledge network?

Forum Synthesis and Summary

Based on
Discussions Heard
at the Electronic
Guidebook
Forum 2005

Sherry Hsi

Forum Organizer

Recall how we started with Jason Teo's (Singapore Science Centre) introduction of the happy problem/hard decisions situation. We have a large design space of options with multiple stakeholders. How do we decide if we should introduce wireless content and/or technologies? What should we introduce, when should we introduce it, how should we introduce it, and to whom? Here is a summary of what I heard at this workshop.

SEGMENT THE AUDIENCE, KNOW THY USER

- We need to better target and differentiate an audience and create a profile of what our prototypical users might be (e.g, using profiles of a family from the GettyGuide™ information).
- We should do ethnographies and front-end evaluation: Design a solution that would work in more than one place.
- Should the design be "one size fits all"? Or should it have individualized content, tailored to interactions with seniors, kids, signers (e.g., interpreters for the deaf), and others?
- We should provide scaffolding for different levels of visitors, but first-time visitors should have a new experience—let them explore.
- If this is a teaching audience, how important are standards? Find out if this is really important to this group.
- Maybe the user is not the visitor but the museum staff who support museum operations.
- We should consider if we are designing for the horizontal (applicable across settings) or the vertical (targets a specific need, such as graphing calculators).

TECHNOLOGY IS A MOVING TARGET OF INNOVATION

- Compare 2001 to now: There are better/more WiFi technology, hot spots, and smart phones. At the same time, because of the nature of technology, there is an obsolescence problem.
- While technology may converge, the same longer-standing issues about user experience, cost, maintenance, and sustainability are still unsolved. We are still working on the same problems we were working on four years ago.
- We need to identify when a feature/application is horizontal or vertical.

WHEN TO INTRODUCE INNOVATION: IN THE WORKFLOW OR THE ACTIVITY FLOW?

- Are we deliberately disrupting the user's flow of activity?
- Do we put the handheld into interstitial spaces? Handhelds are good for killing time when you're competing with boredom, i.e., when you're waiting for the bus.
- How are we modifying the visitor's experience?
- Alerts and real-time event messages: Are these good or bad?

REVENUE MODELS

- What are different revenue models?
  - The public has to pay.
  - Creative partnerships and/or neutral host provider supply funding.
  - A hybrid: Access is free up to a certain number of minutes or free if only science questions are asked.

DESIGN TO MEET EXPECTATIONS OR DESIGN FOR CHANGE?

- There needs to be a balance between what a PDA can do and what you want to design it to do.
- The public brings prior conceptions into their museum "dead zoo" and "noisy museum" problems.

- Should we change the museum's image and therefore what are user expectations?
- With a noisy museum, should there be a quiet area provided or would that be impossible?
- Should games be introduced into exhibit-focused play space?

Two Ways to Think about Designing for Handhelds

- Issues to think about as an institution:
  - We need to reflect on our own practices and design processes of how knowledge is generated and captured.
  - How do we have to change the way we work as institutions?
  - We need to reduce the lifecycle of designs and thus also costs.

- Issues to think about in the design and implementation of electronic guidebooks and their evaluation. Some of these design issues are as follows:

  - Designing for Tiny Screens
    - Not what to put on there, but what to leave off

  - Social Interactions
    - There needs to be a balance between being engaged with the exhibit and being engaged with the PDA content.
    - We should strive for hands-on, not heads-down.
    - Is it appropriate to use social chat because we can?
    - Should this be a private personal experience or a public group activity?

  - Respecting Emergent Practices and Norms
    - Be aware of cheating in school with cell phone SMS (short message service/text messaging).

  - Context Matters . . . or Does It?
    - There were several examples that made use of context, but others that drew users out of their context. When should context matter?
      - › In Mirjana's [Spasojevic, HP Labs] presentation, she showed a picture of a question mark taken with a camera phone that could be interpreted as spam.
      - › A handheld can engage you in an activity that takes you out of your current space into a new virtual space.
      - › In the Getty example, the handheld could only be used in a specific gallery where artifacts are present

  - How to Be a Supportive Technology
    - Helping to go deeper; providing scaffolds
    - Inputting time you have; device recommending a path
    - Wayfinding in the museum
    - Speaking your language; using your gestures or signs

  - Extending Experiences
    - Bookmarking, photo souvenirs, printouts, postcards—do users really want to do this or just because they can?
    - How do you balance exhibit interaction with PDA content?

  - Equity and Access
    - Can we assume everyone will have his/her own device?
    - Who provides the device?

  - Games and Gaming
    - When do we use games?
    - Where does this fit in? This was mentioned throughout many discussions.

CLOSING QUESTIONS, COMMENTS, AND OBSERVATIONS FROM PARTICIPANTS

■ What teams have guidebook projects put together?
- • Many of us wear at least five hats.
- • Within your own team what types of expertise are required?

■ Can we leverage existing frameworks?
- • We should look for a model of a very compelling guide that works and transport it into a handheld.

■ Technology keeps changing over time.
- • Is the technology converging or diverging?
- • The exhibit is separate from the infrastructure.
- • Separate data from the tools.
  - Is that useful?
  - Is it common practice?

■ Learning is one of the goals in your design, more than just enhancing the experience.

■ There is a huge range of different interactions possible. Which ones do we want to support? Which ones get handled by other technology?

■ Many of these applications benefit staff and not necessarily visitors or users. We haven't heard from the visitor that this is something they want. It's being driven by the staff/institution. The need is arising from within rather than externally.

■ Following up on this question: Do we wear it or carry it? I wonder if it is even on us? Does it travel with the exhibit? Goéry [Delacôte, Executive Director of the Exploratorium] talked of the Mac Mini that travels with the portable exhibit. Maybe the technology is not with us at all.

■ Where is the money coming from that supports the work? If we show that it is valuable, how do we work it into the institutional goals?

■ What about multi-institutional partnerships and experiences? Can we draw a strand, carve a larger pathway, navigate through spaces that might have institutional boundaries visitors can cross? There are opportunities here in the room that we can explore.
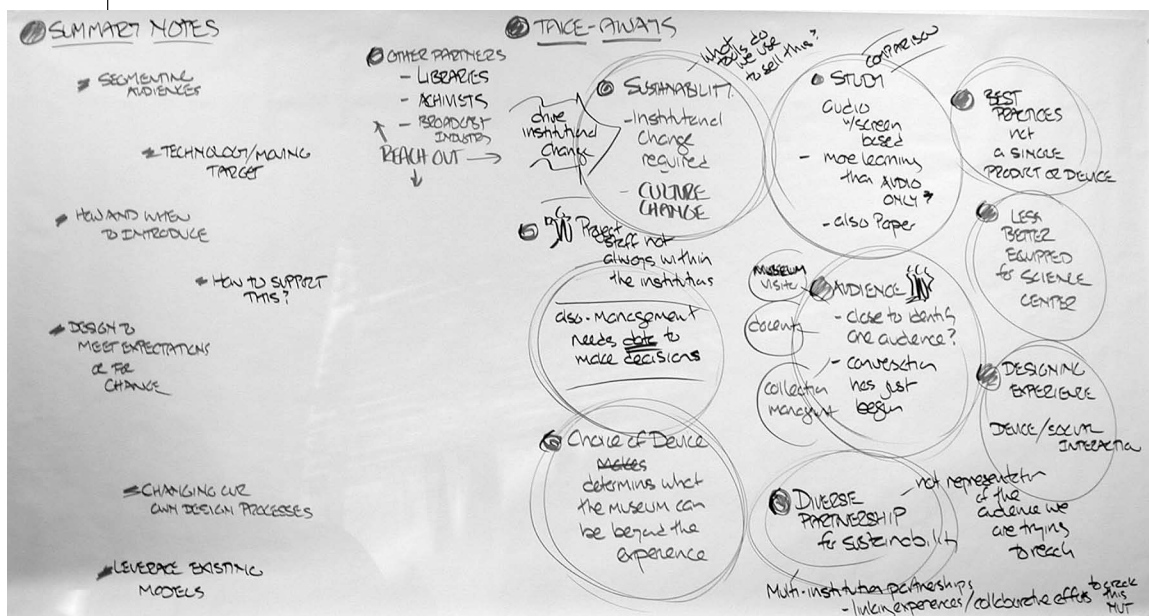
Selected Reports, Books, and Papers

Aaron Marcus and Associates
"Design of a Future Wireless Information Device."
http://www.amanda.com/resources/ACDwireless/AMA_WirelessDesign.pdf

Geri Gay, Angela Spinazze, and Michael Stefanone
"Handscape: Exploring Potential Use Scenarios for Mobile Computing in Museums." 2002.
http://www.cultivate-int.org/issue8/handscape/

Sherry Hsi
"The Electronic Guidebook: A Study of User Experiences Mediated by Nomadic Web Content in a Museum Setting." *International Journal of Computer-Assisted Learning* 19, no. 3 (2002): 308–319.
http://www.exo.net/~sherryh/papers/Hsi_JCALpaper.pdf

Peak Group, Heller Reports
"Wireless Technologies in Education: The Beginning of a Phenomena." 2002.
http://www.peakgroup.net/educationoutlook/wirelesstechnology.html

Jeremy Roschelle
"Unlocking the Learning Value of Wireless Mobile Devices." *International Journal of Computer-Assisted Learning* 19, no. 3 (2003): 260–272.
http://clt.sri.com/pubications/download/UnlockingWILDS.pdf

Scott Weiss
Handheld Usability. Hoboken, NJ: John Wiley & Sons, 2002.

Museum-Based Applications

The Blanton iTour—An Interactive Handheld Museum Guide Experiment
Anne M. Manning and Glenda L. Sims
A paper from the Museums & Web conference about a handheld guide
http://www.blantonmuseum.org/
http://www.archimuse.com/mw2004/abstracts/prg_250000695.html

GettyGuide™
The J. Paul Getty Museum's GettyGuide™ is a kiosk and handheld-based system intended to provide museum visitors with a variety of information.
http://www.triplecode.com/projects/getty.html

Tate Modern Multimedia Tour
A PDA guide developed by Antenna Audio for the Tate Modern Museum in London
http://www.tate.org.uk/modern/multimediatour/default.htm

TechTags
Mike Drennan, Greg Brown, and Peggy Monohan, and the Tech Museum of San Jose
RFID wristbands are used by kids to turn on exhibits and collect online cards.
http://my.thetech.org/

Electronic Guidebook and Wireless Learning Technology Resources

Other Wireless Applications

CitiTag
CitiTag is a wireless location-based multiplayer game, designed to enhance spontaneous social interaction and novel experiences in city environments by integrating virtual presence with physical. Co-developed by Open University in the UK with HP Labs.
http://cnm.open.ac.uk/projects/cititag/

Environmental Detectives
Integrates GPS, Bluetooth, and handheld computing for a five-team inquiry exploration.
http://cms.mit.edu/games/education/Handheld/Intro.htm
http://education.mit.edu/ar/matm.html

NetWorlds
The NetWorlds exhibition enables visitors to purchase RFID cards containing the chip that identifies each visitor and allows a personalized animated character to accompany and interact with the visitor throughout the exhibit. With each new exhibit visited or repeat visits at a later date, the network stores the user's ID to bring up the user's online avatar.
http://www.msichicago.org/exhibit/networld/index.html

Initiatives and Consortia

G1:1—Global Network of Collaborative Researchers on 1:1 Educational Computing
A network of international researchers interested in promoting learning, design, and collaborative research through one-on-one computing: one device per learner.
http://www.g1on1.org/

MOBIlearn
A worldwide European-led research and development project exploring context-sensitive approaches to informal, problem-based, and workplace learning by using key advances in mobile technologies.
http://www.mobilearn.org

Ubiquitous Computing Evaluation Consortium
A group and a list of resources that focus on the impact of ubiquitous computing and K–12 schools.
http://ubiqcomputing.org/

Research and Development

Paul Aoki, Peggy Szymanski, Jim Thorton, and PARC
"Social, Mobile Audio Spaces."
http://www2.parc.com/csl/projects/audiospaces/index.htm

Electronic Guidebook at the Exploratorium
http://www.exploratorium.edu/guidebook

Sherry Hsi, Robert J. Semper, Waylon Brunette, Adam Rea, and Gaetano Borriello
"eXspot: A Wireless RFID Transceiver for Recording and Extending Museum Visits."
Ubicomp 2004—ACM Conference on Ubiquitous Computing.
http://ubicomp.org/ubicomp2004/adjunct/demos/hsi.pdf
http://www.exploratorium.edu/exspot

Probesight at the Concord Consortium
Computer-based probeware in education
http://probesight.concord.org/

Usight at the Concord Consortium
Ubiquitous technologies in education
http://usight.concord.org/

Wireless Internet Learning Devices
Valerie Crawford, Roy Pea, William Penuel, Jeremy Roschelle and SRI team
http://ctl.sri.com/projects/displayProject.jsp?Nick=wild

Mobile Design and Developers

Acoustiguide Corp
http://www.acoustiguide.com

Antenna Audio
http://www.antennaaudio.com

Caterpillar Mobile
http://www.caterpillarmobile.com

7th Floor Media, Simon Fraser University
http://www.7thfloormedia.com

UbiquityInteractive
http://www.ubiquityinteractive.com

Developer Tools

Macromedia Mobile and Devices Developer Center
http://www.macromedia.com/devnet/devices/

Nokia Tools and SDK
http://www.forum.nokia.com/main/1,6566,033,00.html

Windows Mobile Developer Center
http://www.microsoft.com/windowsmobile/developers/default.mspx

Wireless Developer Network
http://www.wirelessdevnet.com/channels/printlinks.phtml?category=13

Conferences and Workshops

IEEE Workshop Wireless Mobile Technologies in Education
November 28–30, 2005
Tokushima, Japan
http://lttf.ieee.org/wmte2005/

Museums and the Web 2005
Strand on Handhelds
April 13–16, 2005
Vancouver, British Columbia, Canada
http://www.archimuse.com/mw2005/index.html

Ubicomp 2005
September 11–14, 2005
Tokyo, Japan
http://ubicomp.org/ubicomp2005/

WILD@Stanford
Monthly lecture series
A special-interest group at Stanford and in the San Francisco Bay Area who use Wireless
Internet Learning Devices to improve teaching and learning.
http://scil.stanford.edu/events/wildSIGindex.html

User Groups

FlashLite User Group (Macromedia's Flash for cell phones)
http://www.macromedia.com/cfusion/webforums/forum/categories.cfm?forumid=68&catid=472

Palm User Group (Silicon Valley)
http://www.svpug.com/

Pocket PC (groups listed by region)
http://www.pocketpcmag.com/_top/User_Groups.asp

Electronic Guidebook Forum 2005: Issues and Questions about Wireless Learning Technologies and Handheld Computers In and Beyond Museums

January 13 and 14, 2005
At The Exploratorium, San Francisco
Location: IFI Classrooms, Palace of Fine Arts

THURSDAY

8:30	**Continental Breakfast**
9:00	**Welcome and Context Setting**, Sherry Hsi and Rob Semper
9:15	**A Welcome from Goéry Delacôte**, Executive Director of Exploratorium
9:30	**Meeting agenda, ground rules, and logistics** – Steve Christiano
	Short self-introduction – Please say your name, organization, position
9:45	**Invited Talks:** Current Research and Applications

    Christina Olsen, Getty Museum
    Jason Teo Shen Yuan, Singapore Science Centre
    Sherry Hsi, Exploratorium
    Mirjana Spasojevic, HP Labs
      Timing: 15 minutes each presenter (up to 10 minutes to present, 5 minutes for Q&A)

10:45am	**Coffee Break**
11:00pm	**Sound Bites**: What Are You Puzzling About?
12:00pm	**Lunch**
1:00pm	**Demonstrations Set-up**
1:30pm	**Demonstrations,** Museum Floor

    Digihound, Chabot Science Center
    Probeware, The Concord Consortium
    Explainer IGuides, Exploratorium
    Exspot, Exploratorium
    Imprints/Museum Detectives, Spotlight Mobile
    Zooke, Caterpillar Mobile

2:30pm	**Debrief Demonstration Experience**
	• Participants brainstorm "takeaways" and insights
2:45pm	**Cases: Mobile Phone Partnerships** - William Barnett, The Field Museum and Wayne LaBar and Denise Bressler, Liberty Science Center
3:15pm	**First Day Breakout Groups**
	Small breakout groups: (group determines topical groups)
4:15pm	**Group Reports**
5:15pm	**Wrap Up**
	• Quick group evaluation of day one (What worked well? What would you add or change for tomorrow's meeting?)
	• Review agenda for Friday
5:30pm	**Adjourn Meeting** (Happy Hour on Chestnut Street)

FRIDAY

9:00am	**Continental Breakfast**
9:30	**Context Setting**
9:40	**Second Day Breakout Groups**
10:15	**Group Reports**
10:45	**Coffee Break**
11:00	**Invited Talks:** User Experience, Assessment, and Evaluation

    Julie Zilber, Simon Fraser University
    Valerie Crawford, SRI International
    Leora Kornfeld, UbiquityInteractive.com
      Timing: 20 minutes each presenter (up to 15 minutes to present, 5 minutes for Q&A)

12:00	**Lunch**
1:00	**Group Discussion**
2:00	**Forum Synthesis and Summary**
	• Based on discussions heard at Forum, Sherry Hsi & Steve Christiano
3:00	**Adjourn**

Forum Agenda

1) Name: _____(optional)

2) Primary institutional affiliation:

❏ Museum / Science Center / Informal Science Institution
❏ University / College
❏ Private industry
❏ School
❏ Government agency
❏ Other (please describe) _____

3) Please rate the quality of your experience at this workshop

	Poor	Marginal	Fair	Good	Exceptional
a) Quality of presentations	1	2	3	4	5
b) Technology demonstrations	1	2	3	4	5
c) Level of new information learned	1	2	3	4	5
d) Content of breakout sessions	1	2	3	4	5
e) Structure and process of breakouts	1	2	3	4	5
f) Quality of interactions/networking opportunities	1	2	3	4	5
g) Opportunities to develop new ideas or projects	1	2	3	4	5
h) Opportunities to identify partners for future collaborative work	1	2	3	4	5
i) Opportunities for your own career development	1	2	3	4	5
j) Overall workshop quality	1	2	3	4	5

4) Would you recommend this workshop to colleagues?   Yes   Maybe   No

5) What were you hoping to accomplish by attending this workshop? In what ways did the workshop meet or fail to meet your expectations ?

6) Will your experience at this workshop lead to new working relationships, new partnerships, or collaborations beyond your previously established network of professional contacts? Please explain:

7) Did this workshop help you to pursue your professional goals? Did this workshop help you to refine those goals or alter your vision of how to achieve them? Please explain:

8) Were you exposed to any new ideas about handhelds or wireless technologies at this workshop? If so, what were these ideas, and how important do you think they will be to your work?

9) Please list any URLs you think would be interesting to this group:

10) Other comments or suggestions:

Timeline chart with three tracks — **Technology Developments**, **Guidebook Applications**, and **Institutions** — plotted along a time axis from 1960 to 2020.

Time	Technology Developments	Guidebook Applications	Institutions
1960			• Acoustiguide
1970	• HP is 25 years old • Intel		• Exploratorium • Lawrence Hall of Science
1980	• Xerox Dynabook • HP-35 calculator • Cell phone invented		• Singapore Science Centre
1990	• Probeware and sensors • Laptop invented • CISCO born • Commercial RFID • Sharp 1500 • Poqet • NCSA Mosaic		• Antenna Audio • SFMOMA 50th
2000	• SMS, textchat • Newton • Palm PDA • Camera phone • PDA coined • eMate • MyMo • WindowsCE • Bluetooth • Billion cell phones • SideKick • MacMini	• SLiC • Petrosains "A Resourceful and Intelligent Friend" • SFMOMA Points of Departure • eXspot RFID • TechTags • CILT • The Stanley, Field Museum • eGuidebook • ScienceAlive • Palm Education Pioneers • GettyGuide™ • Tate Tour	• Liberty Science Center • The Field Museum 100th • Chabot Space and Science Center
2010			
2020			