

Visitors' Evaluations of ICTs Used in Cultural Heritage

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Abstract

Technology that serves to enhance the visitors' experience is gradually becoming more commonplace at Cultural Heritage (CH) sites. However ICT is not usually the CH professional's area of expertise and they have to make choices from a bewildering array of technology, often without fully understanding their visitors' ICT needs. This research aims to alleviate the situation by gathering visitors' evaluations of technologies that are frequently used at CH sites along with advanced applications, to identify which technologies visitors use and what they need. The research took place in five CH attractions in the UK and incorporates the results of one hundred and sixty four interviews with visitors. Both CH professionals and technology developers can use this research to gain insights into the use of ICT applications at sites and to identify emerging needs in the marketplace. The findings of this research indicate that ICTs in use at the CH sites involved were underutilised. Despite this, respondents strongly supported the advanced applications which included: Augmented Reality; an Interactive Museum Installation; a Mobile Media Guide and an Avatar Application. This is because they could see how they would benefit. This paper concludes that the use of ICT was supported by visitors to some degree. However in order to encourage use, the benefits must be clearly communicated to visitors.

1. Introduction

In software development it is of primary importance to ensure that the end product meets users' needs, within the confines of the project's objectives. Therefore it is essential to engage users in design and to gain user feedback at every stage of the project [Cap90]. This feedback also assists those who have commissioned the project. In CH, professionals report feeling overwhelmed by the array of technology available. Their concerns are centred on choosing the application that best meets their visitors' needs [Che05]. Despite the importance of communication and collaboration in systems development, CH and ICT professionals often work in isolation. This research gathers visitors' views and aims to provide the CH and ICT professional with an insight into what visitors think about ICTs used at CH sites. The purpose is to support CH and ICT professionals to understand the priorities and preferences of their users and to determine where to allocate resources in the future.

A review of the literature found that there has been significant work in developing software for CH and

to a lesser extent research that obtained user's views of technology applications in CH. Two conferences in particular: VAST and Computer Applications of Archaeology [CAA] are targeted towards this research area. However no evidence has been found of any studies which gather visitors' requirements for ICTs at CH sites in order to identify what could enhance visitor experience. This research seeks to address the gap in the literature and to add to the general body of knowledge in this area.

The primary objective of this study is to research visitors' views on the use of ICTs in CH to identify their needs. A further aim is to initiate a dialogue between technologists and CH professionals for further collaboration. This study assesses technologies used before, during and after a visit. Four advanced CH ICT applications are evaluated by visitors. These include: an augmented reality application; an interactive museum installation; a mobile multimedia guide and an avatar application. The applications were identified as representing major trends in technology development from papers presented at VAST 2003 and 2004.

2.0 Literature review

There is growing recognition in the literature of the role that ICT can play at CH sites [Ric96; Kee98; and Ben04] and in particular how ICT can enhance the visitor's experience [San03; Sig05 and Ad05]. The following paragraphs summarise ways in which ICTs can add value to a site visit.

i) Entertaining: ICTs offer new ways to make interpretation entertaining. Interactive games are designed to be fun to use and educational at the same time. This is known as Edutainment or a combination of education and entertainment [Buh03].

ii) Helps me to understand: There are lots of ways in which technology can help visitor to understand [Ben04]. For example Augmented Reality can help visitors visualise what an exhibit used to look like.

iii) Educational: Most CH visitors seek to learn during their visit [MdC02]. Interactivity allows content to be layered. The user selects the depth of information they wish to receive. Therefore different types of visitors can use the same application. For example they could be novices or experts etc.

iv) Usability: If the application is complicated to operate, the visitor's concentration is focused on how to use the system, rather than the presentation. Conversely an application that is easy to use enables the user to quickly find the content they require.

2.1 Technology trends

A review of papers presented at VAST 2003 and 2004 identified several specific trends in terms of ICT applications for CH. Four applications were found to be particularly useful for visitor interpretation. These are as follows:

i) Augmented Reality (AR): is the term used for a computer generated reconstruction which overlays a photograph or film [LL00]. This enables comparisons to be made between before and after scenarios.

ii) Interactive Museum Installation: Interactivity refers to a system that is computer-based, where the user's input is then processed by the system, which in turn affects the output [Bee05]. This application can only be used within the site.

iii) Mobile Multimedia Guide: An enhancement of the traditional audio guide so that multimedia can be presented. Wireless devices have a context specific capability where the user's position can be tracked and appropriate information sent accordingly [VDB*04].

iv) Avatars are computer generated images which represent the user in the virtual world [Bee05]. In a CH context, avatars are used to guide visitors around the virtual site and to disseminate information.

For the purpose of this research the ways in which technology can enhance a visit to the site was tested by visitors evaluating advanced applications on the basis of concepts identified from the literature.

3.0 Methodology

The research design required all respondents to be visitors of CH sites. Conducting research within the actual premises of a CH site ensured that this pre-requisite was met. A pilot study was carried out at one site in order to test the questionnaire design. The actual study was undertaken at five well-known CH sites which attract different types of visitors.

3.1 Site selection

The research focused on three kinds of CH sites: museums, monuments and archaeological sites. Each site was chosen as an outstanding example of their field. Sites were also selected on the basis that they used different technologies, in order to obtain views on a wide range of applications.

3.2 Sample selection

The interest of this study focuses on visitors to CH sites in Europe. However it would not be feasible to conduct research at every site in Europe, because the population of interest is too broad and respondents widely dispersed. This research focuses on CH sites in England. Since CH visitors tend to originate from many countries, the inferences produced here should be representative of CH visitors throughout Europe.

It was not practical to conduct probability sampling due to the exploratory nature of the research. Therefore non probability sampling was used. This means that the findings cannot be generalized to the population. However this study's contribution is to provide exploratory data on a topic which has little coverage in the literature. Audience segments were identified to ensure a wide range of visitors were interviewed. These are as follows:

i) Age: The study sought to examine whether children who are growing up with exposure to ICTs from a young age have different views to adults [Dea96], or perhaps it would be the "silver surfers" those who have retired and have taken up computing as a hobby, who are most likely to use ICTs at CH sites.

ii) Gender was tested to see if there were any differences in the opinions and use of technology between men and women. It is a common perception that men adopt technologies quicker than women. This research aims to examine whether this is the case at CH sites.

iii) Domestic / International visitors could have different needs in terms of: culture; language; previous experience and expectations of the site etc. Therefore identifying domestic and international visitors and examining their responses may bring to light differences in perspectives.

iv) Adopter category follows Rogers' Diffusion of Innovations theory [Rog62] which classifies people into five categories in terms of how quickly they adopt ideas. It begins with people who are the fastest to adopt ideas, the "Innovators", to those who are the last to adopt ideas, the "Laggards" (Figure 1). For this research respondents were classified according to how quickly they adopt technology to see whether the diffusion of innovations curve was followed in terms of their opinions and use of technology at CH sites.

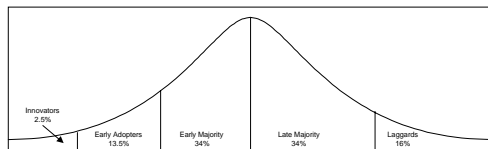


Figure 1: Rogers' Diffusion of Innovations Curve

A quota was established to ensure that each segment was large enough to enable the findings to be examined in some depth [Tro04]. It was not necessary to ensure that the respondent categories were proportional to each other. Rather that each category reached a minimum, set at 10% of the total number of respondents.

3.3 Survey method

The data collection method chosen was questionnaires. The main advantage of questionnaires is that response rates are usually high and cost is low. Quantitative closed questions were used on subjects where information could be captured quickly. Qualitative open ended questions were used to give interviewees the opportunity to make further comments and expand on their views. When evaluating the advanced ICT applications, respondents were given visual aids which had a picture of each application printed on them. The questionnaires were personally administered so that the interviewer could explain the technologies shown on the visual aids and answer any questions the respondents had. This also ensured that the questionnaires were completed in full.

3.4 Survey procedure

The interviewer chose locations where respondents would not be in any hurry such as a café or gift shop. In the café setting interviewees were selected as they were sitting at their table. In the museum and gift shop locations the researcher approached the person as they arrived at the interview point. The interviewer introduced herself and explained the purpose of the questionnaire and gave an indication of how long the research would take. Once permission had been granted, the interviewer read out the questions and the possible answers. The interviewer recorded the respondent's answers and any other comments that they chose to make.

The questionnaire was divided into three scenarios: technology used before, during and after the visit. The advanced applications were evaluated in the during the visit section of the questionnaire as this is the situation where they are most likely to be used. The number of technologies evaluated was limited to four to minimise interviewee fatigue.

3.5 Modifications to the questionnaire

During the pilot study it emerged that the interviews were taking too long to complete. Therefore for the actual study, although structure of the questionnaire remained the same, the questions were streamlined to allow more people to be interviewed. For example some of the closed questions had the number of optional responses reduced so that they would be quicker to read. Also the original evaluation method for the advanced applications used the open ended questioning technique. This was changed for the actual study to rating the following five criteria:

Respondents were asked to rate how *entertaining* they thought the application would be. Interviewees were then asked whether the application helped them to *understand* to find out whether the visitor thought they understood the message better having viewed the application. Visitors were then asked to what extent they thought each application would be *educational*, followed by if the application looked complex or *easy to use*. The final criterion was to find out whether the respondents felt that the costs of developing the technology was *a good use of public / private spending*. Or in other words, money well spent, or whether it would be better spent elsewhere.

A five point Likert scale was used to rate respondents' reactions where 1 = strongly disagree, to 5 = strongly agree. Any comments that respondents made were written down during the course of the interview.

4. Findings

The findings are organised in terms of evaluating ICT visitors' need: before, during and after the visit. Quantitative findings are presented along with an analysis of visitors' comments which helps to provide an insight into this subject. Table 1 and Figure 2 describe the demographics of the respondents.

Type	Freq.	Type	Freq.
Male	50%	Female	50%
Domestic	88%	International	12%
Day visit	68%	Overnight stay	32%
Been before Yes	57%	Been before No	43%

Table 1: Description of Respondents.

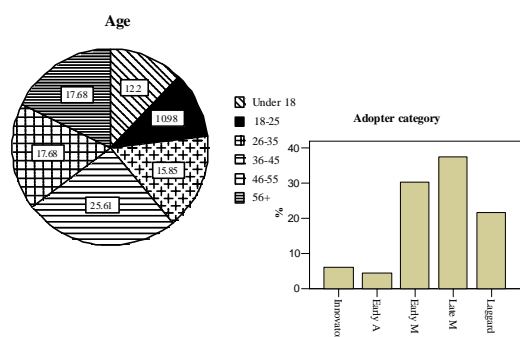


Figure 2: Respondent profile.

4.1 Before the visit

The Internet's capabilities of generating awareness about the site and information provision were examined. The results found that 70% of the interviewees did not hear about the site from a specific source. They already knew about the site. This can partly be explained by the fact that 88% of respondents were domestic visitors and many were repeat visitors. 5% heard about the site from the Internet. This demonstrates that there is some potential for generating site awareness through the Internet.

In terms of what visitors used to gather information, the most frequently used source was tied between the Internet and leaflets / brochures (11%). 62% of respondents did not need to look for information because they had been before etc. Visitors were using the Internet to search for dynamic information which is subject to change such as admission and exhibit information and leaflets / brochures for more static information about the site.

Some CH sites have added advanced booking to their websites. The research found there was strong resistance to advanced booking as 55% of respondents said they "definitely would not book over the Internet" and 66% "definitely would not book over the telephone". The main reason was that people felt they would be restricted to visit at a specified time. Some respondents indicated they might use advanced booking if there was an important benefit such as to avoid queuing or discounts. The question was asked at sites that charged an admission fee because most visitors to sites that do not charge, simply walk in. Also by asking the question to respondents who paid an entrance fee, enables the results to be comparable with other European sites. However caution should be applied to the results because the research was carried out in low season when visitors are substantially fewer. If the research was conducted in high season and the respondents had to queue, the results may have been different.

Respondents were asked about the extent to which technology influenced their decision to visit. 89% said that it had had "very little influence" on their decision. Interviewees explained that they didn't visit a site simply to use the technology. They came to see what the site is known for, such as the Dinosaur exhibition at the Natural History Museum and so on. Although in terms of visitor segments, some weak relationships were found where the younger the respondent, the more technology influenced their decision to visit ($r=-.17$) ($p=.026$). Also the faster the respondent adopts new ideas the more technology influences their decision to visit ($r=-.17$) ($p=.029$).

4.2 During the visit

Respondents were asked what technology they had used at the site. Table 2 depicts the percentage of respondents who used each technology taking into account availability at the site. Touch screens were most frequently used and searchable catalogues the least used. However the results clearly show that every application could be used by more visitors.

	Touch screen	Audio guide	Computer game	Searchable catalogue
%	58	40	15	7
Base*	99	139	99	139

* Number of respondents

Table 2: Technology used at sites.

The use of technology at the site was compared with the audience segments specified in section 2.2. There were no significant differences found. The use of technology was compared between those who had "been before" and those who were on their first visit. A much higher percentage of those who had visited the site previously (16%) used a computer game in comparison to only 4% of respondents who used a computer game on their first visit. Therefore on repeat visits, people were more likely to use computer games. This demonstrates that on an initial visit people want to see the actual artefacts. Whereas on repeat visits visitors start using other resources such as using computer games. This suggests additional uses for technology: to entice the visitor back to the site and to enhance the repeat visit experience by exploring the technology on offer. However it has to be said that touch screens were the only device where a significant difference was found. Nevertheless technology could feasibly provide added value for repeat visitors.

Respondents were asked what they used to help them navigate around the site. They could specify more than one category. Table 3 depicts the results.

	Signs	Audio guide	Staff	No assistance	Touch screen
%	74	30	21	8	6
Base	164	136	164	164	99

Table 3: Navigational aids at sites

Audio guides were given out to every visitor at one site. This may cloud the picture of audio guide use because at other sites they were designed to be used in a specific area, rather than the whole site. Touch screens were used by just 6% of respondents. However it is recognised that many touch screens are not designed for site navigation.

4.3 Advanced technologies

Interviewees were asked for their views on four advanced technologies. It was not feasible to install each of the four advanced technologies at the sites where the study was undertaken. Instead visitors were presented with an image of each technology, and were given a description of how it worked. Respondents were asked to rate their first impressions based on the descriptions of the technology.

4.3.1 Augmented Reality Application

Figure 3 shows an augmented reality application developed by ENAME, in Belgium. The viewing platform on the left hand side of the picture contains a computer screen through which a computer

generated image of an abbey that once stood at the site (shown on the right hand side) can be viewed.



Figure 3: Augmented Reality application. [ENA04]

The evaluation criteria with the highest mean score for the augmented reality application was "understand" (4.27) followed by "educational" (4.26). The lowest mean score was (3.75) "entertaining". The mode value was 4 or "agree" in every category. In terms of who was using the application, there was only one relationship found in terms of: the younger the respondent the more likely they would say it helped them "understand" ($r=-.16$). ($p=.038$). There were no significant differences found for this application which demonstrates that it appeals to a wide range of audience segments.

From the respondents' comments, the most frequently cited benefit of this application was that it helped them to picture the subject. The second most frequent comment was that it gave them further information, such as 3D measurement and perspective. One respondent felt that content was more important than the device presenting the information. If the content is disappointing, the user is unsatisfied with the overall experience. This view was found to be supported during the visitors' evaluations of the interactive museum installation. Therefore ICT developers need to work closely with CH experts in interpretation design.

4.3.2 Interactive Museum Installation

Figure 4 shows an application that was developed for a museum associated with the Olympic Games in Greece. The idea is to fit pieces of the pottery together in order to identify which of the vessels shown at the top of the picture it is.

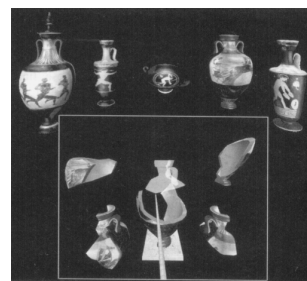


Figure 4: Interactive Museum Installation [GCP04]

The highest mean score for the interactive museum installation was “easy to use” (3.9) followed by “entertaining” (3.7). The lowest mean score was “helps me to understand the subject” and “good use of public / private spending” (3.36 jointly). The mode was 4 for each evaluation criteria. Therefore the most frequent response was “agree”. Significant differences were found between domestic / international with respondents rating “educational” as ($p=.001$) and “easy to use” as ($p=.008$).

The most frequent comment from respondents was that this application is more suited to a child than an adult. It was regarded as being “too easy” for adults to use. However ease of use is necessary if children are going to use the application. Several adults said they would like to see more content added. For example explaining the reasons why the shape and pattern were chosen, to explain the meaning associated with them. This demonstrates that interpretation is important to the visitor. However, the mean rank scores from Kruskal Wallis tests showed the international visitors gave a higher score than domestic visitors for “educational”, 113.39 compared with 78.45 respectively. Perhaps respondents were indicating their support for an application that could be understood in any language. However in order to cater for the need for more interpretation without alienating visitors who speak different languages, interpretation / instruction should be available in multiple languages.

4.3.3 Mobile Multimedia Guide

Figure 5 shows a mobile multimedia guide application that has been tested in Pompeii, Italy and Olympia, Greece. The idea is that as the user walks around the site, multimedia content is sent to the device according to where they are located. The glasses can be used to see computer generated reconstructions of what once stood at the site. Therefore visitors can compare the site's appearance today, with what it once looked like.

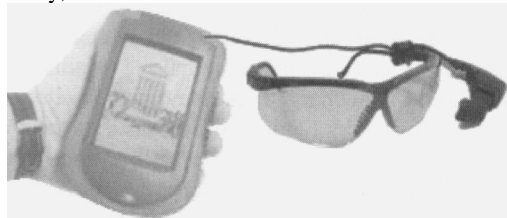


Figure 5: Mobile multimedia guide [VDB*04]

The highest mean score for the mobile multimedia guide was (4.38) for “educational” followed closely by “helps me understand” (4.37). The lowest score was for “good use of public / private spending”

(3.82). Three of the evaluation criteria had a maximum score of 5. No other advanced application tested in this research achieved a mode value of 5 for any of the evaluation criteria demonstrating that interviewees found this device to be the most useful out of all four applications.

Although the results show that this device had the strongest support from visitors, some felt that it looked very complex to use. However one respondent had a different perspective. She felt that this device would be easier to use than audio guides because the visitor does not need to press any buttons which is often very confusing for the visitor. Some visitors were concerned that they would be so busy trying to operate the device, that they would miss seeing what is actually at the site. Despite these comments, there was a very positive reaction to this device overall.

4.3.4 Avatar Application

Figure 6 depicts an avatar application that is based on a town in Germany. The avatar takes the user on a virtual tour of the site. The user can move the avatar around the scene and can ask questions about the buildings etc. to the avatar who supplies the answers.



Figure 6: Virtual Guide [RFD04]

The highest mean score for the avatar application was (4.11) for “educational”, followed by “entertaining” and “helps me to understand” which both scored (3.98) respectively. The lowest mean score was for “good use of public / private spending”. The mode was 4 (agree) for every category.

In terms of who would use this device, many adults felt this application would appeal more to children than themselves, although the statistical tests found that the children's scores were similar to the adult's scores. There was a relationship found for adopter category where the closer respondents were to being innovators, the higher they rated the application as educational where ($r=-.018$) ($p=.021$). Domestic / international also differed in terms of “helps me to understand” with domestic visitors giving higher

mean rank scores than international visitors 85.77 to 57.55 respectively. This was possibly due to the application's reliance on language.

There was some resistance among adults for this application because of the fact that it looked like a computer game. It emerged that one of the reasons for visiting a site was to give children a change from playing computer games. However some respondents said that they would like this application to be made available over the Internet for use at home. This would also avoid the problem of bottlenecks of visitors waiting to use the application.

4.4 After the visit

Respondents were asked if they would look for further information after leaving the site. Of the 52% of respondents who said they would look for information, 51% would use the Internet and 64% would use books. Many respondents said they would use both books and the Internet. This shows that although traditional methods are still the most frequently used source for finding further information after the visit, the Internet is catching up.

Visitors were asked would they recommend the site on the basis of technology. More than half of respondents (55%) said they were "likely" to "very likely" to recommend the site on this basis. Therefore after having seen and considered the use of technology at the site, more people would recommend on this basis (55%) than were influenced themselves as 89% said that technology had "very little influence" on their decision to visit.

Respondents were asked to rate their satisfaction with the technology at the site and satisfaction with the site overall using a 5 point Likert scale where 1 = extremely unsatisfied to 5 = extremely satisfied. Table 4 shows the results.

%	Satisfied use tech	Satisfied variety tech	Satisfied site overall
Extremely unsatisfied	0	0	0
Fairly unsatisfied	2	4	1
Neither satisfied nor unsatisfied	18	27	3
Fairly satisfied	57	57	34
Extremely satisfied	23	13	62
Base	136	136	158

Table 4: Site satisfaction ratings (%)

Most respondents said they were either fairly or extremely satisfied with the site. There were no relationships or significant differences in terms of

age, adopter category, gender and domestic / international categories found between their satisfaction with the use of technology at the site and their evaluations of the site overall. However there was a positive relationship found for "variety of technology at the site" and "satisfied with the site overall" with ($r=.030$) ($p=.028$). Therefore the more the respondent was satisfied with the variety of technology, the more they were satisfied with the site overall. This demonstrates that variety was more important to interviewees than use. This contrasts with some respondents' views cited earlier, that interpretation was more important than the device which presents the information.

5. Conclusions

This research examined CH visitors' views of the benefits that technology could bring in terms of enhancing interpretation and whether visitors used technology currently available.

It was found that visits are frequently spur of the moment decisions or repeat visits. Therefore many visitors do not have the need to look for information, or book in advance. Technology plays a negligible role in the decision to visit. The main driver is to see the site and actual artefacts at first hand.

In terms of technology currently operational at the study sites, all were found to be underutilised. Yet this did not affect the ratings for the advanced applications where all of the evaluation criteria for every technology had a mean of greater than 3 out of a possible score of 5. Therefore once the technology was in front of the respondents, they could see for themselves how they would benefit.

The Internet was identified as a primary source to gather further information after visitors had left the site. Also despite the use of technology being incidental to the visit decision, more than half of interviewees said that technology would influence their recommendations to others. However a quarter of respondents indicated that they would be very unlikely to recommend a site on the basis of technology alone. According to the satisfaction ratings, respondents preferred more of a variety of technology, rather than how it was used.

In terms of who was using technology there were few marked trends although there seemed to be slight indications of innovators and children adopting the technologies quicker. However this varied according to the device.

The main issue arising from this research was to increase the use of applications both for existing technologies at the site and new technologies to be

introduced in the future. It is an easy mistake for those developing technology to assume that the visitor will use the device because it happens to be there. Visitors are trading off their time with using the technology. Therefore the application's benefits and uses must be made immediately apparent to the visitor in order to encourage use.

This research examined the extent to which visitors used and valued the use of ICTs at sites. Due to the limited studies in this area, this research concentrates on a preliminary analysis of ICT needs. Further research could involve an investigation of the advanced applications *in use*. An additional limitation of this research is that it required respondents to have a good understanding of English otherwise they would have difficulties answering the questions in the study. Future research could involve interviewing respondents who spoke different languages.

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