Testing Object Management (TOM): A Prototype for Usability Knowledge Management in Global Software

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Abstract. The collection and sharing of results from usability laboratories around the world has not yet made good use of emerging models of Internet-based knowledge sharing technologies. This paper will present a model for a system that could improve the sharing of knowledge on a global scale and also facilitate the linkage of design guidelines and patterns to the accumulated evidence from the many worldwide studies that are not processed into academic publications.

Keywords: knowledge management, usability testing, global software development.

1 Introduction

A number of criticisms have been directed at lab-based usability testing. These are mainly centered on the cost of setting up and running the labs and the effect they have on users' behavior. Despite such criticisms, a number of labs have arisen all over the world that are constantly conducting tests and obtaining potentially useful information that could be implemented to support usability design. The international spread of usability expertise is increasing greatly [15].

A criticism that is not often made about such labs is that the data they produce at great expense is not cost-effectively used. What is learned from usability tests is passed on to others generally through non-standard documents with a limited distribution. Results from usability laboratories are sometimes presented within papers published journal and conferences. However, the results presented in such papers are not readily available in a standard digital format that would allow cross study, collection and comparison of the data. There have been attempts to draw from such reported studies in order to provide some support for commonly proposed design guidelines. For example, http://www.usability.gov, managed by the US Department of Health and Human Services, references academic papers that provide some supporting evidence to its published guidelines. This activity has proved surprisingly difficult, with most guidelines having at most only a few studies providing support.

A problem in using academic papers is that they are not often focused on a particular design issue, and they are formatted in a way that suits the needs of the academic community rather than those of practitioners trying to identify specific evidence-based design guidelines. Usability tests on particular software are more

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directly focused on design issues, but the report formats are often varied and there are no established publishing outlets. There has been an attempt to address this problem of reporting standards by the introduction of the standard document format for usability test reporting (the common industry format). While this goes part of the way to solving the problem outlined above, the objective of this paper is to propose an alternative scheme that provides a more complete solution and allows knowledge about cultural differences in design to be more clearly identified.

1.1 Current Approach

Currently, Microsoft Word or Adobe PDF documents are the primary methods for communicating information related to usability problems. Finding a document related to a specific usability problem is often difficult, and even if such a document is found, locating specific information about the problem within the document is also difficult. Navigation within the document is complicated by the fact that it is not organized according to a standard format. Creating a standard document format is the advocated approach to solving this problem, and this approach has become popular in some domains, such as the reporting of clinical trials. The Consolidated Standard of Reporting Trials, or CONSORT [3], establishes guidelines for the standard reporting of clinical trials. These guidelines help researchers better communicate the results of their trials so that they can be more clearly understood, and can be compared and consolidated. The National Institute of Standards and Technology has established the Common Industry Format (CIF) [11] to achieve the same goal for usability testing (ANSI INCITS 354-2001).

Establishing common document formats is only a partial solution, however, because the flow of usability information is still constrained by the traditional document-centric view of knowledge communication. If someone is interested in knowing what test results relate to a particular technology or design attribute, he or she has to identify the appropriate documents and process the contents before collating all the related results.

1.2 Network/Object Centered Approach

A number of domains (e.g. software engineering, learning, technical documentation) have accepted that one way to increase the reuse and sharing of knowledge is to granularize a system into objects and to categorize and store the objects in digital libraries that can be browsed and searched. The aerospace and defense industries association of Europe has developed S1000D as an object based approach to the construction of technical documentation (see http://www.s1000d.org/).

An example of a networked environment to support the reuse and sharing of knowledge objects which are normally integrated in reports is Net-Centric Performance Improvement (Net-PI) [5] [14]. Net-PI is a system that allows teams to collect and critique knowledge during a human performance analysis project. The resulting knowledge is compiled into both a conventional report and a set of XML-based information objects that capture the key analysis data. These objects are included in a digital library that allows subsequent analysts to build on existing knowledge, rather than having to reanalyze the problem from scratch.

The general idea of using the power of the Internet to increase the generation, sharing and dissemination of new knowledge is gradually developing. Initially the document focused approach people were already familiar with was merely translated to the Internet domain in the form of e-journals. The newest development is the concept of cyberinfrastructure, which strives to use the power of Internet technology to more effectively promote progress in science and engineering [2]. A key part of this is improving the processes of collaboration and knowledge sharing.

2 Usability Test Result Object

There is scope for adapting object-based standardization efforts in other domains, particularly in e-learning, to facilitate the reuse and sharing of knowledge in usability. A starting point involves the capture of key data from tests in XML-based digital objects. These objects can then be catalogued according to user profiles and goals (or use scenarios) in a globally accessible test knowledge repository. Usability test objects have the advantage of being both embeddable within a traditional document and storable in digital repositories where they can be accessed, collected, and compared by a global community of usability specialists. An initial standard for a test object schema is based on key fields derived from the common industry format (Table 1).

Table 1. Initial data elements for a usability test object

Element	Description
The use case/ test scenario	One specific goal assigned to a test subject
Specific interface component	The design components included in the test, e.g. date selector, form, shopping basket
Subjects	Details on the subjects used in the test
Intended end-user	Description of the intended end user
Test method	How the test was conducted
Problems identified	Specific elements of the design that caused the users' problems and why
Recommended solutions	How to address each problem noted above
Dublin core metadata	This is the accepted standard for web resource meta-data and includes such items as author and date created.
Unique object identifier	This would allow registration of the object in a digital library

For each design, a digital test results object (TRO) is collected, which can be stored in a database or a single XML file. The TRO can be compiled into a conventional report; it can also be registered in a digital library of objects relating to the goal. A range of data would be collected in the TRO; an initial specification for the contents is presented in Table 1. As with all standards, different parties need to comment on the proposed elements before the standard can be fully adopted. It is also possible to allow extensions to core standards or to make some elements optional, depending on the circumstances.

3 Tools for Knowledge Sharing

There is a need for a set of tools to assist in the Test Object creation and access. Test Object Management, (TOM, see figure 1) is a prototype for such a tool. Existing user test data from third party usability studies is used to illustrate that objects can be derived from existing CIF compliant reports. TOM allows the creation of objects and the storage in a digital repository that is catalogued according to software types, user roles and user goals.

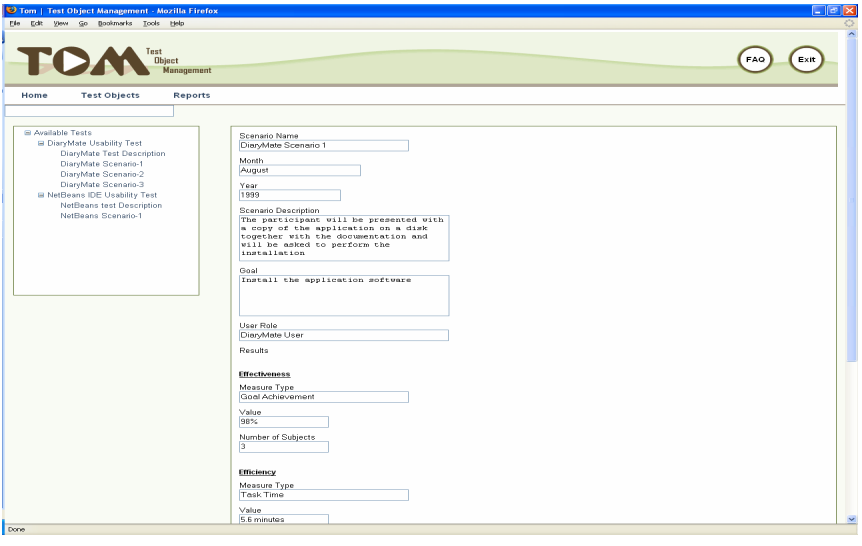

Fig. 1. A screen from the Test Object Management system, which displays test projects and scenarios, and provides test object editing

Under the TOM system, labs will separate the collected data not just by the product tested but also by the specific users' goals in the interaction scenarios tested (e.g., booking a flight). The specific interface design components relating to the goal will then be identified for different interfaces designed to assist users in achieving this goal. One goal may have several different interface design components or specific designs for specific regions or countries.

TOM is just one example of a tool for the creation and management of test result objects. It is possible to adapt other web-based meta-data creation tools with templates for test result objects [9]. Another possible approach is to create add-ons and templates for popular word processing tools. This would allow for the creation of reports with tools users are already familiar with, while enabling the extraction of data to be converted into the object format.

4 Repository Model

A federated scheme similar to that of the latest thinking in repositories for digital content used in training is a useful model for usability testing. Kahn and Wilensky [8]

conducted some of the earliest work in confederated libraries and the design and development of infrastructures for open architecture. Further work has been conducted by the Digital Library Research Group at Cornell University and the Corporation for National Research Initiatives (CNRI) [12]. However, the most developed model for this approach is the Content Object Repository Discovery and Registration/Resolution Architecture (CORDRA), which is a collaborative activity emerging from the U.S. Department of Defense's Advanced Distributed Learning (ADL) initiative [13].

CORDRA was created with the assistance of the Corporation for National Research Initiatives (CNRI) and Carnegie Mellon University's Learning Systems Architecture Laboratory (LSAL). CORDRA is a model for a global infrastructure for the federation of content repositories. Although primarily targeted at e-learning content, it is flexible enough to incorporate many types of content objects. CORDRA allows groups of separate repositories to form federations by entering their content in a central registry. Registers can themselves be registered in a higher-level Registry of Registries, with one root-level Master Registry of Registries where a unique identifier is assigned to each registered item. The individual federations can vary with regards to metadata standards, access policies, and organizational principles. Applied to usability testing, such a scheme would allow each individual testing organization to operate its own repository and to decide what it shares through a central registry. There can be registries for each country that all feed into the root-level registry.

4.1 Repository Tools

In addition to standards for the Test Result Object and the tools to create objects, standards must be created for the digital library or repository through which the objects would be catalogued and accessed. There are already well-developed models in other domains (e.g. learning content objects) that can be readily adapted for the purpose of TROs. (See for example the sharable content object reference model, SCORM at www.adlnet.org.) The main tool needed is one for organizing groups of objects into meaningful collections.

One possible scheme we will investigate is organizing objects by identified user goals. In this scheme, each separate test on one user goal results in a TRO, which is in effect a specific instance of a general class of tests for a specific type of interface design component. When tests conducted in different countries reveal similar results, they are included as an object that is linked to the main class of tests. When tests in different countries reveal different results, a new subclass for that country is created.

Another possible approach is social book marking [7]. Social book marking works by utilizing the contributions of the diverse, independent, and decentralized contributions of users through the tagging of content. This is essentially the approach used by websites such as flicker.com and del.icio.us. Such an approach would enable the community of users (educators, testers, developers, and researchers) to identify and classify what is important to them.

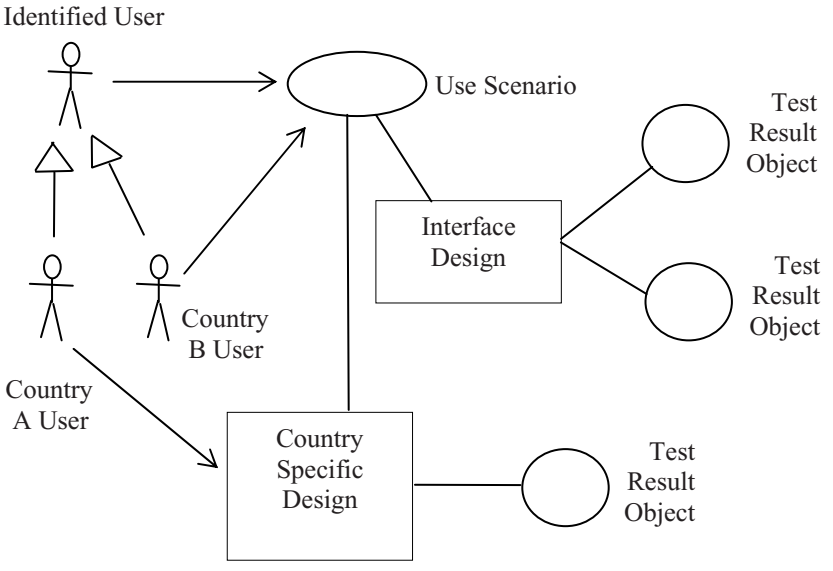

Fig. 2. An organization scheme for linking usability test objects to country specific interface designs for user roles and goals

4.2 Connecting Guidelines and Patterns

Effectively collecting data derived from international tests is a first step towards more efficient test reporting and archiving. The next step would be to use the repository to investigate how the stored data can translate into effective design advice for developers of new technology. This is necessary to analyze the data and derive effective guidelines for developers. The system proposed would enable the aggregation of data from a number of labs and tests to provide a level of confidence in backing certain recommendations (see Figure 3). An effective system would reduce usability errors more effectively by preventing them from arising in the first place.

The National Cancer Institute supported an effort to collect web design guidelines and to identify the evidence that supports each guideline [10], relying mainly on work published in academic outlets. Many tests documented in usability labs are not available because there is no place to publish the results and non-academics do not always have the time to write up the results in a form acceptable for an academic publication. An open Internet-based repository in which any lab can publish results has the potential to accumulate more substantial evidence for certain guidelines and to provide more specific indications of how guidelines can be implemented in certain types of interfaces, or for users in certain countries. Studies in cross-cultural usability suggest a need to make distinctions in certain guidelines and priorities [4] [6] [17].

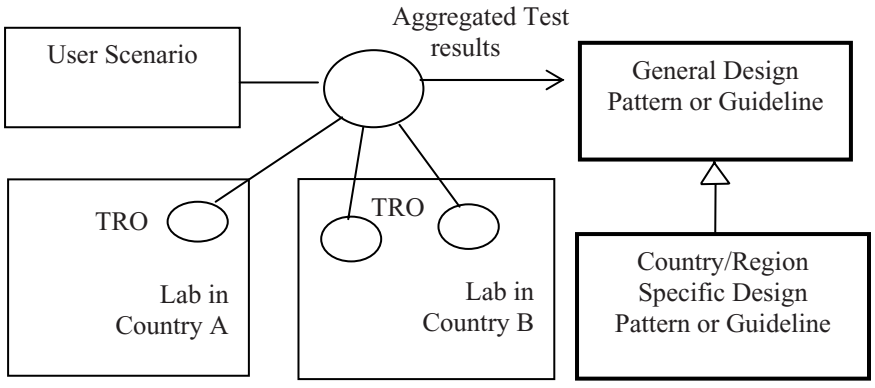

Fig. 3. An organization scheme for linking usability test objects to country specific interface designs for user role and goals

The design patterns movement prevalent in a number of design domains presents a mechanism whereby internationally collected testing data can be abstracted into design patterns that have variations for particular regions or countries. Design patterns arose in architecture when Alexander [1] noted that certain abstract patterns could be identified across a range of successful room, building, and city designs. Alexander determined a patterns language whereby these patterns could be described in a standard way and then rated and discussed by the design community. There have already been attempts to develop a set of patterns for interface design [16] but, as with the National Cancer Institute guidelines, results reported in a few academic papers are mainly used to validate the patterns. Patterns provide a potentially useful mechanism to aggregate results from a range of tests.

Another problem is that of context. An interface that has been proved to support a user goal in one context may not work well in another. This problem also applies to the concept of patterns, where abstracting problem-solution pairings from a limited number of concrete problem analyses may give a false indication of the general applicability of the pattern. In a sense, this perceived limitation derives from seeing both the object and pattern creation activities as discrete, rather than continuous processes. As more people share their test data and identify different contexts where the perceived patterns and guidelines do not apply, the community can determine when new or special cases, guidelines, and patterns are needed. A system like the one proposed in the previous section could provide the data for the community to refine and recognize the limits of patterns and guidelines.

5 Conclusion

This paper proposes to investigate an open-standard based approach to the sharing of test results in the form of digital objects. Not only would such an approach reduce the needless replication of tests that occurs when there are no public records of previous tests conducted, but it would also allow for the accumulation of a good deal of evidence to support certain usability design patterns and guidelines. Results from labs

in different countries would facilitate the identification of cases where specific guidelines and patterns require special variations for audiences in certain countries. The emergence of such a collection of knowledge would be of great benefit to all developers. Without it, developers are either restricted in their access to usability expertise or have to rely on their own best estimate as to what interface design works best and how it should be adapted for different countries.

The proposed scheme is adapted from similar efforts to facilitate the reuse and sharing of knowledge in other domains, particularly in e-learning. It involves the capture of key data from tests in XML-based digital objects and unique identifiers for cataloguing. These objects are organized in digital repositories according to user profiles and user goals in a globally accessible repository. Usability test objects have the advantage of being both embeddable within traditional documents and storable in digital libraries where a global community of usability specialists can access, collect, and compare them. The objects can be linked to existing design guidelines published on the web. The test data objects would thus serve to produce individual reports and to accumulate a body of evidence to support both general and specific design guidelines.

A global repository of test knowledge can be developed and used to help better validate design guidelines and patterns. The proposed system would allow this knowledge to be aggregated and distributed on a global scale, and it would be useful in identifying regionally and culturally specific variations in design guidelines.

References

1. Alexander, C.: The Timeless Way of Building. Oxford University Press, New York (1979)
2. Atkins, D.E., Droegemeier, K.K. et al.: Revolutionizing Science and Engineering Through Cyberinfrastructure (2003) Retrieved June 9, 2006 from: http://www.communitytechnology.org/nsf_ci_report/
3. Begg, C., Cho, M., Eastwood, S.: Improving the Quality of Reporting of Randomized Controlled Trials: the CONSORT Statement. Journal of the American Medical Association, pp. 276–637 (1996)
4. Del Galdo, E., Nielsen, J.: International User Interfaces. John Wiley & Sons, New York (1996)
5. Douglas, I., Butler, J., Nowicki, C., Schaffer, S.: Web-Based Collaborative Analysis Reuse and Sharing of Human Performance Knowledge. In: Proceedings of the Inter-Service/Industry Training, Simulation and Education Conference (I/ITSEC), pp. 1023–1030 (2003)
6. Fernandes, T.: Global Interface Design. Morgan Kaufmann, San Francisco (1995)
7. Hammond, T., Hannay, T., Lund, B., Scott, J.: Social Bookmarking Tools: A General Review. D-Lib Magazine 11 (2005)
8. Kahn, R., Wilensky, R.A.: Framework for Distributed Digital Object Services. International Journal on Digital Libraries 6, 115–123 (1995)
9. Malaxa, V., Douglas, I.: A Framework for Metadata Creation Tools. Interdisciplinary Journal of Knowledge and Learning Objects 1, 151–162 (2005)
10. National Cancer Institute: Research-Based Web Design and Usability Design Guidelines (2006) Retrieved November 29, 2006 from: http://www.usability.gov/guidelines/

11. National Institute of Standards and Technology: Common Industry Format for Usability Test Reports. Industry Usability Reporting Project (2001) Retrieved November 30, 2006 from: http://zing.ncsl.nist.gov/iusr/documents/cifv1.1b.htm
12. Payette, S., Blanchi, C., Lagoze, C., Overly, E.A.: Interoperability for Digital Objects and Repositories: The Cornell/CNRI Experiments. D-Lib Magazine (1999)
13. Rehak, D.R., Dodds, P., Lannom, P.: A Model and Infrastructure for Federated Learning Content Repositories. In: Proceedings of the Interoperability of Web-Based Educational Systems Workshop, 14th International World Wide Web Conference (2005)
14. Sasson, J., Douglas, I.: A Conceptual Integration of Performance Analysis, Knowledge Management and Technology: From Concept to Prototype. The. Journal of Knowledge Management 10, 81–99 (2006)
15. Schaffer, E.: Offshore Usability: Helping Meet the Global Demand? Interactions XIII.2 (2006)
16. Tidwell, J.: Designing Interfaces: Patterns for Effective Interaction Design. O'Reilly Media, Sebastapol, CA (2005)
17. Vatrapu, R.: Culture and International Usability Testing: The Effects of Culture in Interviews (2006). Retrieved November 9, 2006 from: http://scholar.lib.vt.edu/theses/available/etd-09132002-083026/unrestricted/Vatrapu_Thesis.pdf