A Knowledge Management Support Tool: Visualizing Design Activities

Kamran Sedig
Faculty of Information and Media Studies &
Department of Computer Science
The University of Western Ontario
sedig@uwo.ca

ABSTRACT

As organizations try to become more competitive, their success depends on how they capture the strategies and activities that are embedded in their work processes. Some companies capture this knowledge in the form of narrative-based case studies and success stories. Computer-based visualization tools can assist this process. This paper presents and discusses a knowledge management support tool, UCD_Vis. This tool applies visualizations to a narrative-based case study to provide a map of the case study, to facilitate navigation through the information space, and to support the conversion of knowledge—i.e., its externalization from tacit to explicit.

INTRODUCTION

Much of the knowledge created within organizations is not explicit (Nonaka and Takeuchi 1995). A great deal of the created knowledge is tacit and is embedded in the work processes and activities carried out by product and design groups. Narrative-based case studies and success stories have been suggested as a viable method for capturing, transferring, socializing, and externalizing this type of knowledge (Choo 1998; Nonaka and Takeuchi 1995; Wenger 1998).

We have been working with a number of organizations (e.g., Bank of Montreal, IBM, and Nortel) to investigate how to design knowledge management tools to support their work in the design of human-computer interaction (HCI) products (Carey and Sedig 2001). User-centred design (UCD) refers to an HCI design methodology that keeps the needs and goals of the user as the focal point of its activities. The why, where, when and with whom of use determines and affects the what and how of the design (Carey et al. 1998). Transfer of UCD knowledge is not easy, neither is learning to become a competent user-centred designer. UCD often involves teams of multidisciplinary people working with each other on a design case for a period of time to develop products that satisfy users. The experiences and activities of the team members in each case can be captured as a case study by recording the events that transpire during the design process—made of the thoughts and impressions of the members of the management group, the design group, the quality assurance group, and so on. Frequently, this captured information is embedded in multimedia chunks—text, audio, drawings, and video. Making sense of this information and developing insight into why things work or fail, and how to improve existing processes is not always easy. Often times, discovering the know-whys is not possible, as the person who studies the case cannot see the unknown interactions and

causal relationships among unseen situations, decisions, and processes described in the multimedia chunks.

This paper presents and discusses a knowledge management support tool, UCD_Vis. This tool applies visualizations to a narrative-based case study to provide a map of the case study, to facilitate navigation through the information space, and to support the conversion of knowledge—i.e., its externalization from tacit to explicit (Choo 1998; Jacobsen 1999; Tufte 1998).

WHY VISUALIZATIONS?

A great deal of research and development is under way to create computational tools to support knowledge management processes (Tiwana 2000). Most of these tools, however, address issues such as data mining, searching, and browsing of information spaces. Design of narrative-based knowledge support systems has not received much attention, despite the possibilities that visualization tools offer as mindtools—tools that augment and support mental activities and interpretive processes (Jonassen et al. 1999). Visualization of information can encode scattered information into perceptually concise and efficient visual representations (Card et al., 1999). Visualizations amplify thinking, foster sense making, assist in abstracting knowledge by making deep structures and patterns within the information visible, support perception of unanticipated emergent properties, allow hypothesis formation, and facilitate construction of mental maps of the information space (Card et al. 1999; Jonassen et al. 1999; Spence 2001; Tufte 1998; Ware 2000).

As was stated before, the experiences and activities of a team during the design process can be captured by interviewing the project participants and recording these as multimedia chunks. Once stored and represented in digital form, the transfer of this knowledge to others, however, is not straightforward. The user of the multimedia system needs to navigate through the whole information space to construct a mental map of the landscape (Chen 1999). The system can be built such that these multimedia chunks are presented in a hypermedia form. Alternatively, all the chunks can be put together and presented as a multimedia document. Both these methods require the user to go through the whole information space to have an understanding of the temporal and causal relationships among the events during the project and the ideas generated and dealt with by the team. This research has the following objective: to visualize the entire design process so that the user can easily navigate through the space, get a quick overview of the entire space, observe its salient patterns and structures, and develop insight into the UCD process by analyzing when, how, and why things work or fail.

Creation of visualization environments involves a number of issues (Spence 2001). Among these issues are: 1) selection—selecting the most relevant information from the entire space to reduce clutter; 2) focus+context—representing the entire space graphically at a glance, but providing enough depth and detail to help the user understand a particular concept or dimension of information; 3) interaction and navigation—providing interactive facilities for the user to observe, move through, and examine the

information space; and 4) externalization—representing information structures graphically to allow the user to construct appropriate mental models of the information space. Depending on the structural characteristics of the information space, designers should employ different types of visualizations (Shneiderman 1998)—such as temporal, 1-dimensional, multi-dimensional, and hierarchical. For instance, process descriptions and sequential events lend themselves to temporal visualizations, and complex, narrative-like subject matters lend themselves to multi-dimensional visualizations.

USER-CENTRED DESIGN VISUALIZATION (UCD_Vis)

The UCD case study system was originally conceived as a tool to assist corporate employees to acquire knowledge about HCI design methods. The sponsors of the system and their representatives on the development team were technical professionals in the information technology development area. They had built their own knowledge of HCI from personal motivation, demonstrated the benefits of UCD through involvement in a pilot project, and wanted to use this experience to improve the resources available internally to support the transfer of UCD knowledge (Carey et al. 1998; Carey and Sedig 2001). The captured knowledge forming the content of the UCD case study comprises of a set of interviews in the form of multimedia chunks (e.g., text, speech, and video).

Among other things, the collected information has two characteristics. It is temporal and multi-dimensional. The UCD process involves a number of temporal stages such as team formation, job shadowing, requirements definition, design, initial prototyping, and testing. The content of the narrative has several facets (or dimensions). Examples of these facets include the actual progress of the team during the project, the perceived progress of the team, understanding of the work by the participant team members, and understanding individual roles and project concepts. All this information is embedded and distributed among the different multimedia chunks. UCD_Vis aims at encoding this scattered information into perceptually concise and efficient visual representations so that the user of the system can get a holistic, spatial view of the entire information space and can navigate through it quickly. The following is a list of some of the features of UCD_Vis.

Timeline

Figure 1 shows a snapshot of a UCD_Vis screen. At the bottom of the screen the timeline of the project is represented visually along the horizontal axis. The timeline consists of a series of icons representing the events (or activities) during the project (e.g., scissors representing paper mock-up creation). This visualization is intended to allow the user to get an overall picture of the entire context of the activities during the project. The timeline icons are interactive. They are linked to event information—i.e., narrative descriptions of these events and their outcomes as embedded in the multimedia chunks. The user can focus on each event more closely by clicking on a timeline icon. This brings up a window of a multimedia chunk of the case study pertinent to that event and containing its outcomes (see Figure 2). As seen in the figure, the user can examine this chunk in the context of the overall activities of the project.

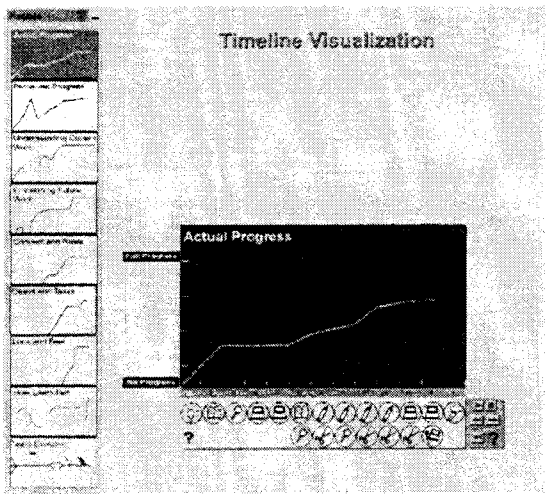

Figure 1

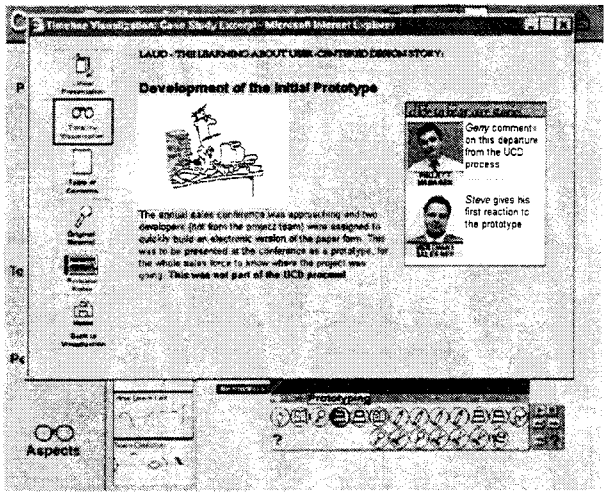

Figure 2

Facets

Facets of the narrative case study are visualized as two-dimensional graphs. The menu on the left of Figure 1 consists of a list of these facets. The facet graphs are distilled from the captured information narrated by the project participants and represent approximations of what the participants perceive about the events during the project. The horizontal axis of each graph represents time and corresponds directly to the timeline events. The vertical axis represents a range of values pertinent to a given facet. In Figure 1, the user can see the facet of 'Actual Progress', whose values range from 'No Progress' to 'Full Progress' . From the graph one can see that during certain stages of the project the progress was sharper than others, and that during some stages the progress plateaued. Figure 3 shows that the user can move the mouse over the timeline icons and observe how they correspond to different portions of the graph.

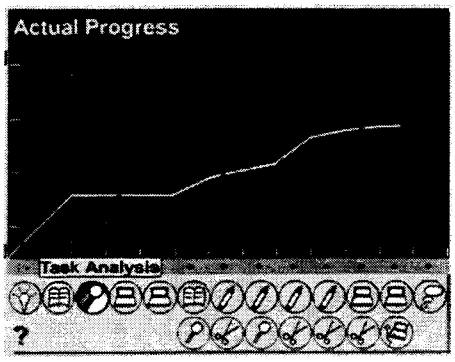

Figure 3

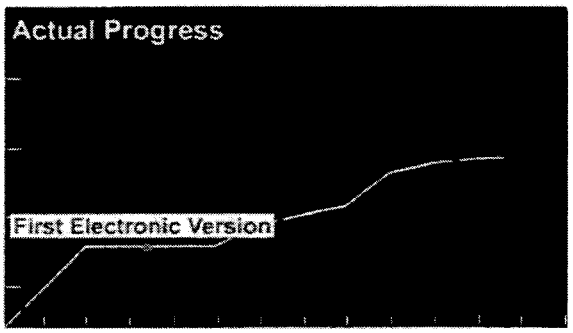

Figure 4

The facet graphs are interactive and are linked to the case study elements. By moving the mouse over the hotspots on the graph, the user can get a sense of the activity performed at that point of the graph. The user can also click on points on the graph to get more detail

on that point and read (or watch) the chunk of the case study as narrated by the project participants (Figure 4)—similar to the case of clicking on a timeline icon.

The facets menu (see Figure 5) is interactive. The user can move the mouse over any item, and that facet gets enlarged and placed above the current facet. In Figure 5, for instance, the user sees 'Actual Progress' and 'Perceived Progress' simultaneously. This allows the user to compare different facets. As shown in the figure, during prototyping the team perceived that they had made more progress than their actual progress. To interact with the graphical representation of a facet (as described above), the user can click on the corresponding menu item, and the selected facet replaces the current central facet—'Actual Progress' in the figure.

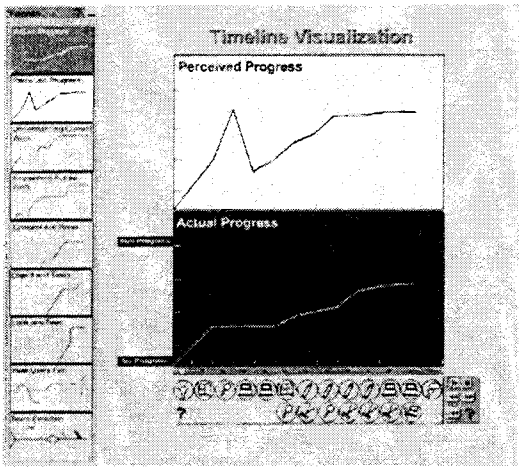

Figure 4

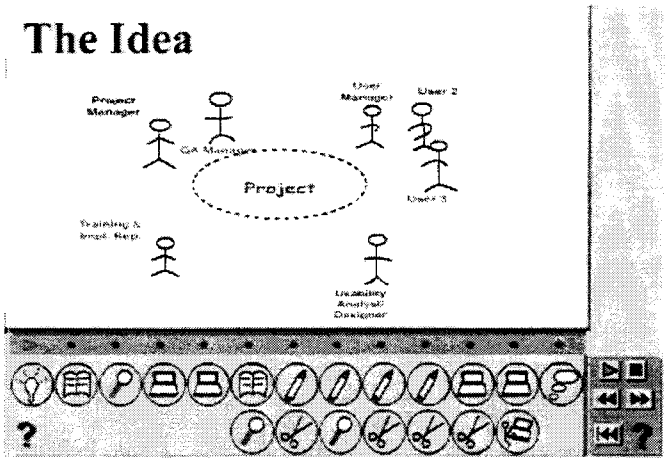

Figure 5

Visualization of the project facets is intended to externalize aspects of the design process which may not be readily perceptible. The graphs are meant to allow for an analysis of the causal relationships among unseen situations, decisions, and processes. For instance, the user may notice a sharp decline in progress during some portion of the project. By examining that aspect of the project in detail, it may become clear that as a result of management interference and redefinition of certain requirements of the project, some members of the team became confused and the project lost momentum.

Animations

Often times, a user may want to get more than a holistic view of the structure of a narrative case study. The user may want to get the gist of the narrative without having to go through all the multimedia chunks. UCD_Vis uses animation to facilitate this process. Figure 6 shows a snapshot of a UCD_Vis screen containing a frame of one of the animations. The controls on the right of the screen allow the user to start, pause, rewind, and restart an animated movie of the entire project. Characters participating in the project are depicted as stick-people with labels attached to them. For each stage of the timeline, there is a corresponding animation, containing the events and their outcomes. Each animation is 10 to 20 seconds long—the whole movie being approximately 4 minutes.

Semantic Networks

UCD_Vis uses semantic networks to visualize who the project participants are, how many they are, who they represent, and what their relationships are. This is intended to assist users to get a quick sense of the participants and their relationships. For instance, by looking at the semantic network, the user can see that the participants involved in the project consisted of eight team members—four users, a project manager, a quality assurance and usability manager, a usability analyst and designer, and a training and implementation representative—and the management. The nodes of the network are represented as stick-people. Clicking on any node results in a video screen popping up and the team member introducing himself/herself.

DISCUSSION AND FUTURE WORK

The design of UCD_Vis has highlighted a number of challenges pertaining to these tools. Among these challenges, two are discussed here. One of these challenges is with regard to facet graphs. Although the visualization and linking of navigation to facets of content can foster reflection on and promote insight into the not-easy-to-see and embedded ideas in the captured knowledge, they can also be a source of confusion. Informal usability studies conducted so far show that such visual representations help users get a quick overview of the case study. However, the graphs seem ad hoc since they represent the designer's understanding of their values. Further research is required to identify and determine alternative methods for visual representations of the different facets of the narrative. Another challenge has been the animations. Some users find it difficult to get the gist of the narrative by watching the animation movie. Currently, the animations are silent. Future work can add voice to the animations. Also, it is important to provide a facility for users to control the rate by which the animation frames are played.

One of the future possibilities of UCD_Vis is for it to have a database of case studies. Users can then load these cases and compare trends across different projects. A manager, studying the facet graphs of a set of different cases, may, for instance, discover common trends among projects, and as a result rectify that trend when running new projects.

Designing visualizations for narrative-based case studies is not an easy task (Spence 2001; Tufte 1998). However, both narrative-based case studies and visualization tools can play an important role in knowledge management activities within organizations, particularly in the process of externalization of tacit knowledge and provision of reificative tools supporting collective reflection (Choo 1998; Wenger 1998). Additionally, as organizations try to upgrade the knowledge of their employees, such tools can play an important role as learning environments. Tools such as UCD_Vis are initial attempts at investigating how to develop visualization tools to support knowledge management activities, in this case design activities.

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