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Multimedia Technical Libraries: Informedia Digital Video Library System

Harvey K. Hallman

May 1996

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Harvey K. Hallman

Software Engineering Information Modeling

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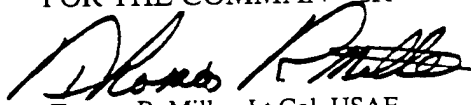
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Multimedia Technical Libraries: Informedia Digital Video Library System

Abstract: Multimedia technical libraries have great potential to change the way we train technical people and the way we develop software. However, it will be a challenge to create such a technical library. In this report, I present different approaches for creating a library, based on both source and intended use. I present four strategies for information development, complete process outlines for five strategies of archival preparation, and user-and system-guided navigation strategies that can be used with the Informedia™ Digital Video Library System to access multimedia files. I also discuss the audio translations strategies that must be used with multimedia files.

1 Introduction

Multimedia technical libraries have great potential to improve the way we store and access technical information. This can change our methods of finding technical information, the way we train technical people, and the way we develop software.

Multimedia libraries make “fingertip access” possible. Fingertip access, which is discussed in [Hallman 96], allows software engineers to extract project or reference materials from a repository of data and to assimilate those materials directly into their current work files (which remain open and active during the search.) Fingertip access gives software engineers fast and easy access to current project information and state-of-the-practice and the state-of-the-art technologies—including text, graphics, audio, and video. Fingertip access also makes “fingertip learning” possible by providing training on how to use the reference materials. While fingertip access remains unavailable, software engineers will continue the massive amounts of re-invention present in projects, companies, and the industry.

The software development process will greatly benefit from the availability of multimedia libraries. For example, meetings recorded with video or audio can be archived for future developers so that they can view first-hand the decision-making and the rationale behind it. Actual presentations on the project and the technology will be available to software developers when they need it—that is, while they are creating the product. People who will maintain and expand the product in the future will understand more clearly what effects a change in the product will have. These problems, which have plagued the software industry from the beginning, can be alleviated with the thorough documentation that a multimedia library promises.

The potential of a multimedia technical library is so great that it is necessary to address ways of creating it and using it. The Informedia Digital Video Library (Informedia DVLS) could potentially provide learning materials, access to design decisions and rationale, technical data, multimedia scratch pads for creative sessions, formalized searches, current literature, and

product documentation—all at the user's fingertips. Informedia DVLS will pave the way for faster and more comprehensive creation and distribution of product documentation than just print and text forms. This paper addresses methods for adding technical information to the library and approaches to using the library once it is created.

1.1 The Informedia Digital Video Library

The Informedia DVLS Project at Carnegie Mellon University (CMU) [Stevens 95] is developing new technologies for data storage, search and retrieval from digital multimedia libraries, based in part on the work of the Software Engineering Institute (SEI) in information modeling and digital video user interface.

Informedia DVLS was originally implemented on a Macintosh® (Mac).¹ The current version provides a full-content search and retrieval from digital, video, and text libraries. Information and learning materials can be located through a hierarchical approach; the system provides an intelligent search mechanism using synonyms to find alternatives to the topic in both text and video. It uses a weighted presentation algorithm to present the most likely technical discussion first. When the video, audio, or text is searched, the media is automatically positioned at the point where the match was found.

There are a number of reasons for creating the Informedia DVLS:

- An organization may want to develop expertise in a certain area. Key papers, presentations and courses in this area can be amassed on the Informedia DVLS.
- Project managers may want to make training available to project members.
- A product development project may want to record design decisions and the rationale for these decisions as they are being made. These can be reviewed not just by the people implementing the system but also by the people who maintain and expand the system in the future.
- An individual may want a quick way to pull specific, relevant information together from various digital sources onto a local disk.

Although Mosaic [Schatz 94] and other implementations on the World Wide Web (WWW) [Berners-Lee 94] provide many of the functions of the Informedia DVLS, the entries in those systems have to be prepared with hypertext links² to the information. Although hypertext links are available with the Informedia DVLS, the "Find" function provides a means for locating information even if it is not linked.

1. Informedia DVLS at the time of this writing was running on a color Macintosh Quadra 840 with 16M of RAM, and the library was on a gigabyte hard drive. This version is now unsupported and is no longer being expanded or updated. The new version being developed is on a PC.

2. The hypertext link enables the viewer to find and select information by clicking the mouse on a specific text or graphic. The viewer doesn't need to know where the document exists or even how to find it; the hypertext link provides all of the information necessary to locate the document. The support system takes the hypertext link and obtains the multimedia document.

The Informedia DVLS has been used to implement a prototype of a "SAIL Library for Software Engineering (SE-SAIL)." To create this prototype, several papers and video courses which discuss Requirements Elicitation were placed on the SE-SAIL Library. Several approaches were then explored to make these multimedia documents interactively available to the user. We then conducted experiments, varying the size of the files and the size and speed of the video, and developed methods for making text in the video more readable. We also developed a potential organization for a multimedia software engineering library. Linda McCalla from Texas Instruments collaborated in the video production effort.

2 Strategies for Preparing Information

There are a number of strategies that may be used to prepare technical information for a multimedia technical library such one used by the Informedia DVLS. A specific strategy may be the result of the availability of certain technical resources, the intended application for the information, or the effect that needs to be created.³

Library information can be grouped in two categories:

- Information development -This part of the library will be used by many people, and therefore needs to be formal and substantive. It may have interactive materials, and is similar to a publishing or information service.
- Archives -Only a few people will need access to this part of the library, which will store project documentation and will provide easy, informal, and accurate access to local technical information. Archives may not have interactive materials.

Any productive application of the Informedia DVLS will probably need to provide both of these categories. Strategies for operating within these categories are given in the following two sections (2.1-2.2). Detailed activities for each of these strategies are discussed in Section 3, "Creating Library Additions" on page 13. User-controlled and system-controlled approaches for navigating about the library to find related information are discussed in Section 2.3, "Navigation Strategies" on page 10.

Also, several approaches for providing the transcript of the video and audio files for searching purposes are discussed in Section 2.4, "Audio Translation Strategies" on page 11.

2.1 Information Development Strategies

When a topic is added to the library, it is important to consider what it will be used for and how it will be used. If the topic will be accessed by many people or for general information, it must be more carefully planned than if the topic was for individual or limited use only. Users looking for general information will be frustrated by irrelevant topics that clutter the screen.

Each topic must be carefully planned. One way to make documents manageable is to break up the topic into pieces, called clips, so that the user can just sample small parts of the technology and then choose larger aggregations as desired. Some other strategies that can be used to create a library addition for wide usage include the following:

- Create a multimedia topic.
- Add an existing video.

³. Most of the strategies described here have been used to add information to the Macintosh version of the Informedia DVLS. Specific references may refer to the latest Mac version.

- Add animated graphics.
- Add an existing text document.

Several of these strategies can be useful in making a topic more interesting and effective for the reader. Animated graphics may be used in the parts of the movies or text where the charts and graphs would normally appear. New video can be developed to embellish or up date existing ones. Using information development strategies, described in detail below, can help the author provide a more effective product.

2.1.1 Create a Multimedia Topic

This strategy is used to prepare for and create a highly effective interactive multimedia video on the Informedia DVLS. Usually very few materials have been created prior to the decision to create the video.

First, you need to prepare a plan. This should include creating an outline and a storyboard of the intended multimedia topic. Graphic materials are produced. Next a transcript is created for both the video and audio segments. High quality video and audio segments are recorded. The video, graphics, and audio are then merged into video clips and an abstract is developed. The clips are placed in a folder on a test bed, and the transcript is added. The results are tested and reference material clips are identified.

2.1.2 Add an Existing Video

This strategy provides an efficient way to add an existing video to the library, keeping in mind that it will be used by many individuals for a considerable time. As a result of this strategy, the user will be able to review parts of the video without having to look at its entirety, which makes effective use of the user's time.

If a video already exists, it probably has been created for some other purpose. When the decision is made to add it to the Informedia DVLS library, you should prepare a plan, digitize the video into clips, create and replace inadequate graphics, and add the transcript for searching. The video should be tested at each step for correctness.

You should also extract an outline from the video, determine where audio should be used over graphics, decide on the hierarchy of the video clips, and then proceed with the same steps as Section 2.1.1, "Create a Multimedia Topic" above: digitize the video and audio segments, create the transcript, merge the video, graphics, and audio into video clips, develop an abstract, place the clips in a folder on a test bed, add the transcript in the process, identify reference materials, place it on a folder in the library and user-test the results.

Occasionally it is desirable to quickly add a video to the library. In this situation, you might consider the archival strategy in Section 2.2.1, "Document a Meeting with Video" on page 8.

2.1.3 Add Animated Graphics

Animated graphics, which help users to understand things quickly and can be viewed as a whole or in parts, are a very effective way of communicating information using the Informedia DVLS system. To make an animated graphic, prepare a plan, an outline, and a storyboard. Then create a transcript, record audio segments, create the graphic materials, digitize the audio segments, merge the audio, and graphics into video clips, and then add the transcript for searching. Test the results at each step of the process.

This strategy is similar to the strategy for creating a multimedia topic (page 6), except that there is no need to create of a video environment and or record a video. The animation effects may be created during the merging process.

2.1.4 Add an Existing Text Document

With this strategy, an existing text, report, or technical paper can be added to the library to make the library more robust on the topic. In addition, new papers can be created especially for the library. This results in an interactive approach to reading a technical report and allows the user to access parts of the report without knowing in advance that it contains the desired information.

This strategy is used to extract an outline and abstract from the existing paper, convert the paper to digitized form if necessary and (optionally) to HTML⁴ [Deuel 93], develop the clip hierarchy, and extract the text clips. Graphics are then created to represent the tables and charts, links are added in the text to tie everything together, and reference material clips are identified. Finally, the file is placed in a folder in the library and user-tested.

2.2 Archival Strategies

Archived topics will not be detailed as extensively as information development topics because there are few users (the addition can be planned and then executed by assistants). Users will still be able to find and capture otherwise unavailable information quickly and accurately, but in the name of the archivists' efficiency, will have to scan through larger, more general clips. Examples of valuable information which can be archived are: descriptions of requirements, design decisions, and information about the rationale behind them.

The following strategies can be used to make archive topics more effective:

- Document a meeting with video.
- Document a meeting with audio.
- Document a slide presentation.
- Add an existing slide presentation.

⁴. Conversion to HTML is not required for the Informedia DVLS to find and present the text. The use of HTML formatting commands can make the scanned text more attractive and easier for the user to read. The addition of hypertext links are only necessary if the document is also to be published on the WWW.

- Add a text document quickly.

Merging the video segments of a meeting with slide (or other) materials used during the meeting is another effective way to convey information about a topic. A video of an individual discussing a specific topic can supplement text on the topic. Some of the information development strategies listed in Section 2.1.4, "Add an Existing Text Document" on page 7 may also be useful.

There is a trade-off made between the efficiency of entering the topic into the library and the ease of user's search. It will take a great deal of archivists' time to segment files into clips, but if the user must search too hard, or if the search mechanism of the Informedia DVLS is unable to locate information, no one will use the library. Both efficiency and ease of use have to be considered in balance.

These strategies are summarized here and described in detail below.

2.2.1 Document a Meeting with Video

With this strategy, technical meetings—especially decision-making meetings—are videotaped and are made available for future viewing. Design discussions can then be reviewed and the results implemented more accurately than if they were documented after the fact or in personal notes. People who were not at the technical meeting can view the discussions that apply to their area of responsibility to get a fuller understanding of the decision as well as the rationale behind it.

This strategy is used to record the meeting or presentation in video form, digitize the video into video clips, and then add the transcript for searching.

The outline must be extracted (if desirable), the clip hierarchy determined, and the transcript created either automatically or manually in abbreviated form. Then the video is broken into clips, the clips are placed in a folder on a test bed, the transcript is added to the video clips, the results are tested, and the reference materials clips are identified and placed in the folder in the library.

When a video already exists that should to be placed on the library quickly, this strategy can be very effective. It is also effective in archiving prototype demonstrations. This is a quick way to add a video to the library when the special processing described in Section 2.1.2, "Add an Existing Video" on page 6 is too time consuming.

2.2.2 Document a Meeting with Audio

With this strategy, the meeting can be documented in audio form, with similar results to those obtained if it was documented in video form. Although audio is not as effective as video, it will take less space in the libraries. This strategy can be effective when an audio already exists that needs to be placed on the library quickly.

This strategy is used to record the presentation in audio form, create a graphic representing the meeting, combine the audio track clips with the graphic to make video clips, and then add the transcript for searching. It includes extracting the outline if desired, determining the clip hierarchy, and creating the transcript either automatically or manually in abbreviated form. This is followed by breaking the audio into digitized clips, creating a graphic about the meeting, and adding the graphic to the audio to make video clips.⁵ The clips are then placed in a folder on a test bed, the transcript is added to the clips, the results are tested, the reference material clips are identified, and the folder is placed in the library for further user testing.

2.2.3 Document a Slide Presentation

With this strategy, the presentation of the slides as well as the slides themselves can be placed on the library so that people who missed the live presentation can use them. It can also be used interactively to view just the relevant part of the presentation. In the future, this may be a viable way of documenting an entire project and saving large volumes of paper. It may be a very efficient way of communicating technical information on a project. Occasionally, when recording a meeting on video, it may be desirable to merge the video segments captured with slide materials used in the meeting.

This strategy is used to record the presentation in audio form, digitize the slides, combine related slides with the audio track into a video clip, and then add the transcript for searching.

It includes extracting the outline desired, determining the clip hierarchy, and creating the script (either automatically or manually) in abbreviated form. This is followed by breaking the audio into digitized clips and digitizing the slides by either scanning or from the electronic source into single-frame videos and added to the audio clips. The clips are then placed in a folder on a test bed, the transcript is added to the clips, the results are tested, the reference material clips are identified, and the folder is placed on the library for further testing.

2.2.4 Add an Existing Slide Presentation

Often, the individual who needs a presentation cannot locate it. With this strategy, existing slide or transparency (overhead) presentations can be added to the library for efficient recovery. Although this strategy makes a whole or a part of a presentation available to the user who missed it through the presentation materials, the discussion used to present the slides may not be available.

This strategy is used to digitize the slides into single frame videos, combine the related slides into a video clip and then add text for searching. No audio track is created.

⁵ With the Informedia DVLS for the Macintosh, there is no convenient place to hang the transcript when only an audio track exists. It needs the transcript in at least abbreviated form to accomplish the search. See Section 2.4, "Audio Translation Strategies" on page 11. The audio is added to the graphic to make a single frame video clip. With the PC version this video clip will no longer be required. A transcript may be added directly to the audio track and used in the search.

It includes extracting an outline (if desired), determining the clip hierarchy, creating or extracting the significant text, and creating the video clips. The pieces are then placed in a folder on a test bed. The text is added to the video clips, the results are tested, the reference material clips are identified, and the folder is placed on the library for further testing.

2.2.5 Adding a Text Document Quickly

Unlike the strategy described in Section 2.1.4, "Add an Existing Text Document" on page 7, where a wide number of individuals will use the document, this strategy is used to add an electronic version of the text onto the library quickly so that users can access it. The user's request will access the document positioned at the point of the information searched. Few interactive capabilities will be available.

This strategy is used to obtain an existing text, digitize the text, and add it to the library.

It includes (optionally) extracting an outline and abstract from the text, adding the HTML formatting commands (if desired), developing the clip hierarchy, extracting the text clips, and adding the necessary hypertext links in the text to tie everything together.

2.3 Navigation Strategies

As the library gets larger, it is important to consider how information will be found. Many methods can be employed to allow the user to locate information.⁶ Those used in the SE-SAIL library include: the SE-SAIL directory, a Master Reference for reference materials in the library, a table of contents for each addition and information about the source of the addition. Text clips may contain a section labeled "See Also" for additional references. Video clips contain "Next," "Previous," and "More Context" buttons to help in navigating through the materials. In addition, the Informedia DVLS provides a sophisticated "Find" function and the ability to return to previously viewed clips. With all of these aids to the user to locate the desired materials, it is necessary that the methods available to the user to "navigate" through the library be considered early in the project and be kept as simple as possible.

There are several strategies that may be used to find the materials desired and then navigate through the library.

- system guided navigation
- user guided navigation

A combination of navigation strategies may be appropriate.

⁶ Some of these methods are discussed in [Christel 95], [Heath 95], [Lagoze 95], and [Rao 95].

2.3.1 User Guided Navigation

With user guided navigation, the user employs the "Find" function or the various tables of contents to locate the information he or she is interested in viewing. The user decides what to look at next, whether to view another one of the found files or to change the search parameters. The contents of the file viewed may cause the user to initiate an additional "Find." The user may continue exploring the library until his or her interests are satisfied.

This method of navigation allows the user to get into the library quickly, find the information he or she needs easily (in what ever media it is stored) without the clutter of other information. The user can then get out of the library quickly.

2.3.2 System Guided Navigation

With system guided navigation, the navigation through the materials is predetermined by the author of the library addition. The user follows the guidance prepared for him or her by using hypertext links that have been set up. He or she may have been told where to start (with one of the tables of contents, or with the "Find" function). After viewing the initial file, the user chooses from options (provided by the author of the materials) to go to the "Next" file, go back to the "Previous" file, go to a file containing "More Context," or view a "Skim" version of the video file. Imbedded hypertext links may have also been provided for excursions into more details, which return to the original when completed.

This method of navigation allows the user to use the library as a learning tool, to access a topic that he or she wants to learn and then follow the developer's path for learning the topic. The author may take the user through materials in various media.

2.3.3 Mixed Navigation

The user may mix the navigation methods. In user guided navigation, the user may decide he or she needs to learn more about the subject matter being viewed and thus follow the system guided navigation aids for a while before returning to user guided navigation. Or when in system guided navigation, the user may want to view other author's opinions on the same topic by using the user guided "Find" function to locate them. Although both navigation methods exist, it is the user that determines the preferred method. Both options are available at all times.

2.4 Audio Translation Strategies

In order for the Infromedia DVLS to find the video clips requested by the user, text has to be available with the video clip that is associated with its content. Several strategies can be pursued to obtain the text:

- Use automatic audio recognition.
- Key in the entire transcript and place it in the transcript of the video clip.
- Place notes about the contents at the beginning of the video clip.
- Enter key words from the audio at the appropriate places in the video clip.

Automatic audio recognition is being pursued by the Infromedia DVLS project. A significant research aspect of the project is the development of automated mechanisms to search the library through integrated speech, image, and language understanding. The Sphinx-II part of the Infromedia DVLS research uses a large vocabulary and speaker-independence to obtain continuous speech recognition of an audio track. Sphinx-II, developed at Carnegie Mellon University to transcribe narratives and dialogues automatically, relaxes time constraints and allows the transcripts to be generated off-line, so that it can be adapted to handling the video library domain's vocabulary and diverse audio sources without degrading recognition rates. The user can make request to search this transcript for subjects of interest [Christel 94]. Although Sphinx-II is currently a stand-alone function, it is being integrated into future versions of the Infromedia DVLS to provide speech input for library exploration. PC versions of the Infromedia DVLS use an optional microphone interface, allowing the user to make "Find" requests aloud. Prototypes with this function are in development and have been very effective in simplifying the interface for the user.

The transcript may also be available for the video such as where the video has been formally developed for addition to the library, like the videos in the prototype system. In other cases the audio track may need to be transcribed.

Sometimes notes about a presentation are available or can be created to reflect the content of the video. These are especially helpful when pursuing archival strategies. It may be desirable to create the notes intentionally for the archives.

In lieu of transcribing the entire audio track, key words or thoughts can be entered either with an editor directly to the Infromedia DVLS. These key words are then available for the searching of the requests of the user. This is less desirable than having the entire transcript because the search system uses the context of the words surrounding synonyms to find a possible match. The user will not always know the exact keyword to use to find the data—so the closer the transcript is to the full translation of the audio track, the more likely it is that the system will find the desired data.

3 Creating Library Additions

There are many approaches to creating additions to the library. The following section will give some insight into the processing necessary to accomplish these strategies. Activities that are used in many strategies are described in Section 3.1, "Generally Applicable Activities" below. Activities performed when following specific strategies are described in later sections.

Creating library additions may be as simple as digitizing the source media and adding the result to the library. It may include adding a transcript of the audio track, dividing the media into smaller pieces (referred to as clips), replacing unreadable sections with easier to read graphics, or restructuring the original media into a hierarchical format. All of these things may be desirable when preparing to add a multimedia topic to the library.

3.1 Generally Applicable Activities

A number of the activities common to the various strategies are described here. This allows us to see the differences between general and specific strategies. The following activities are generally applicable:

1. Plan the approach.
2. Create an outline.
3. Determine the clip hierarchy.
4. Digitize the video and audio into segments.
5. Create an abstract.
6. Create the graphics.
7. Merge the audio, graphics and video segments into video clips.
8. Create the transcript of the audio track when it doesn't exist.
9. Convert the text to HTML.
10. Add the video clips, etc. to an the Infromedia DVLS test system.
11. Merge the transcript with video clips.
12. Add the hierarchy links to video clips.
13. Identify the reference materials and add to list.
14. Test results.
15. Add to the SAIL Library.
16. Re-test the results.

Some of these activities will not be appropriate for some of the strategies. For example, the video oriented activities are not appropriate with text-only strategies. Some steps will be omitted when following an archival strategy.

Following is a detailed description of each step.

3.1.1 Plan the Approach

There are a number of things that need to be planned prior to beginning the creation of a multimedia addition to the Infromedia DVLS. Decisions need to be made about the source of the materials, the target users, what size restriction shall be placed on the size of the resulting pieces or clips, what naming convention should be used, where the resulting addition will reside both temporarily and permanently, how the resulting addition shall appear to the user, what decoders are going to be used, and what tools are going to be needed to create the clips of information. Some of these decisions may have already been made because the piece will be added to an already existing library. Often a plan can be constructed that can be followed repetitively for all additions.

3.1.1.1 Source of Materials

In laying out the plans, the source of the materials needs to be determined. Some questions the author may need to ask are: Is it video, text, audio, or graphic? Does it need to be created? If it is video, what format is it in: Beta, VHS, SVHS, Super 8? A VCR with the proper format will need to be available. Similar questions may be asked about audio.

If the source is text and is in electronic form, the format needs to be known. What word processor was used to create it? There are converters available that will convert text from one format to another such as "RTF to HTML" by Chris Hector (cjh@cray.com), and "MIF to RTF Export Utility" from Frame Technology. Occasionally, several converters may be necessary to get to the desired format. The target editing format for text in the Mac version of present and future versions of Infromedia DVLS is HTML [Deuel 93]. A small amount of effort may be necessary to complete the conversion to a satisfactory result. Although clear text is satisfactory for the Infromedia DVLS system, it is often easier to read and scan large amounts of text with the appropriate mark-up language commands. If the text is to be made available on the World Wide Web, it is also useful to add these mark-up commands.

If the source is hard copy of considerable volume, a flatbed scanner may need to be available. If it is small volume, it may be easier to enter it than to find the scanning equipment. If the text is scanned, it may be necessary to proofread it and add the HTML commands.

3.1.1.2 Potential Users

The plan should identify the potential users of the information. This will have a heavy influence on the way the materials are developed and the amount of time required to prepare them. If there are many users or the type of user is unpredictable, you must assume that the user will have a minimum amount of training on the subject. Therefore, the use of the library needs to be easily understood and guidance needs to be provided. The plans will have to indicate the guidance strategy for the author.

If there are few anticipated users or if the only users will be the people who enter the information, it may be appropriate to assume that the user will be trained external to the system and will need less guidance.

3.1.1.3 Type of Clips

Each of the strategies produce one or more video, audio, graphic or text clips. A clip is the smallest unit that is stored and retrieved on the library regardless of its media content. The number and size of these clips will determine the efficiency of retrieval in different ways, and can affect the type of navigation strategy used.

Small clips can be both a positive and a negative to the user. When using the searching techniques with system guided navigation, he or she will want to be able to scan shorter discussions, rather than wading through long clips. However, when he or she wants to view entire topics with user guided navigation, short clips will take longer and require more physical actions on the part of the user. Frequent clips of less than one minute can be irritating to the user since he or she must click the "Next" button after the end of each clip in order to continue. To create smaller clips, the developer must have the time to create, process, and name them. The best use of small clips is when the information development strategy is attempting to provide a large amount of selectivity and interaction for the user.

Larger clips imply that the user will get the advantage of being able to view longer clips without any action on their part. However, if the user searches using system guided navigation, he or she will be placed in the middle of a large clip and not know how much of that clip is appropriate to their search. Larger clips implies that the developer has fewer of them to create, process and name. But larger clips may require the developer to use a more intensive effort and possibly a larger computing facility. The best use of long clips (that are about a minute long) is in an information development strategy that provides a learning situation for the user.

Why not use the entire subject as one clip? Very large clips cause a number of problems. Authoring tools have an effect on the maximum size of clips. Some tools will run very slow if they are working on a large clip in a relatively small area of memory. Also, transporting files across systems can become a problem; large video files will have large transcript files, and some processors have restrictions about the size of transcript files (for example, the Mac version of Informedia DVLS has a 32K restriction for all text files). Ways of removing that restriction are being researched for the PC version.

So why not always have smaller clips? All clip breaks, regardless of size, need to be at a logical position. When the subject matter is a vignette or a story, the continuity can be destroyed by breaking at unnatural spots in the video. The clip break is determined according to content.

3.1.1.4 Frame Size

The next most important decision to be made during the planning of the effort involving a video or graphic is the frame size of the resulting presentation. Is the frame size to be 320 x 240 pixels? Is it larger? Is it smaller? This decision depends a lot on where the clips will be stored and what they will contain. The smaller the frame size the more work required to make the graphics comprehensible to the user. The larger the size, the more space used to store the clip, and the slower the motion on the video (this translates into a faster computer engine being required to make the video look like normal motion). 320 x 240 pixels is a good place to start. If there is motion video in the source, this aspect ratio should be maintained.

3.1.1.5 Product Appearance

Decisions have to be made on the appearance of the end product. Will the graphics in the video need to be replaced with easier to read graphics? If the graphics need replacing, the preparation time will be longer. Will the video playback rate need to be greater than 15 frames per second? The lower threshold of acceptability by un-sympathetic audiences is 15 frames per second. Normal NTSC motion video is 30 frames per second. The more frames per second, the larger the file will be in the library. And the user will need a faster computer engine or a special hardware assist to keep up to the recorded rate.

3.1.1.6 Naming Conventions

Naming conventions may need to be planned at the very beginning, especially if a large volume of files are going to be added to the library. A special naming convention was developed in the prototype using the Mac version.⁷ Although the new PC version no longer displays the file names, the library manager may still want to establish a naming convention in order to facilitate changes and updates to the clip. Naming will also help to organize folders containing the files.

3.1.1.7 Residence

The residence of the library will have effects on the processing of the information to be placed on the library. Will it be on a CDRom, a high speed hard disk, a server, or some other storage device? What is the capacity, density and speed of the target device? Is there a temporary residence where the clips can be held during the preparation? These questions need to be

⁷ A unique letter prefix was used to identify all clips associated with a specific library addition, whether it be a technical report or an interactive video. Since most of the subjects were broken down into themes, a theme identifier (number) followed the letter prefix. Beyond this prefix was an outline identifier and a name associated with the content. Other control information was added as necessary; for example, the media type was included in the name as a suffix.

addressed early to avoid reprocessing. The answers to these questions will place restrictions on the use of the library. For example, when the video is digitized the target residence characteristics become preset. The speed required to access the materials often depends on the digitizing algorithm and whether it is hardware assisted or not.

3.1.1.8 Software and Hardware

Software and hardware issues need to be identified and resolved. Is the software in the form of commercial off the shelf (COTS), or is it unique to the project? What are the decoders? Are they standard (MPEG, HTML, etc.)? Is the hardware standard or unique to the project?⁸ Is the system fast enough for the Infromedia DVLS to display the videos at the designated frames per second (at least 60 mhertz on the Mac)? Does it have hardware assisted decoders? Is it PC or Mac based? Will it handle libraries from either base? These questions need to be addressed before the planning can be completed. When the videos are digitized, the target hardware characteristics have been determined—if not by design, then by default. If these characteristics cannot be decided early, then standard decoders should be used and extra time should be set aside to redo things later.

There are two sets of hardware and software needs with multimedia applications. First, you must consider what will the user be using, and second, what the author will be needing. With archival strategies, these systems may be the same. With the information development strategies, the authors system requires a higher speed engine, more memory, and more disk space than the user system. Otherwise, the author will waste a lot of time waiting, moving files, and patching pieces together.

Videos require a large amount of memory to process—at least 16 megabytes. They also require large amounts of high speed disk space (at least 1/2 gigabyte). The AV engine speed will determine how much waiting is necessary and therefore what special effects can be included in the result, since their creation burns computer time. A lower speed can be used but a 60-mhertz processor speeds thing up considerably. On a Mac IICI it is not unusual for some of the simpler processes to take minutes to complete.

There is little reason to use software that doesn't run on a desktop computer. These systems are readily available and can complete all of the functions necessary. It should allow for the preparation of video, audio and graphic clips, for cropping and editing of the videos, merging of medias, etc. Since many of the functions necessary to process the videos are complex and lengthy with today's personal computing hardware, it needs to be a robust system. It should seldom fail and should give the author active messages to tell if processing is proceeding or locked. Several processing views are needed (see Figure 1, "Three Views Needed in Video Editing"). A time view is needed to add and merge several media entities into one clip. A storyboard view is useful to assemble the parts and a player view provides the ability to view the work in progress without leaving the software system.

⁸ For this paper, it is assumed that the target user's software system is the Infromedia DVLS running on the Mac Quadra 810 AV or a faster machine. Future versions will run on Microsoft Windows™ on PC-based machines.

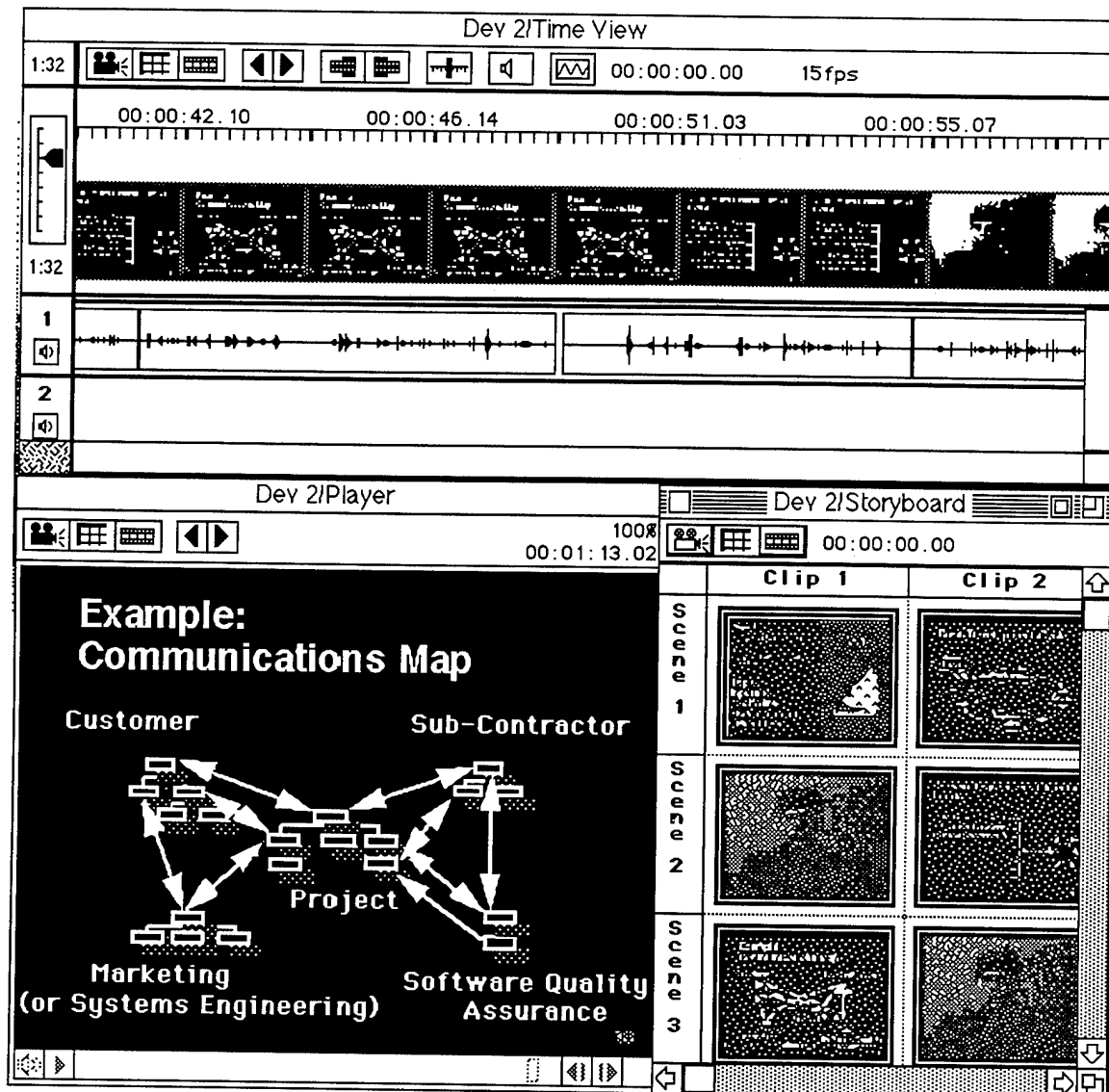


Figure 1: Three Views Needed in Video Editing⁹

3.1.2 Create an Outline

The outline is used during the creation of an addition, to provide the basis for developing materials, defining clip structure, and assigning names to clips and their intermediate pieces. It is also added to the library as one of the alternative approaches to accessing the materials.

⁹ The examples of the three views were obtained with the use of VideoFusion™. VideoFusion is the registered trademark of VideoFusion Incorporated.

The outline may already exist in the source materials, or it may have to be extracted from the materials. This is easier to obtain when the source is text rather than video. With existing video, it is helpful to listen to the video, writing down the major topics and sub-topics. Also identify when there are significant shifts in the scenes—it will be helpful later if the elapsed time on the VCR is recorded with each note. When the entire subject of the addition has been reviewed, organize the notes in outline format. It may be necessary to review the video again to fill in missed notes and eliminate any confusion in the outline. While examining the video to find the outline, take notes on the quality of the graphics and whether they should be replaced etc. Figure 2, "Outline Example" is an outline example from a video.

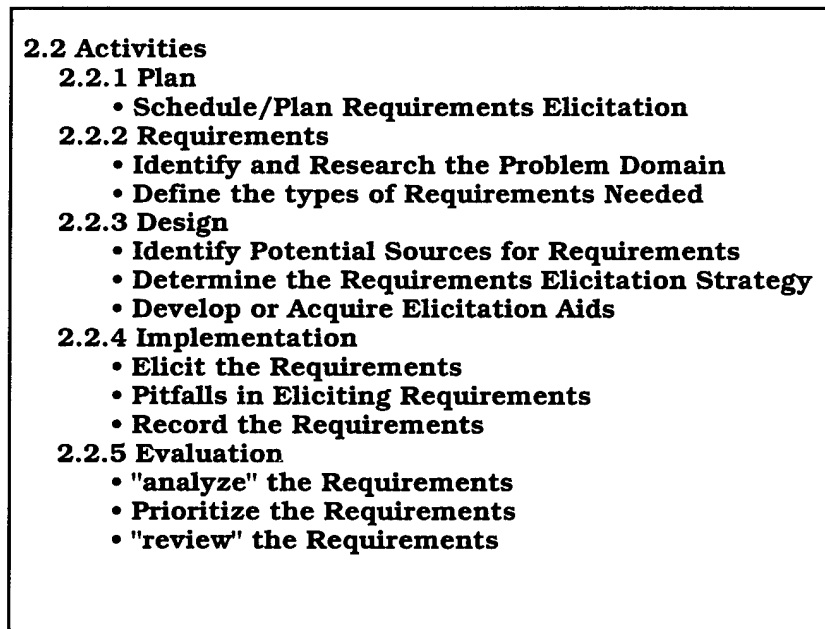
- 
- 2.2 Activities**
 - 2.2.1 Plan**
 - **Schedule/Plan Requirements Elicitation**
 - 2.2.2 Requirements**
 - **Identify and Research the Problem Domain**
 - **Define the types of Requirements Needed**
 - 2.2.3 Design**
 - **Identify Potential Sources for Requirements**
 - **Determine the Requirements Elicitation Strategy**
 - **Develop or Acquire Elicitation Aids**
 - 2.2.4 Implementation**
 - **Elicit the Requirements**
 - **Pitfalls in Eliciting Requirements**
 - **Record the Requirements**
 - 2.2.5 Evaluation**
 - **"analyze" the Requirements**
 - **Prioritize the Requirements**
 - **"review" the Requirements**

Figure 2: Outline Example

A video or a text may have several themes. Identify the breaks in these themes in the outline. Frequently, in a video presentation, a theme will be contained within another theme. Because the resulting product may be viewed hierarchically (that is, not in the same sequence as the original video) the use of themes provides the user with a mechanism for either sequential or hierarchical examination. For example, In the Major Topic "An Introduction to Software Requirements Elicitation at Texas Instruments" in the SE-SAIL library, the theme on "Requirements Elicitation Methods" was embedded in the section on "Design" in the original video. Since this sub-section was large, over 26 minutes, and distracted from the original discussion on the requirements elicitation process, it was extracted as a separate theme. A reference was added to the video at its original position. The outline presents it as a separate theme. ("Appendix A: Sample Table of Contents" contains an example of an outline that has been converted into a Table of Contents for "An Introduction to Software Requirements Elicitation at Texas Instruments" in the SE-SAIL library.)

3.1.3 Determine the Clip Hierarchy

The outline above is used to create a clip hierarchy and to break the text or video into manageable pieces, keeping in mind the size of the video or text included in a clip. Text files are easier to break into clips because the subject matter is usually covered more intensely and evenly in text documents. Note that some text editor software, including some HTML editors, have a 32K limit on file size. With video, notes on timing (recorded while establishing the outline) help to determine the size of a clip. Some subject matter will be covered more thoroughly than others, and these larger sections may need to be broken down into a hierarchy of clips. Figure 3, "Video Clip Hierarchy" shows a potential clip hierarchy of the "Outline Example" in Figure 2 above.

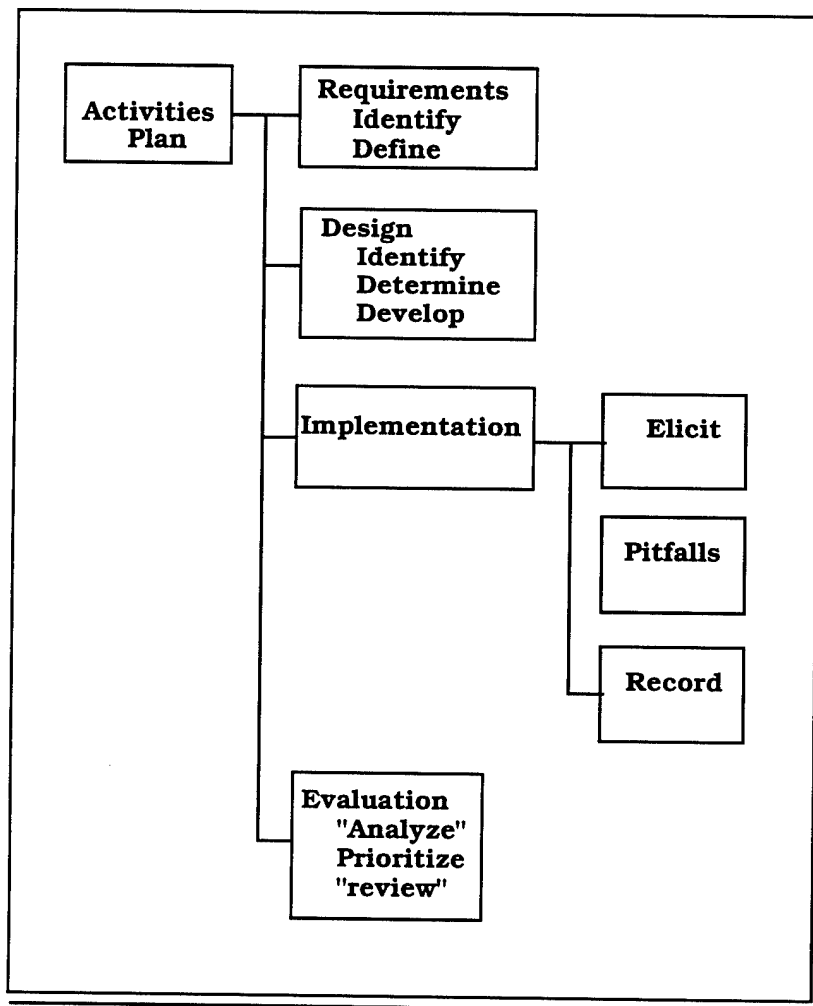


Figure 3: Video Clip Hierarchy

Appendix A on page 55 contains a larger example of the hierarchy definition. The indicator of the hypertext links to the video clips is the word "Movie." Not all outline elements are individual clips. Some are aggregated together because of the size and content. In the prototype, very few video clips exceeded two minutes in length. Text clips were often several pages long.

The clip hierarchy is easily written as notes on a copy of the outline. At the same time, give the clips file names that will remain through the development of the library addition. Add the names to the copy of the outline following the name convention defined during the planning.

3.1.4 Digitize the Video and Audio into Segments

Using the clip hierarchy, digitizing the video into segments is accomplished with an audio/video (a/v) editor or a similar tool.

If the video contains no graphics, or the graphics are sufficient and do not need improvement, this process is purely digitizing the video with the selected programs and hardware and assigning the names defined. The video segments become video clips.

Many times the graphics will need to be replaced in order to be visible. Notes taken while extracting the outline will be helpful in making this decision. In these cases, the audio will be digitized for the areas needing replacement and the video digitized for all of the other segments of a clip. This results in several files or segments for each clip that need to be kept together and in sequence. One method is to place an alphabetic suffix on the outline identifier. For example:

4.1 Questionnaires

- B.2.4.1-qt-Question.mov**
- B.2.4.1a-a-4.1-pp slide 24.qt**
- B.2.4.1b-a-pp slide 25.qt**
- B.2.4.1c-av-consider.movie**
- B.2.4.1d-a-pp slide 26.qt**
- B.2.4.1e-av-Advantages.movie**
- B.2.4.1f-a-pp slide 27.qt**
- B.2.4.1g-av-Disadvantage.movie**
- B.2.4.1h-a-pp slide 28.qt**

The graphic that is to be replaced also needs to be identified. It is easiest to record its identity in the audio file name. The identity may be a graphic number or a cross reference into another list. If all of the files are placed in the same working folder (directory), a list of the files in the folder will provide a plan for merging below. (Appendix B on page 58 contains an example of a module list created and used as a divide, add, and merge plan during the creation of the prototype.)

3.1.5 Create an Abstract

An abstract is a convenient way for the user to find out if he or she wants to view the library addition. The abstract will be easier to define for text additions than for video additions. To create an abstract, authors should review the video and the outline and place themselves in the user's shoes to try and see what would they need to know about this addition in order to decide to look at it in more detail. Although it may not seem like an abstract is necessary in archival strategies, an abbreviated description may be useful. An abstract may identify the subject of the meeting, why was the meeting called, was this the result of a previous meeting, what decisions were discussed, were any conclusions arrived at, was another meeting setup to further the discussions. An organization may be able to use an electronic template to record abstracts. (Appendix C on page 62 contains an sample template for abstracting an archival addition.)

3.1.6 Create the Graphics

In many situations it is necessary to either capture or create the graphics used in the topic. These may be available in electronic form in a graphic editor PowerPoint. Capturing the graphic may be as simple as saving the graphic as a PICT file to be merged into the appropriate clip, or it may have to be scanned into the system or it may have to be recreated entirely. In other cases the graphic is created to add content to the resulting addition.

The graphic should be stored as a PICT file or series of PICT files. Other intermediate formats may be required by the a/v editor instead of the PICT format.

When the source is text that is going to result in a text clip, the graphics may not be available in electronic form. They will have to either be scanned into the system or recreated. Occasionally, it may be necessary to split the original graphic into two or more graphics so that they will be readable. Unlike video clips, graphics are stored as separate files and hypertext-linked into the text. They are brought into separate windows—so they do not all have to be the same size, as do video clips. But restrictions on size will still exist so that the graphic fits on the target hardware. If the graphic is changed, the text may have to be modified so it is compatible. Tests need to be made to see if the graphic can be understood by the user at the target graphic size. Animated graphics get the topic across more easily; parts fading in or out can have a dramatic effect and can be used to identify the areas being discussed.

When the result is a video clip, consider the frame size— the maximum and minimum size of the graphic. A font size that is visible on an overhead projector may not be readable when it is shrunk down to the desired frame size, so the original graphic may need to be changed. Animated graphics can make the presentation more effective, and remains a viable option when working on crowded graphics that need to be split.

Graphics are usually created by the graphics processor overlaying text, lines, figures etc., in an accumulating structure. These structures can become very complex and take additional computer time whenever the graphic is produced for the user. The Informedia DVLS provides an application function, QuickenPICT, to convert these into a bitmap and still retain the intel-

ligence that has been added to the graphic for the Informedia DVLS. (The QuickenPICT application program, one of the utilities developed by Michael Christel at the SEI for the Mac version of the Informedia DVLS, scans a PICT file, converts it to a bitmapped PICT file, and stores the button position and other "Hot Spot" information along with its associated text in the resulting PICT file so that it can be used by the Informedia DVLS.)

3.1.7 Merge the Audio, Graphics, and Video Segments into Video Clips

Merge the audio with the graphics to provide a video segment that can then be merged with other video segments to make up a video clip. Sometimes the clip will be made up of a number of audio over graphics segments. One way to accomplish this is to create a video from the graphic PICT file that is slightly longer in time than the audio and place it into the storyboard. In Figure 4, "Example of a Storyboard View," the first two clips of scene one and scene two are graphics that were used to reflect what was said on the audio track.

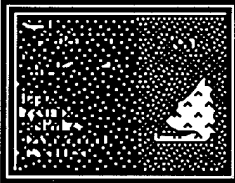
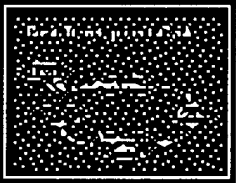
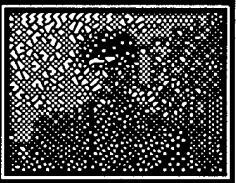
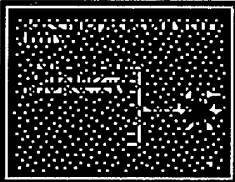


	Clip 1	Clip 2	Clip 3
Scene 1			
Scene 2			

Figure 4: Example of a Storyboard View

Clip two, scene two is an example where the audio is then merged on top of a graphic, resulting in an audio/video segment in the a/v editor. This merge is usually accomplished using the time view as in Figure 5, "Example of a Time View."

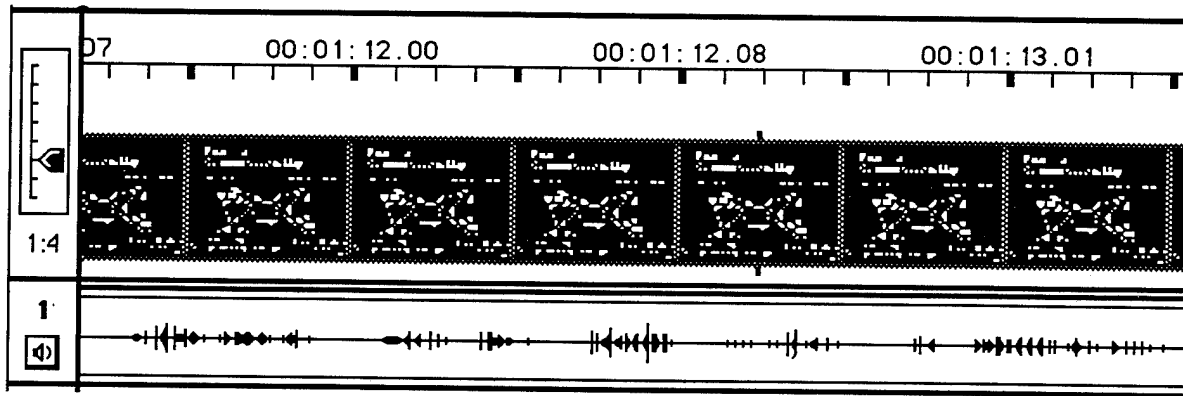


Figure 5: Example of a Time View

Occasionally, the graphic is used to replace a poor video portion of an existing audio/video clip. In this case a video segment is created from the graphic PICT file that is the exact length and frame density of the video to be replaced. It is then laid over top of the video in the a/v editor. Figure 6, "Example of a Poor Quality Original Video Frame" shows the result of recording the graphic information captured on NTSC and digitizing it alone with the full motion video. Figure 7, "Example of a Graphic Replacement" shows the results of creating a presentation slide and placing it directly into the video clip.

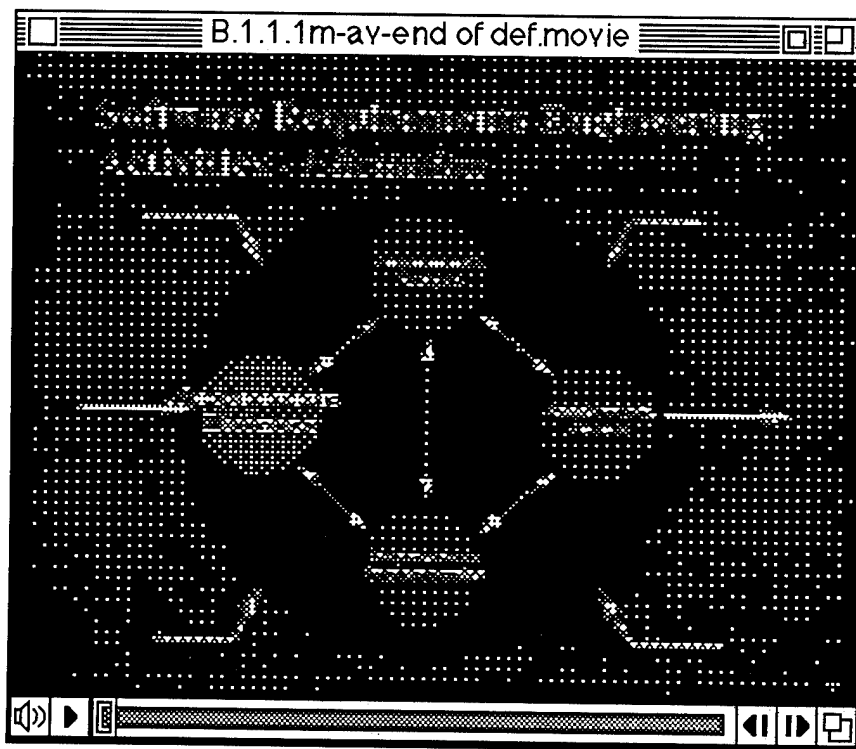


Figure 6: Example of a Poor Quality Original Video Frame

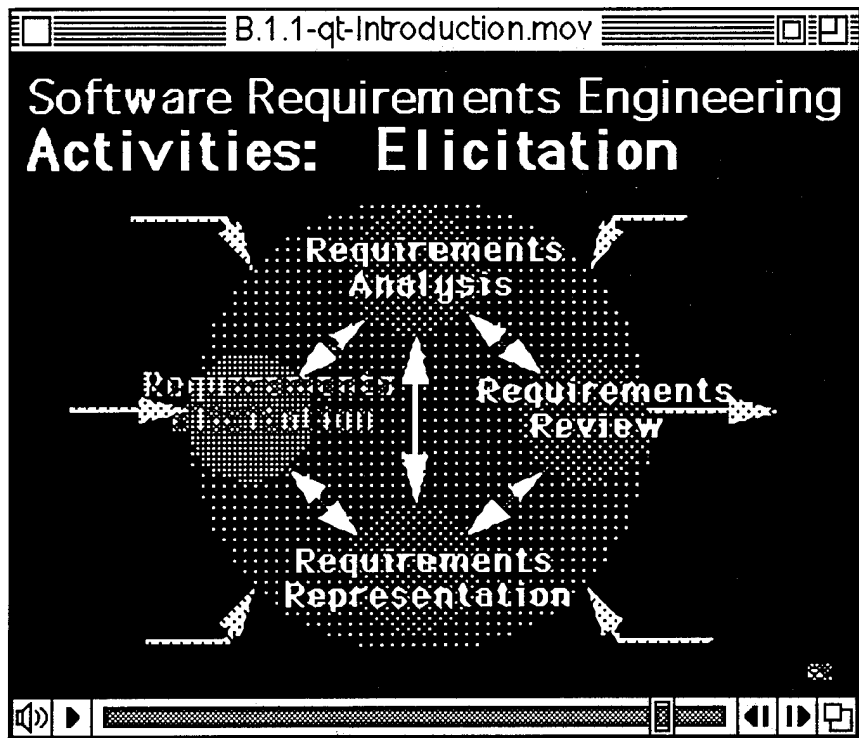


Figure 7: Example of a Graphic Replacement

3.1.8 Creating the Transcript of the Audio Track When It Doesn't Exist

In most cases when working with video or audio, the transcript of the audio track on the video does not exist in readable text format. The Informedia DVLS uses a textual version of the audio track to locate requested video segments within the video clips. Without this text, the search will not be able to find the video.

Several strategies can be pursued to obtain the necessary text:

- Automatic audio recognition.
- Key in the entire transcript and place in the captions of the video.
- Place notes about the contents at the beginning of the video file.
- Enter key words from the audio at the appropriate places in the video file.

These are described in Section 2.4, "Audio Translation Strategies" on page 11. The strategy used may vary depending on the intent of the addition to the Library. The first two apply more often to information development strategies while the last two may be the method of choice for archival strategies. In all cases, some textual way to identify the contents of an audio or video is essential if the users requests for the information will be able to find it.

3.1.9 Convert the Text to HTML

The text clips should be converted to HTML for more attractive presentation. The Informedia DVLS on the Mac uses HTML as its text presentation language. This also provides compatibility with Mosaic [Schatz 94] and other World Wide Web browsers. Conversion utilities exist for converting some of the standard intermediate formats such as RTF and MIF. These can be created by many of the desk top publishing editors.

The Informedia DVLS will present files with a ".html" suffix according to the HTML rules [Deuel 93]. Files with other suffixes will be presented without translation. In some strategies, such as "Quick addition of a text document," the use of clear text may be appropriate. Whenever the text contains hypertext links to other information, whether it be graphics, video or other text, these hypertext links are HTML hypertext links and therefore the file needs an ".html" suffix.

3.1.10 Add the Video Clips Etc. to the Informedia DVLS Test System

All of the video and text clips and associated pieces except for the video transcripts are added to a named folder on an the Informedia DVLS test bed. The name of this folder should be unique to the expected library to which it will be added. All of the technical subject matter concerning this addition will be contained in this folder.

This may include the outline that has been converted to a table of contents for the technical information being added. The HTML hypertext links to the associated clips should have been added. Appendix A on page 55 shows an outline as it might appear in the Informedia DVLS after it has been converted to a table of contents. The heavy printed and underlined text reflect these hypertext links.

The abstract that was prepared is added. With some strategies the abstract may not exist or serve another purpose such as a list of subjects addressed.

If a separate file has been created to provide biographic information about the authors, it should also be added. With some strategies, additional materials may have been created, such as

- reviews or skims
- examples of use
- reinforcement materials
- terminology
- bibliography

They should also be added at this time.

3.1.11 Merge the Transcript With the Video Clips

The transcript is added to the video clips in the Infromedia DVLS. It is first separated into text segments representing the content of the video clips, which are then added to the appropriate clips using the transcript functions provided by the Infromedia DVLS. Timing information can be added at the same time to allow the search function to position the video at the point where the search subject is found.

3.1.12 Add the Hierarchy Links to Video Clips

Using the hierarchy charts developed earlier, and updated as necessary, add the forward and backward hypertext links to the video clips. This provides the system guided navigation paths for the user to view. The following buttons are provided on the video on the Infromedia DVLS:

- Previous
- Next
- More Context
- Skim

Figure 8, "Information Window for a Video Clip" shows an example of the window presented by the Infromedia DVLS when the requested clip is a video.

The "Next" button on the video is set up to hypertext-link to the appropriate next video clip when clicked by the user. This enables the author to create a logical scenario of clips for the user to follow with system directed navigation strategies. (The "ResEdit" application program provided by Apple Computer, Inc. is used to make these additions to the "STR" table.)

The "Previous" button is set up to hypertext link to the previous video clip. This enables the author to provide a way for the user to go backwards in the scenario. Even when these buttons have not been set up, the user has the ability to go back to video files previously viewed through the "Go Back" pull-down screen of the Infromedia DVLS.

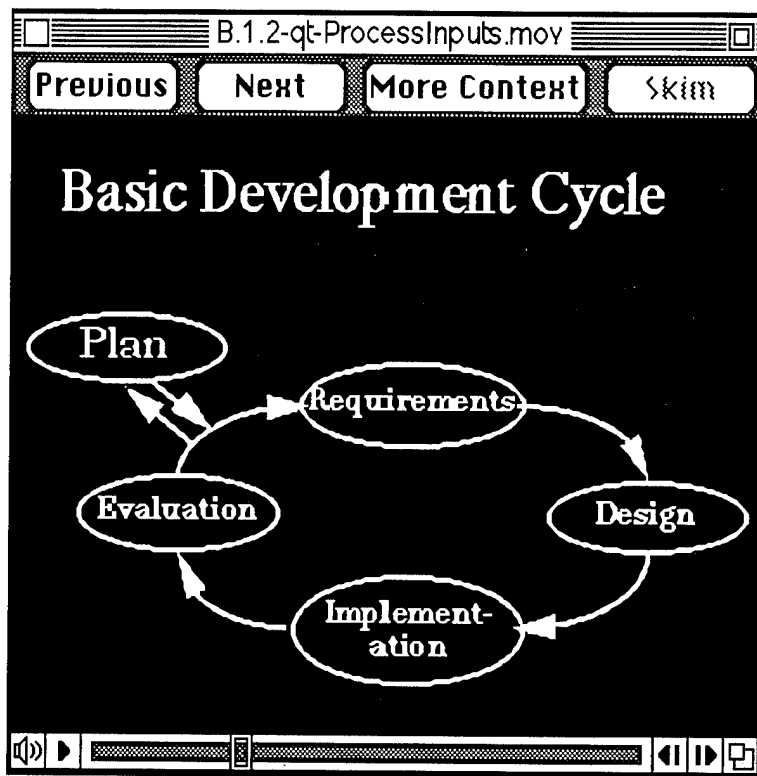


Figure 8: Informedia Window for a Video Clip

The "More Context" button is set up when the author provides a higher level or more global view of the subject matter being presented. When a more global view is not available, this can be set up to hypertext link to the Table of Contents for the subject matter being presented.

The video also provides a "Skim" button. This is not set up as a hypertext link in the same manner as the other buttons. If the video clip file being presented has a sister file spelled exactly the same with a ".SKM" suffix instead of the ".mov" suffix, this button will be activated and the file will be viewed when the user clicks it. The user should be able to skim the video looking at the highlights. A skim may be provided by the author.

These buttons provide a smooth way for the user to navigate around a particular technical information topic that is made up of video clips. Hierarchy links for text clips should have been added as HTML hypertext links when the clips were created.

3.1.13 Identify the Reference Materials and Add to List

After all of the clips have been defined and added to the test system, they should be examined to identify those that contain reference materials for the subject being added. Not all clips are potential reference materials. The deciding question is "Will the user familiar with this subject matter want to find this clip at a later time to obtain the materials contained in it?" If so, a hypertext-link should be added in the Master Reference List for the identified clip. (The "Master Reference List.html" is located in the SE-SAIL/SAIL folder and is in alphabetical order.)

3.1.14 Test the Results

The frequency of testing varies with the strategy being used to create the subject matter addition. With archival strategies there is not a lot of variance in the process being used. Also, cost can be a considerable motivation to only test everything when it has finally been placed on the test bed system.

With the information development strategies, tests are performed at each creative step in the process. This allows repair immediately while working with the specific process and tools.

When everything has been placed together on the test bed an exhaustive test is performed trying every path in the subject matter addition. And after these tests have been satisfactory, an additional test is performed by someone who has not been working on the addition.

3.1.15 Add to the SAIL Library

Verify the folder name to assure that it is unique to the library. Move the named folder from the test bed to the library for public usage. Add an entry in the library directory referring to the new addition. The library directory for SE-SAIL is "SAIL Directory.html" is located in the SE-SAIL/SAIL folder.

Finally, perform any indexing procedures required by the system. With the Mac version of the Infromedia DVLS implementation, this is accomplished through the Preferences Window located in the "File" pull-down menu.

3.1.16 Re-test the Results

The addition to the library should be re-tested to assure that it has not impacted other library data. If hypertext links exist in the new material to other parts of the library, they should be tested to assure that they are active and accurate.

4 Information Development Strategies

The use of information development strategies for adding multimedia information to a library such as an Informedia DVLS Library require a lot of thought and processing. Since the library additions will be viewed by many people of unknown backgrounds and capabilities, we cannot predict tolerance for less than perfect media presentation. Therefore, the quality of the addition must be high. Since the library addition will be used by many people, the results must be tested at each step to eliminate any deficiencies as early as possible.

Note: Many of the activities that are used in these strategies have been described in Section 3.1, "Generally Applicable Activities" on page 13. As new activities are encountered in the description of these strategies, they are described in detail. In the tables for these strategies describing the activities, the asterisk reflects the steps that are added or changed from those described in Section 3.1. Refer to the table of contents for activities that appear in earlier sections.

With all of these strategies, the addition of materials into the library includes adding an entry in the library directory which references the addition. It should contain bibliographic information about the addition plus total running time of any video clips. The following is an example of a directory entry from the "SE-SAIL" library:

Major Topic: C. **An Introduction to Software Requirements Engineering at Texas Instruments**, By H. K. Hallman and L. F. McCalla. (1994), 30 Minute Multimedia; **Abstract**, **TOC**.

It contains hypertext links to the abstract and table of contents.

4.1 Create a Multimedia Topic

Creating a new interactive multimedia topic for the Informedia DVLS provides the opportunity to take advantage of all of the features of the Informedia DVLS. Animation or discussions and conversations can be used effectively. This requires planning. After all of the following steps have been completed and the results have been tested with a user, it may be desirable to cut a CD-ROM for distribution.

To create a multimedia topic, first create an outline and a storyboard to prepare for the development of video, graphic and audio production. Then determine the clip hierarchy, decide the content of video and graphic segments, create graphics to assist in providing the content of the topic, prepare a transcript to make sure that all the necessary information in the audio is covered, record the video and audio segments, and merge the graphics and the video to make video clips. Finally, add the topic to the library.

Following are the activities necessary for this information development strategy when creating a video:

Table 1: Activities for Creating a Video

1. Plan the approach.
2. Create an outline.
3. **Prepare a storyboard.
4. Determine the clip hierarchy.
5. **Determine the video, graphic and audio segments.
6. **Create a transcript.
7. **Create the graphics for presentation.
8. *Test results.
9. **Create the video environment.
10. *Test results.
11. **Record high quality video and audio segments.
12. Create an abstract.
13. *Digitize video segments.
14. *Test results.
15. Merge the audio, graphics and video segments into video clips.
16. *Test results.
17. Add the video clips, etc. to an Informedia DVLS test system.
18. Test the results.
19. Merge the transcript with video clips.
20. *Test the results.
21. Add the hierarchy links to video clips.
22. *Test the results.
23. Identify the reference materials and add to list.
24. **Create the graphic buttons and add to the introduction in the Informedia DVLS.
25. Test the results.
26. Add to the SAIL Library.
27. Re-test the results.

A single asterisk (*) indicates that the activity is not described in Section 3.1, "Generally Applicable Activities" on page 13, but is discussed in this section.

A double asterisk (**) denotes activities that are mentioned in Section 3.1, "Generally Applicable Activities" on page 13, but are expanded upon in this section.

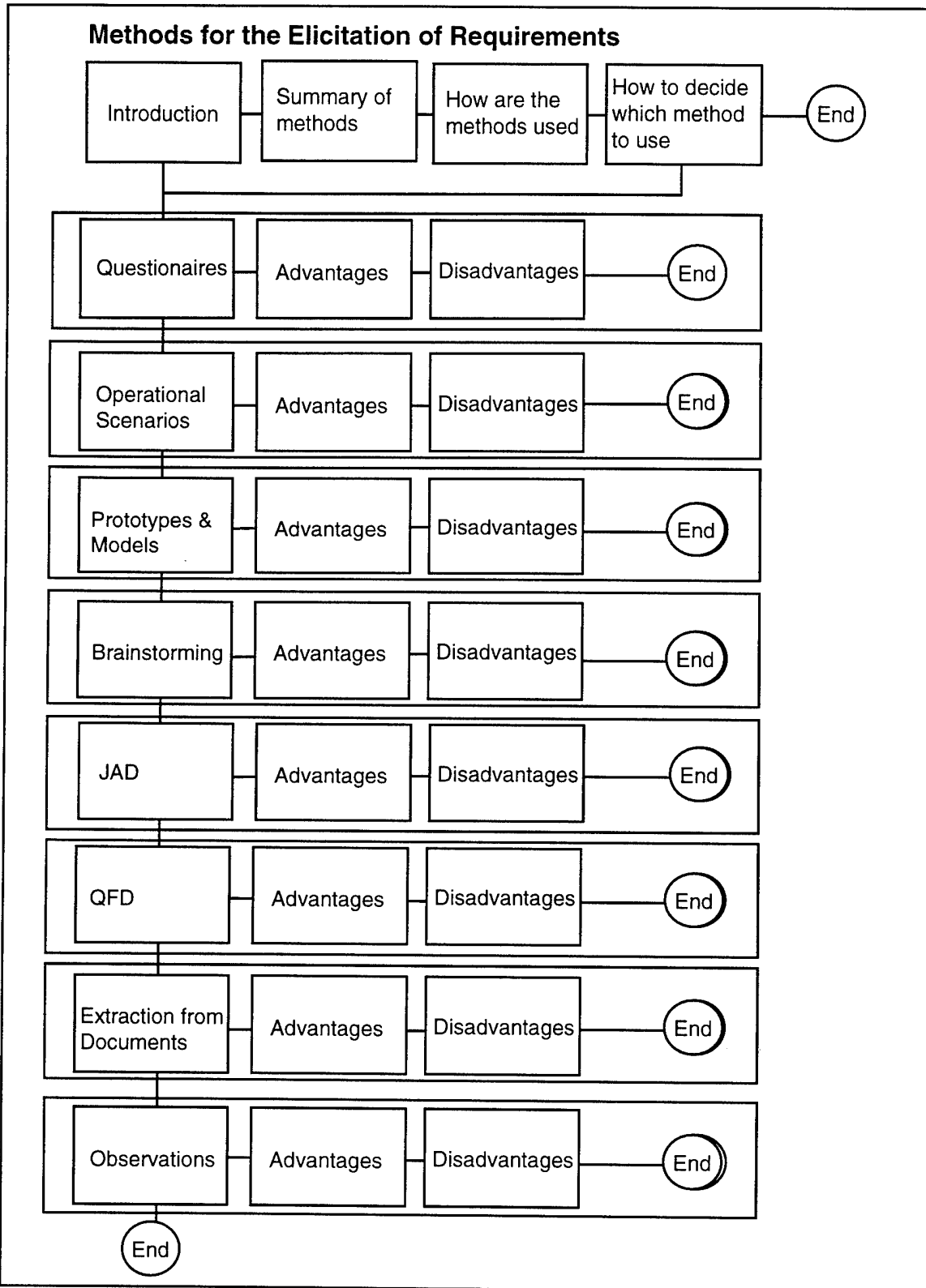


Figure 9: Example of a Hierarchical Storyboard

4.1.1 Prepare a Storyboard

A storyboard of the presentation is prepared to identify the sequence all of the key thoughts that need to be presented. Storyboards, often hand drawn, illustrate the composition of the video or graphic that is to be created. The thoughts are laid out with sequences of actions needed to describe each thought for the video or graphic. It may help to place each thought on cards and arrange the cards on a flat surface for review and reorganization.

Unlike most storyboards, which are sequential, the Informedia DVLS can be hierarchical, similar to a work breakdown structure. Although the thoughts may appear to be sequential, they are broken down into several pieces which in turn may also be broken down. With hierarchical clips, the user can view individual clips without having to see all of them. Figure 9 gives an example of such an hierarchical storyboard.

The storyboard will evolve as the creative process continues. It will evolve from a storyboard for the communication of thoughts, to a storyboard portraying the details needed to plan the making of the video clips. It is a convenient place to record vital information that needs to be handy if things have to be redone.

4.1.2 Determine Video, Graphic and Audio Segments

From the storyboard, decide which clips will be recorded on video and which will be recorded in audio for merging with graphics or video. Usually the boards requiring live action are placed on video. This may be introductory or lecture type segments. It may contain an outdoors scene such as an athletic event, a hiking scene, or the use of a product. Segments where graphics containing text, charts, or pictures are designated as audio segments for the purpose of audio recording. Audio segments may contain a transcript, music, other sounds, or a combination of these. It may be desirable to record each component separately and then merge them later with an a/v editor.

Occasionally, the video will be recorded separately from the audio. When synchronization of the sound track with the video track is unnecessary, it may be wiser to record the video and the audio separately (for example, a video taken outdoors or in a noisy surroundings) so that the listener will benefit from a sound track that was recorded in a sound studio. If the synchronization is critical (if people are talking or a motion is connected with sound), the audio and video will need to be recorded simultaneously on the same video media.

4.1.3 Create a Transcript

The wording of the video and audio segments that are to be created should be prepared to make sure that everything is said in the proper sequence. The transcript should be reviewed for technical accuracy, completeness and understanding prior to the recording of the segment. The transcript also prevents statements from being forgotten during the recording, and may be used in teleprompting the speakers while recording the video or read by the people dictating the audio.

During the planning stage, determine what equipment is needed to perform the recording. Is a teleprompter needed? Some teleprompters are paper driven while others are computer driven. If none is available, a computer screen can act as the teleprompter. The critical ingredient with teleprompters is that the text needs to be large enough to be read by the person or persons (usually referred to as talent) who will be saying the lines. The distance from the camera to the talent determines whether the text can be read; a last minute change in this distance may require a last minute change to the size of the words. Teleprompters are normally out of the view of the camera. When the camera is moved further away, the text will need to be larger. The details of the storyboard also need to specify the distance of the talent from the camera, that is, a head shot, a body shot, etc.

Transcripts for segments that will be recorded on audio only can be printed on paper at larger than normal printing, 12 to 18 pitch, since no video camera will be recording the prompting mechanism.

Transcripts for prompting should contain directions to the talent. These directions may contain actions for the talent to take (lifting a prop, turning in a specific direction, vocal inflections, etc.). They also indicate who the speaker is when multiple speakers are included. They need to be presented in a manner that allows the talent to differentiate between them and the words to be spoken by a different font and style. Sometimes icons are effective when the action is frequently used.

4.1.4 Create the Graphics for Presentation

Graphics are prepared to reflect the storyboard requirements. They are fleshed out in a general sense to assure the flow and then detailed graphics are created. A series of graphics may be needed to flesh out the thought indicated on the storyboard. The graphics may be in the form of a slide presentation. They may depict the technology being described. They may be drawings that can be scanned from hard copy sources and modified to reflect the necessary size of the addition.

By creating the graphics first at least in rough form, the requirements for the remaining media can be more easily understood. They can set the tone of the other media. They may dictate the transcript requirements. They can be used to show what is intended and begin the agreement process if that is necessary.

Occasionally, a professional graphic artist will be an advantage. He or she can bring composition issues to the forefront and provide artistic expertise that is not normally available. They often have sophisticated software that they can use to get special effects.

4.1.5 Create the Video Environment

The storyboard also gives insight into the environment or staging needed to record the video. It can designate the background and foreground of the scene. For example, the talent may be speaking in front of a lake with a sail boat going by while talking about the technology of controlling sail boats with computers. The more complex the situation the more staging will have to be prepared. The "keep it simple" principle applies here. Often, the simpler the environment the more effective it will be.

Here is where the interest of the user is important. The background needs to contribute to the thoughts that are being portrayed. It should not be distracting but should help keep the users interest. With technical presentations, it may be more effective with a sterile background. However, there may be opportunities to have the background contain the actual technology that is being discussed. These situations provide opportunities not found in single media situations. A/v editors allow the merging of several videos or videos and graphics. By recording one video with a neutral background, blue for example, the a/v editor is able to place it on top of another scene or graphic and drop out the neutral background. These effects can be obtained at normal a/v capable workstations without requiring professional video studios and their editing staffs.

4.1.6 Record High-Quality Video and Audio Segments

A high quality video is recorded for the video segments. Since this strategy is used to create new multimedia additions that will be used by many un-sympathetic users, the quality of the video is important. Beta, Super VHS, and VideoHi8 recordings give satisfactory results. Lower quality alternatives include VHS and Video8 which can be effective in certain environments and if good quality equipment is used. If video studios are available and within the budget of the project, higher quality recordings such as Beta SP may be available. VCRs for the recording technology used are a requirement in order to review and digitize the video. This can be a deciding factor for the equipment that will be used.

The audio segments are easier to record with good results. Sound cards are available for the workstation equipment that will be used to digitize and edit the audio/video segments. Microphone, cassette and CD players outputs can be hooked up to many of today's personal computers that are a/v ready.

If not recorded in digital form, the video and audio need to be digitized. They are separated into segments so that they can be merged (video, audio, and graphics) into video clips.

4.1.7 Create a Graphic Button to Add to the Introduction in the Informedia DVLS

It is sometimes desirable for the user to be able to quickly access the subject matter of this addition. The developer has several ways to make this available. An entry in the library directory is one way. Another way is to provide a button to the subject in the introductory graphics of the Informedia DVLS. Figure 10 is an example of an introductory graphic that has several buttons allowing the user many choices to select. These graphics are hierarchical in the prototype system and allow the user to view graphically the top level contents of the library.

A “button” is a spot designated on a graphic window that can be pressed (clicked) to get access to other information. In this case the information to be accessed is designated with a text and picture description of the material. The button is created using a graphics processor by first creating a blank opaque rectangle to outline the button. Then place a symbolic graphic on top of the rectangle. Add unique text on top to represent the button, such as “Prototypes & Models” and “Brainstorming.” This button is then saved as a PICT file and placed on one of the introductory graphic windows of the Informedia DVLS. The graphic is then processed by an Informedia DVLS utility program, QuickenPict. When the button is clicked by the user, the text on the button is used as the name of a file or its alias to bring up the proper starting point of the subject. The text on the button is used as the file name to obtain the designated file. The file or its alias must be placed in the folder SE-SAIL/Informedia Directory/AMORE Data/SAIL with this name. It must be unique in that folder.

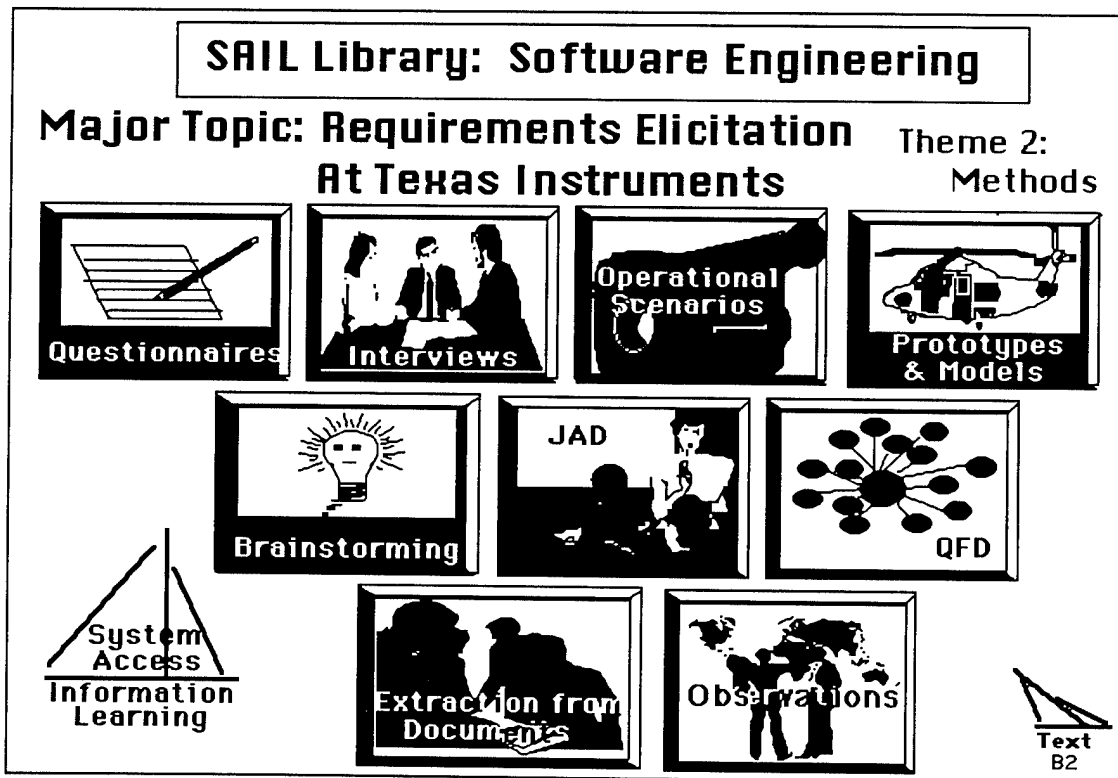


Figure 10: Introductory Graphic with Buttons

4.2 Add an Existing Video

When the video already exists, much of the creative work has already been completed. Since the video has probably been created for another purpose, what remains is the insightful process of how to break it up so that it can be viewed interactively by the user.

Occasionally it is desirable to quickly add a video to the library. In that situation the archival strategy "Documenting a Meeting with Video" described on page 45 should be considered.

The key to success with this approach is to obtain a high quality video master for the digitizing. Although the reduced size of an Informedia DVLS presentation will appear to clarify some shots, the digitizing process cannot make the videos better than they were originally.

This strategy obtains a high quality video master. After reviewing the video, a plan is prepared describing how the video will be converted into a library addition. The video is digitized into video clips. Inadequate graphics on the video are replaced with better quality graphics. Then the transcript is added for searching.

The following table indicates the activities necessary when using this information development strategy.

Table 2: Activities When Video Exists

1. *Obtain high quality video master.
2. Plan the approach.
3. Extract outline.
4. Determine the clip hierarchy.
5. Digitize the video and audio into segments.
6. *Test results.
7. Create an abstract.
8. Create the graphics.
9. **Merge the graphics into video clips.
10. *Test results.
11. Creating the transcript of the audio track when it doesn't exist.
12. Add the video clips, etc. to an Informedia DVLS test system.
13. *Test results.
14. Merge transcript with video clips.
15. *Test results.
16. Add hierarchy links to video clips.
17. *Test results.

18. Identify the reference materials and add to list.
19. Create graphic introduction.
20. *Create the graphic buttons and add to the introduction in the Informedia DVLS.
21. Test results.
22. Add to SAIL Library.
23. Re-test results.

A single asterisk (*) indicates that the activity is not described in Section 3.1, "Generally Applicable Activities" on page 13, but is discussed in this section.

A double asterisk (**) denotes activities that are mentioned in Section 3.1, "Generally Applicable Activities" on page 13, but are expanded upon in this section.

4.2.1 Merge the Graphics into Video Clips

When reviewing the video in order to finalize the plan, it will be recognized that some of the digitized graphics on the video are not clear and readable. These will need to be replaced with direct graphics obtained from a graphics processor. (PowerPoint and Adobe are examples of graphics processors that are often used to create graphics for videos.) This might also be the time to consider animating the graphics. Graphics are merged with the video clips replacing the video segment without affecting the audio track. This is also the time to do some fine editing of the video. Replacements for poor graphics are either re-entered using a graphics processor, scanned from a hard copy source or obtained in digital form. After adjusting for ease of viewing described in "Generally Applicable Activities" above, they are used to replace the faulty video.

A process that has been used effectively on the prototype was to first determine the length of time of the video that was to be replaced. A single frame of the graphic was converted to a video with the equivalent number of frames and added to the back of the video in question in an a/v editor. The video track from this addition was copied and pasted on top of the section of the video to be replaced without touching the audio. The result was reviewed to see if it was appropriate. When satisfied with the result, the graphic video that was added to the back was removed. The resulting video was saved with a temporary name. When satisfied that the new video was appropriate, it was renamed to replace the old video clip.

Occasionally, poor or blemished frames exist on the video clip. A similar process can be used to remove them without affecting the audio track. When the audio track has no contribution for the blemished frames, the entire frame can be removed. This may be true at the end of a video clip.

The first frame of the video clip will be the seen when the clip is loaded by the Informedia DVLS. Sometimes it is desirable to have the first frame be different than the rest of the video. For example, it may be desirable that the first frame be an information frame about the video clip. In this case a meaningful graphic or other frame may be placed in the front of the clip.

The last frame of the video clip is the one that will remain after the user has viewed the video. It may be desirable to delete the last few frames that contain no contributing audio in order to avoid the last frame being distracting. Sometimes the clip creation process will result in a blank last frame. This is annoying to the users eyes.

Any frame can be established as a "Poster frame." Poster frames are used by the Informedia DVLS and other movie player utilities to give a one frame view of the contents of the video. A poster frame should be established in either the a/v editor or in the Informedia DVLS.

4.3 Add Animated Graphics

Occasionally a topic presents itself that is best presented with animated graphics. In this case a new video addition is to be added consisting of moving graphics with an audio track.

This strategy is similar to the strategy for "Creating a Multimedia Topic" above, except that the creation of the video environment and recording the video are omitted. The emphasis is on making the animated graphics effective. Therefore, a storyboard needs to be created. Graphics are created in perhaps in an animated format, a transcript is created and recorded. The graphics and the audio are merged into video clips. These are placed on the library.

The following table indicates the activities necessary when using this information development strategy.

Table 3: Activities for Animated Graphics

1. Plan the approach.
2. Create an outline.
3. *Prepare the storyboard.
4. Determine the clip hierarchy.
5. *Create the transcript for audio recording.
6. **Create the animated graphic video segments.
7. *Test the results.
8. *Record the transcript into audio segments.
9. Merge the audio and graphics segments into video clips.
10. *Test the results.
11. Add the video clips, etc. to an Informedia DVLS test system.
12. *Test the results.

13. Merge the transcript with video clips.
14. *Test the results.
15. Add the hierarchy links to video clips.
16. *Test the results.
17. Identify the reference materials and add to list.
18. *Create graphic buttons and add to introduction in the Informedia DVLS.
19. Test results.
20. Add to the SAIL Library.
21. Re-Test the results.

A single asterisk (*) indicates that the activity is not described in Section 3.1, "Generally Applicable Activities" on page 13, but is discussed in this section.

A double asterisk (**) denotes activities that are mentioned in Section 3.1, "Generally Applicable Activities" on page 13, but are expanded upon in this section.

All of the video clips are composed of graphics or graphics merged with audio.

4.3.1 Create the Animated Graphic Video Segments

The animation effects may be created during the editing process or with a graphics processor. Occasionally, a professional graphics artist is needed to create the desired results. These animations can fall into a number of categories:

- Highlighting of textual graphics is the most common. It involves the movement of text, placement of icons on the text, or changing the color of the text to bring the viewers attention to the item being discussed. This is usually supported by the a/v editor or graphic processor.
- Zooming in on specific areas is an effective way to make graphics that contain a lot of information more understandable. It is useful as an attention getter and as a way of making the graphic larger. This is usually supported by the a/v editor.
- Cartoon motion involves the movement of specific objects of the graphic to make it look like it is accomplishing some task. It may be the running of a figure down a base line. It may be the changing of the lengths of the legs of a triangle to demonstrate some principle. It is often the most effective way to get an idea across. This may take a graphic processor that provides special effects.
- Morph is the technique for slowly transformed one object into another. This is supported by some a/v editors.

The special effects graphics created need to be recorded in digitized form that can be used by the a/v editor to add audio and merge them into a video clip.

4.4 Add an Existing Text Document

When it is desired to add an existing document to the library for many people to use, care must be taken to avoid changing the intent of the document while making it more useful. A properly prepared hierarchically built addition can be more effectively used than one that is just the digitized version of the original. Sometimes, it will appear that the document has been reorganized. In a sense it has. The hierarchical approach is often the way the author may have wanted to present it if there hadn't been the requirement to place it on paper.

A digitized form of the text is obtained and converted to HTML if it doesn't already exist in that format. The pictures, charts, and tables are converted to readable graphics and the result is added to the library.

The following table indicates the activities necessary when using this information development strategy.

Table 4: Activities for Existing Text

1. **Obtain the text.
2. Plan the approach.
3. *Extract the outline.
4. Determine the clip hierarchy.
5. Convert the text to HTML.
6. *Extract the abstract.
7. **Extract the bibliographic section.
8. *Break into text clips to reflect hierarchy.
9. Add the hierarchy and outline hypertext links to text clips.
10. *Test the results.
11. **Create the graphics from the text.
12. *Test the results.
13. Add text clips, etc. to the Informedia DVLS test system.
14. *Test the results.
15. Identify the reference materials and add to list.
16. *Create graphic buttons and add to introduction in the Informedia DVLS.
17. Test the results.
18. Add to the SAIL Library.
19. Re-Test the results.

A single asterisk (*) indicates that the activity is not described in Section 3.1, "Generally Applicable Activities" on page 13, but is discussed in this section.

A double asterisk (**) denotes activities that are mentioned in Section 3.1, "Generally Applicable Activities" on page 13, but are expanded upon in this section.

Frequently the outline and the abstract are in the document and can be easily extracted. As with all of the strategies used in the Information Development, the results are tested after each step. Text clips are created with this strategy.

4.4.1 Obtain the Text

The document is obtained in digitized form either by scanning, by obtaining the original word processing source, or by using both (sometimes it is more effective to scan in pictures and charts than to use the digitized version). The text is then converted to HTML. When the original word processor source is available, it needs to be saved in a format comparable with the converters available.¹⁰ When the document is scanned, the results need to be verified for accuracy. It may also need to have HTML commands added to have the document look similar to the original. It is appropriate to create a hierarchical structure of the text. Breaking the text into clips based on the outline and the hierarchical structure provides the ability to view the document in parts rather than as a whole. Adding hypertext links to the text as the clips are being extracted is essential to providing a continuous path for the individual who wants to read it sequentially.

The pictures, charts, and tables may need to be handled separately.

4.4.2 Extract the Bibliographic Section

The bibliography is usually fairly easy to extract. However, it may need some editing and special processing to make it effective. Differentiating between the entries is sometimes difficult to see on a screen. It may be desirable to provide hypertext links in the text to the bibliography where references to it have been made.

4.4.3 Create the Graphics from the Text

The biggest challenge is the converting of the pictures, charts and sometimes the tables into graphics. This can be the most tedious process in placing an existing document on the library. They have often been oriented to take advantage of the page size of the document and don't show up as effectively when placed on the video. They may need to be resized. When resized they may not be understandable. They may need to be broken up into several graphics. It may be useful to include an overall graphic of the entire picture and then follow it with graphics containing detailed breakdowns of parts of the picture. Links need to be provided in the text where references to the graphic exist. These can be stored as ".gif" or as single frame videos. The later is more effective with the Informedia DVLS as textual identifiers can be included in the video file. They are not merged with the text clips and therefore must be stored on the library folder with them.

¹⁰ Examples are: RTF to HTML by Chris Hector (cjh@cray.com), MIF to RTF Export Utility from Frame Technology

5 Archival Strategies

Archival strategies for adding multimedia information to a library such as an Informedia DVLS Library do not require as much preparation as the information development strategies. They are going to be viewed by few people whose backgrounds are known. They have a tolerance for less than perfect media presentation and are primarily interested in finding the content. The presentation has to be acceptable and readable but doesn't have to be perfect. Therefore, the objective of these strategies is to make the material available and to be able to find it quickly when desired with low cost. Many of the activities that are used in these strategies are described in "Generally Applicable Activities" and "Information Development Strategies" above. As new activities are encountered in the description of these strategies, they are described in a fair amount of detail. In the tables for these strategies describing the activities, the asterisk reflects the steps that are added or changed from those described in the "Generally Applicable Activities" section. Some of these activities will have been described in earlier sections and will not be described in detail again. The "Table of Contents" can be used to locate these descriptions.

With all of these strategies, the addition of the materials into the library includes the adding of an entry in the "Meetings Available List" referencing the addition. It should contain bibliographic information about the addition plus total running time if video clips are involved. The following is an example of a directory entry from the "SAIL- Dev Files" Library:

Meeting: 152. **A discussion of the frame size of the prototype videos**, By H. K. Hallman (June 7, 1993), 10 minutes; **Abstract**, **Movie**.

It contains hypertext links to the abstract and the initial video.

Since the library addition will be used by relatively few people, the results are tested at the end rather than at each step to reduce the cost of the development.

5.1 Documenting a Meeting with Video

When a meeting is recorded in order to place it in the archives, it is anticipated that it will be referred to later for briefings and training. The quality of the result will vary depending on the quality video recorder, and the time spent in preparing it for the library. It is digitized.

This is also a quick way to add a video to the library when the special processing described in the information development strategy "Add an Existing Video" above is too time consuming and not necessary.

The meeting is recorded on video. It is digitized into video clips and a transcript is added. And the result is stored on the library. It can be this simple. But it usually requires more effort.

Optionally, an outline and an abstract may be extracted from the video. The outline may exist in the meeting agenda. A clip hierarchy may need to be produced. If so, the necessary hyper-text links need to be added to the video clips. A clip hierarchy will help in understanding what video segments go together to create the video clips because meetings sometimes cycle back and forth over the subject matter.

The following table indicates the activities necessary when using this archival strategy.

Table 5: Activities for Documenting a Meeting with Video

1. **Record the meeting on video.
2. Plan the approach.
3. *If desired, extract the outline.
4. Determine the clip hierarchy.
5. *If desired, create an abstract of meeting.
6. Digitize the video and audio into segments.
7. **Remove the dead spots in the video.
8. Create the transcript of the audio track when it doesn't exist.
9. Add the video clips, etc. to an Informedia DVLS test system.
10. Merge the transcript with video clips.
11. Add the hierarchy links to video clips.
12. Identify the reference materials and add to list.
13. *Add an entry in the meetings available list.
14. Test the results.
15. Add to the SAIL Library.
16. Re-test the results.

A single asterisk (*) indicates that the activity is not described in Section 3.1, "Generally Applicable Activities" on page 13, but is discussed in this section.

A double asterisk (**) denotes activities that are mentioned in Section 3.1, "Generally Applicable Activities" on page 13, but are expanded upon in this section.

The video may need to be broken into several clips to reflect different topics being addressed and to reduce the size of the clips.

When satisfied with the usability of the meeting video, it is added to the library.

5.1.1 Record the Meeting on Video

When documenting a meeting it is important that the recording not be intrusive. Unlike audio, when the recording is on video an operator of the camera is sometimes used. When the meeting involves just a few people with no presentation aids, an operator isn't necessary as the camera can be set on a wide angle setting. The recording should be a natural by-product of the meeting. The results are better if there is some control over the meeting and there is not a lot of revisiting of topics. Summaries of decisions are also helpful in capturing the final decision.

5.1.2 Remove the Dead Spots in the Video

The video will contain some dead spots that need to be removed from the digitized video. Dead spots occur when nothing is being said or the video contains disturbing and unrelated noise. Figure 11 shows the time view of a video recording with a 7.81 second dead spot. These can be annoying to the user and waste space on the library. Dead spots cannot be avoided when recording meetings. With some of the new digitizing techniques being researched at Carnegie Mellon University, "no noise - no movement" dead spots are removed automatically. An intelligent edit may also remove side conversations that are not related to the subject matter, such as discussions about where to record the comments of the meeting, or questions about materials being handed out, or external interruptions of the presentation.

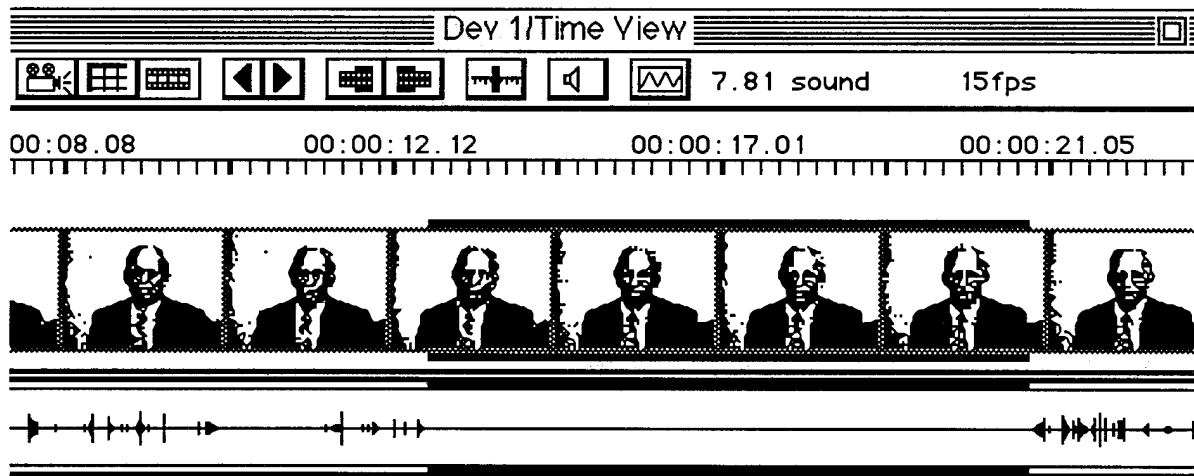


Figure 11: Video Track with a Dead Spot

5.2 Documenting a Meeting with Audio

When a meeting is recorded using an audio recorder, there is no video to associate with the audio. It may be desirable to digitize and store the audio with little change. In many cases, it is desirable to associate the text with the audio and even provide a single frame video with which to associate the text.

An audio of the meeting is recorded using either a video or audio recorder. A graphic is created containing some relationship to the discussion.¹¹ These are merged into a video clip or several clips if several topics are discussed. The transcript of the audio is added for searching. These are then placed on the library.

Optionally, an outline and an abstract may be extracted from the meeting audio or from notes taken during the meeting. A clip hierarchy may need to be produced. If so, the necessary hypertext links need to be added to the final video clips. A clip hierarchy will help in understanding what subjects go together to create the clips.

The following table indicates the activities necessary when using this archival strategy.

Table 6: Activities for Documenting a Meeting with Audio

1. *Record the meeting on audio.
2. Plan the approach.
3. *If desired, extract an outline.
4. Determine the clip hierarchy.
5. *If desired, create an abstract of the meeting.
6. Digitize the audio into segments.
7. *Remove the dead spots in the audio.
8. **Create one graphic for all of the clips.
9. Merge the audio, graphic segments into video clips.
10. Create the transcript of the audio track when it doesn't exist.
11. Add the video clips, etc. to an Informedia DVLS test system.
12. Merge the transcript with video clips.
13. Add the hierarchy links to video clips.
14. Identify the reference materials and add to list.
15. *Add an entry in the meetings available list.
16. Test the results.
17. Add to the SAIL Library.
18. Re-test the results.

A single asterisk (*) indicates that the activity is not described in Section 3.1, "Generally Applicable Activities" on page 13, but is discussed in this section.

¹¹. With InfoPursuit for the Macintosh, there is no convenient place to hang the transcript when only an audio track exists. It needs the transcript in at least abbreviated form to accomplish the search. The audio is added to the graphic to make a single frame video clip. With the next version on the PC, this will be made easier for the developer to accomplish.

A double asterisk (**) denotes activities that are mentioned in Section 3.1, "Generally Applicable Activities" on page 13, but are expanded upon in this section.

The audio may need to be broken into several segments to reflect different topics being addressed and to reduce the size of the clips.

When satisfied with the usability of the meeting audio, it is added to the library.

5.2.1 Create One Graphic for All of the Clips

A single graphic is created reflecting the content of the meeting. It may be as simple as subject, date and attendees. It may contain the abstract of the audio. See Appendix C on page 62. It may also contain some of the graphics that are pertinent to the meeting. It may be desirable to have a different graphic for each clip. The audio and graphics are merged into a video clip. Links need to be added to the resulting video clips to connect them together for the individual who wants to review the entire meeting.

5.3 Documenting a Slide Presentation

When a presentation is being made using overhead slides or transparencies, it is not necessary to place the video of the presentation onto the library. The slides combined with the audio track is sufficient and occupies less space.

An audio of the presentation is recorded. The slides are obtained in digital form. A graphic of each slide is captured. The slide is converted to a video for the duration of the audio describing it. Video clips are created by merging related slide videos and the audio tracks. These are then placed on the library.

Optionally, an outline and an abstract may be extracted from the presentation. A clip hierarchy may need to be produced. If so, the necessary hypertext links need to be added to the video clips. A clip hierarchy will help in understanding what slides go together to create the video clips.

The following table indicates the activities necessary when using this archival strategy.

Table 7: Activities for Documenting a Slide Presentation

1. *Record the meeting on audio or video.
2. **Obtain the digitized version of slides graphics.
3. Plan the approach.
4. *If desired, extract an outline.
5. Determine the clip hierarchy.
6. *If desired, create an abstract of meeting.
7. Digitize the audio into segments.

8. *Remove the dead spots.
9. **Adapt the slide graphics.
10. Merge the audio, graphic segments into video clips.
11. Create the transcript of the audio track when it doesn't exist.
12. Add the video clips, etc. to an Infromedia DVLS test system.
13. Merge the transcript with video clips.
14. Add the hierarchy links to video clips.
15. Identify the reference materials and add to list.
16. *Add an entry in the presentations available list.
17. Test the results.
18. Add to the SAIL Library.
19. Re-Test the results.

A single asterisk (*) indicates that the activity is not described in Section 3.1, "Generally Applicable Activities" on page 13, but is discussed in this section.

A double asterisk (**) denotes activities that are mentioned in Section 3.1, "Generally Applicable Activities" on page 13, but are expanded upon in this section.

The audio needs to be digitized. In the process of digitizing the audio to reflect the clip hierarchy, the dead spots need to be removed, as described above.

When satisfied with the usability of the modified slide presentation, it is added to the library. An entry is added to the "Presentations Available" list for the library reflecting this addition.

5.3.1 Obtain the Digitized Version of Slide Graphics

The slides need to be available in digital form. They may be in a file created by a graphics processor. They may have to be converted to individual digital form by scanning. In either case, they need to be available to create PICT files for insertion into a video. If the slide was scanned in and it needs to be adapted, it may have to be recreated in a graphics processor like PowerPoint.

5.3.2 Adapt the Slide Graphics

The slides need to be reviewed for acceptance by the user. Can the text be read at the aspect ratio and size of the proposed video?¹² Are the graphics visible and understandable? If the answer to either of these questions is "No!", the slides need to be adapted so that they can be seen by the user. They may have to be changed, split into several slides, or summarized.

¹². Experience has shown that with an 320 x 240 window for the viewer, text smaller than 18 pixels will be hard to see by many viewers.

Sometimes an overall slide showing everything in small scale will need to be followed by a blow-up of the important sections of the slide discussed. This has to be taken into consideration when adding the audio. The audio has to be added to the blow-up slide it is discussing. Quiet time may need to be added in order for the user to view the blow-up. Because of time available to process the slide presentation, it may be necessary to direct the user to an alternate method to see the slide, for example, paper copy, loading a graphics processor and viewing the slide in larger form, pulling and dragging at the current video, etc.

5.4 Quick Addition of a Text Document

It may be desirable to add documents quickly in order to make them available to the requests of users. The amount of effort used to place these documents in the library can vary widely.

In its simplest form, the document is digitized, perhaps with a flat-bed or hand scanner. It is then added to the library un-edited. This document is appropriate for use in searching with the Find function. The Informedia DVLS will present non-HTML files without change. They will be positioned at the point at which the search has found the first match.

The document may already be available in digitized form, having been produced by a word processor. This can be converted to HTML or saved as a text only file for addition to the library. Unless the file is in clear text or in HTML format, the control information for the word processor will appear and distract the user.

The following table indicates the activities necessary when using this archival strategy.

Table 8: Activities for the Quick Addition of a Text Document

1. *Obtain digitized text.
2. *If desired, extract an outline.
3. *If desired, determine the clip hierarchy.
4. *If desired, convert the text to HTML.
5. *If desired, extract an abstract.
6. *If desired, extract the text clips to reflect hierarchy.
7. Add the text clips, etc. to an Informedia DVLS test system.
8. *Add an entry in list of documents.
9. Test the results.
10. Add to the SAIL Library.
11. Re-test the results.

A single asterisk (*) indicates that the activity is not described in Section 3.1, "Generally Applicable Activities" on page 13, but is discussed in this section.

Varying degrees of processing can be done before adding the text clips to the library. Adding HTML info will make the document more attractive and readable to the user. Outlines and abstracts are useful and may already be available. Breaking the text of large documents into smaller clips makes the processing, presentation, and reading easier.

Pictures, charts and tables can be handled in various ways. Pictures and charts can be scanned into a graphic file and stored independently. HTML hypertext links can be added to the text at the appropriate spots to allow the user to view them. Some charts and tables can be scanned in as text without problems. Some complex charts or tables may need a lot of work in order for them to be understood. A reference to the original document may be satisfactory.

When the text is added to the library, an entry is added in the "List of Documents" to reflect its addition.

6 Summary

Multimedia libraries have the potential to provide fingertip learning and fingertip access to project information and documentation. To realize its maximum potential, the addition of multimedia information to the library has to be organized and straightforward. Strategies such as the information development, archival, and navigation strategies presented within should be used in order to ensure uniform and thorough development of the Informedia DVLS Library.

These strategies take into account both the users' and authors' perspectives: ease of use, available time and budget, and hardware and software availability. Multimedia libraries with appropriate access mechanisms have the potential of changing the training paradigm for technical people to a fingertip learning process rather than a "just-in-time" learning process or the "re-invention" process.

These strategies have been developed as part of a prototype of a "SAIL Library for Software Engineering" created at the SEI using requirements elicitation as the area of technical information. This was accomplished using the Macintosh version of the Informedia DVLS.

Appendix A Sample Table of Contents

Major Topic:

Multimedia Recording

Approx. 53:00 Minutes

An Introduction to Software Requirements Elicitation at Texas Instruments

Linda F. McCalla
Harvey K. Hallman
November, 1994

Software Engineering Information Methods Project

Software Engineering Institute
Carnegie Mellon University
Pittsburgh, Pennsylvania 15213
Copyright 1993,1994 - CMU and TI

This is the second Major Topic of a two topic multimedia presentation on Software Requirements Engineering at Texas Instruments. It is based on a video tape presentation "Introduction to Software Requirements Elicitation," created at the Software Engineering Institute, Carnegie Mellon University, in conjunction with Texas Instruments, Inc., 11-93.

Table of Contents

Abstract
Source of Material

Theme 1: Requirements Elicitation Process

Abstract

Total elapsed video time = 26 minutes 29 seconds. Allow additional time for interaction.

1. Introduction - **(Movie)**
 - 1.1 Definitions
2. Software Requirements Elicitation Process - **(Movie)**
 - 2.1 Inputs
 - 2.2 Activities - **(Movie)**
 - 2.2.1 Plan
 - Schedule/Plan Requirements Elicitation
 - 2.2.2 Requirements - **(Movie)**
 - Identify and Research the Problem Domain
 - Define the Types of Requirements Needed
 - 2.2.3 Design - **(Movie)**
 - Identify Potential Sources for Requirements

- Determine the Requirements Elicitation Strategy
 - Develop or Acquire Elicitation Aids
 - 2.2.4 Implementation
 - Elicit the Requirements - **(Movie)**
 - Pitfalls in Eliciting Requirements - **(Movie)**
 - Record the Requirements - **(Movie)**
 - 2.2.5 Evaluation - **(Movie)**
 - "analyze" the Requirements
 - Prioritize the Requirements
 - "review" the Requirements
 - 2.3 Outputs - **(Movie)**
 - 2.4 Equipment and Facilities - **(Movie)**
 - 2.5 Training/Knowledge - **(Movie)**
 - 2.6 Roles and Responsibilities - **(Movie)**
 - 2.7 Quality Performance Standards - **(Movie)**
3. Summary - **(Movie)**

Theme 2: Requirements Elicitation Methods

Abstract

Total elapsed video time = 26 minutes 20 seconds. Allow additional time for interaction.

4. Commonly Used Requirements Elicitation Methods - **(Movie)**
- 4.1 Questionnaires - **(Movie)**
 - 4.2 Interviews - **(Movie)**
 - 4.2.1 Before the Interview - **(Movie)**
 - 4.2.2 The Interview - **(Movie)**
 - 4.2.3 After the Interview - **(Movie)**
 - 4.2.4 Conclusions - **(Movie)**
 - 4.3 Operational Scenarios - **(Movie)**
 - 4.4 Prototypes and Models - **(Movie)**
 - 4.5 Brainstorming - **(Movie)**
 - 4.6 Joint Application Design (JAD) - **(Movie)**
 - 4.7 Quality Function Deployment (QFD) - **(Movie)**
 - 4.8 Extraction from Documents - **(Movie)**
 - 4.9 Observations - **(Movie)**

Theme 3: Reference Materials

- Activities - Software Requirements Elicitation. - **(Text)**
- Activities - Software Requirements Engineering. - **(Graphic)**
- "analyzing" Requirements - Checklist for. - **(Text)**
- Basic Development Cycle - Software Engineering Process. - **(Graphic)**
- Common Sources for Requirements. - **(Text)**
- Common Requirements Types. - **(Text; Movie)**
- Communications Map - Example. - **(Graphic)**
- Definition of Requirements Elicitation. - **(Text)**
- Equipment and Facilities - Software Requirements Elicitation.- **(Text)**

- Generic Process Model - Software Requirements Elicitation.- (**Graphic**)
- "Good" Requirements, characteristics of. - (**Text; Movie**)
- Inputs - Software Requirements Elicitation. - (**Text**)
- Interview - Things to Do Before. - (**Text**)
- Interview - Things to Consider During. - (**Text**)
- Interview - Things to Do After. - (**Text**)
- Matrix for Tracking Requirements Elicitation. - (**Graphic** - Part 1; **Graphic**) - Part 2.)
- Methods - Commonly Used for Requirements Elicitation. - (**Text**)
- Outputs - Software Requirements Elicitation. - (**Text**)
- Pitfalls To Avoid While Eliciting Requirements. - (**Text; Movie**)
- Prioritization of Requirements. - (**Text**)
- Requirements Elicitation Strategy - Elements of. - (**Text**)
- "review" Goals for Requirements. - (**Text**)
- Quality Performance Standards - Software Reqmts. Elicitation.- (**Text**)
- Questionnaire - Things to Consider When Developing a. - (**Text**)
- Roles and Responsibilities - Software Requirements Elicitation.- (**Text**)
- Training/Knowledge - Software Requirements Elicitation. - (**Text**)

See also:

- Major Topic: **Issues in Requirements Elicitation**, Michael G. Christel and Kyo C. Kang, (August, 1992). (**Table of Contents**)
- Major Topic: **Group Development Methods**, Inez I. Hill (1992). (**Table of Contents**)
- Major Topic: **An Introduction to Software Requirements Engineering at Texas Instruments**, by Harvey K. Hallman and Linda F. McCalla. This is the first Major Topic of a two topic multimedia presentation on Software Requirements Engineering at Texas Instruments. (**Abstract; Table of Contents**)

Appendix B Sample Clip File Plan

Legend for time:

E = elapsed time for the element = sec.frames

T = start time on original video for the element = min:sec.frames

Format of file names:

<outline paragraph number><sequence letter>-<file type>- descriptive name>.<suffix>

File type:

-a- = digitized audio

-av- = digitized video

-pp- = PowerPoint slide needed for audio

Suffix:

.qt = QuickTime digitized audio

.mov = QuickTime video

.movie = video from digitizer

Sequence of entries:

T = <start time in original video>

<Outline entity>

<file name of final merged video>

<list of source file names in sequence of video> T = nn:nn E = n sec

**Plan for Divide and Merge of B2 THEME 2 into Video Clips - first two pages of six
B2-Theme 2-Index**

for B2-Theme 2- Video

Total elapsed time = 26:19.14

T=11:06

4. Commonly Used Requirements Elicitation Methods

B.2.4-qt-ComMethods.mov

B.2.4.0a-a-pp slide 23.qt T=11:06 E=8

B.2.4.0b-a-pp slide 24.qt T=11:12 E= 7

B.2.4.0c-av-intro.movie T=11:19

T=11:28

4.1 Questionnaires

B.2.4.1-qt-Question.mov

B.2.4.1a-a-4. -pp slide 24.qt E= 4

B.2.4.1b-a-pp slide 25.qt T=11:32 E= 17

B.2.4.1c-av-consider.movie T=11:49

B.2.4.1d-a-pp slide 26.qt T=12:05 E= 63.4

B.2.4.1e-av-Advantages.movie T=13:09

B.2.4.1f-a-pp slide 27.qt T=13:13 E= 46.12

B.2.4.1g-av-Disadvantage.movie T=13:59

B.2.4.1h-a-pp slide 28.qt T=14:04 E= 58

T=15:02

4.2 Interviews

B.2.4.2.0-qt-Interviews.mov

B.2.4.2.0a-pp slide 24

B.2.4.2.0b-a-4.2 Interview.qt E=4.9

B.2.4.2.0c-pp slide 29 T=15:16

B.2.4.2.0d-a-intro.qt E=33.1

T=15:49

4.2.1 Before the Interview

B.2.4.2.1-qt-Before.mov

B.2.4.2.1a-a-4.2.1 pp slide 30.qt E=58

T=16:47

4.2.2 The Interview

B.2.4.2.2-qt-During.mov

B.2.4.2.2a-a-4.2.2 pp slide 31.qt E=55

B.2.4.2.2b-a-pp slide 32.qt T=17:42 E=52

B.2.4.2.2c-a-pp slide 33.qt T=18:34 E=65

B.2.4.2.2d-a-pp slide 34.qt T=19:39 E=35

B.2.4.2.2e-a-pp slide 35 close.qt T=20:14 E=62

T=21:16

4.2.3 After the Interview

B.2.4.2.3-qt-After.mov

B.2.4.2.3a-a-4.2.3 pp slide 36.qt E=62

T=22:18

4.2.4 Conclusions

B.2.4.2.4-qt-Conclusion.mov

B.2.4.2.3a-av-Advantages.movie

B.2.4.2.3b-a-pp slide 37.qt T=22:24 E=31.13

B.2.4.2.3c-av-Disadvantag.movie T=22:57

B.2.4.2.3d-a-pp slide 38.qt T=23:04 E=40 sec

B.2.4.2.3e-a-pp slide 39 Sumry.qt T=23:42 E=16

T=23:58

4.3 Operational Scenarios

B.2.4.3-qt-OP Scenario.mov

B.2.4.3a-4.3 pp slide 24

B.2.4.3b-av- OP Scenar.movie T=23:58

B.2.4.3c-a--pp slide 40.qt T=24:02 E=51.8

B.2.4.3d-av-Advantages.movie T=24:54

B.2.4.3e-a-pp slide 41.qt T=24:59 E=58.5

B.2.4.3f-av-Disadvantages.movie T=25:58

B.2.4.3g-a-pp slide 42.qt T=26:04 E=12.5

T=26:18

4.4 Prototypes and Models

B.2.4.4-qt-Prototypes.mov

B.2.4.4a-a-4.4 pp slide 24.qt E=5.3 sec

B.2.4.4b-a-pp slide 43.qt T=26:23 E=1.5.8

B.2.4.4c-av-Advantages.movie T=27:30

B.2.4.4d-a-pp slide 44.qt T=27:46E=31.3 sec

B.2.4.4e-av-Disadvantages.movie T=28:18

B.2.4.4f-a-pp slide 45.qt T=28:30E=25.8 sec

T=28:57

4.5 Brainstorming

B.2.4.5-qt-Brainstorm.mov

B.2.4.5a-a-4.5 pp slide 24.qt E= 4.7 sec

B.2.4.5b-a-pp slide 46.qt T=29:02E=1.48.3

B.2.4.5b-a-Advantages.qt E= 6.14

B.2.4.5c-a-pp slide 47.qt T=30:58 E=24.5

B.2.4.5d-a-Disadvantages.qt E=5.3

B.2.4.5ej-a-pp slide 48.qt T=31:28E=16.8

Appendix C Template - Archival Abstract

Date:

Previous meeting:

Subject:

Next meeting:

Why called:

Moderator:

Attendees:

Topics discussed:

Decisions concluded:

Significant Other comments

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