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A SOLID SURFACE FROM WHICH TO EXPLORE: THE EXECUTIVE SUMMARY AS THE FRONTISPIECE OF A TECHNICAL HYPERDOCUMENT

THESIS

Alicia M. Williams, B.A.
Captain, USAF

AFIT/GIR/LAR/95D-11

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A SOLID SURFACE FROM WHICH TO EXPLORE: THE EXECUTIVE SUMMARY AS THE FRONTISPIECE OF A TECHNICAL HYPERDOCUMENT

THESIS

Presented to the Faculty of the School of Logistics and

Acquisition Management

Air Education and Training Command

In Partial Fulfillment of the

Requirements for the Degree of

Master of Science in Information Resource Management

Alicia M. Williams, B.A.

Captain, USAF

December 1995

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Alicia M. Williams

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Abstract

This research analyzes the purpose and organization of a well-written executive summary, reviews the characteristics of hypermedia, and compares the strengths and weaknesses of a typical executive summary published originally on paper and now under consideration for transition to hypermedia in order to determine which elements of an executive summary are essential before effective transition to hypermedia.

The executive summary of a technical report is a stand-alone description of what was done, how it was done, what the results were, why they matter, and where further information is found in the report body. Executive summaries have a wider audience than the entire report and thus are written in non-technical language.

To use the features of hypermedia (linked text, sound, animation, pictures) to create an effective online executive summary, several crucial executive summary elements must be in place in order for it to serve as a solid hyperdocument anchor node: what was done, how it was done, what the results were, and why they matter. Traditional elements such as implications and an orientation to the body of the report need not be included in an online executive summary.

A SOLID SURFACE FROM WHICH TO EXPLORE: THE EXECUTIVE SUMMARY AS THE FRONTISPIECE OF A TECHNICAL HYPERDOCUMENT

I. Problem Identification

The United States Air Force's Wright Laboratory's Flight Dynamics Directorate at Wright-Patterson Air Force Base, Ohio, creates over two hundred technical documents each year in the form of technical reports. These reports are presently published as paper reports ranging from fifty to several hundred pages in length. Wright Laboratory's Pilot Vehicle Interface Branch is interested in exploring multimedia technology as a possible method of report presentation. As Wright Laboratory's Major Peter G. Raeth says: "Computer-based CD-ROM multimedia technology presents a unique opportunity to advocate and transition the results of cockpit research and development" (1994). In the spring of 1994, Wright Laboratory contacted the Air Force Institute of Technology to propose a thesis which would assess the technology of multimedia and develop a plan for using it in cockpit-related technical and executive communication. This thesis is a result of Wright Laboratory's proposed thesis topic.

composition, audience, and function of technical reports. Because technical documents are typically broken down into several segments of varying purpose, I have confined my research to what is generally considered the most important and most read segment: the executive summary. Chapter Two of this thesis discusses the executive summary in great detail, to include answers to questions about its definition, purpose, and audience.

It is also crucial that the features and limitations of multimedia itself be understood. Chapter Three of this thesis explores the current state of multimedia as it relates to online document presentation.

Only after the elements of both technical documents and multimedia are fully explored can they be evaluated jointly in order to make an informed decision about the possibility of combining them. Chapter Four of this thesis contains an analysis of a sample Wright Laboratory executive summary and recommendations for areas of improvement before attempting to convert a technical document to a hypermedia format.

II. The Executive Summary

What is an Executive Summary?

The executive summary is a prefatory summary which leads the reader through the introduction, the problem statement, the related literature, the procedures, and finally, the results of the report it precedes by providing a short synopsis of each part. "The executive summary, within a few paragraphs, should tell what was done, and why; what the results were; and why they matter" (Eisenberg, 1989:427). It contains no specific technical material, but is rather a broad, stand-alone overview of what is to follow in the body and appendices of the report.

> "Begin at the beginning; go on 'til you reach the end. Then stop," the Queen of Hearts advises in *Alice in Wonderland*. But this is not the way most people read technical materials. Before they read the beginning of the text, most look for clues that will tell them what they are about to read . . . (Eisenberg, 1989:357)

Giving readers of technical documents such an overview is important. It allows them to decide whether to read the technical document or not, and whether to read it in its entirety or read just certain portions. If the reader decides to read the report, the executive summary serves to introduce the material by providing a preview of all major portions to follow in the full technical document. A well-written executive summary is a stand-alone road map telling the reader what is ahead -- including the main points in the argument, the conclusions, and where in the body of the report to look should they need further information on any section mentioned in the executive summary. "This knowledge helps readers move more rapidly through the text; they have expectations, guideposts so they are not simply wandering" (Eisenberg, 1989:357).

There are generally two to three pages of executive summary for every one hundred pages of report. But, as Holtz says: "A basic rule for length is this: Make the executive summary long enough to present all those points you believe to be decisive, but no longer than that" (1990:230)

When the executive summary prefaces a report, or proposal, prepared as a contract bid, it serves as a sales pitch as well as a guide for the report reader. The executive summary is designed ostensibly to present a brief overview of the proposal, but the writer's chief objective is actually to make a sharply focused and hardhitting sales presentation by summing up the most cogent arguments found in the proposal (Holtz, 1990:225; Hill, 1993:168). It describes the critical areas for performance of the contract, the salient points of the technical proposal, a brief resume of the bidding company's experience and expertise in this work, why this company is best qualified, and a concise description of what is in the proposal (Helgeson, 1985:60-62).

The sales pitch aspect of the executive summary is an important one, even if the report was not prepared as a bid. Quite often papers are selected for publication or presentation on the basis of their abstracts (Hawes and Harkin, 1982:92) and organizational funding decisions are made based on the outcomes of previous research grants. "Used properly, the executive summary often proves to be the most important element in the proposal. At the least, it would be a serious error to underestimate its importance and so fail to utilize it effectively" (Holtz, 1990:223).

Helgeson states, "The executive summary should be dynamic, terse, and designed to capture and hold the interest of the nontechnical reader . . . . Keep it simple, direct, and to the point. Use words that have impact" (1985:60). The executive summary is the writer's opportunity to sell his or her report -- to describe the "devilishly clever, innovative solutions" (Helgeson, 1985:61) they have found to the problem addressed in the report. An executive summary should be a miniaturized version of the main report which highlights the main topics, it should not merely indicate that they are included in the report (Hawes and Harkin, 1982:92). The executive summary should not tantalize the reader with hints of what is to come or try to keep the reader in suspense:

> Get everything up front . . . . You are not writing a novel. This is not a treasure hunt. You have one chance here to influence the most important minds engaged in the selection process . . . This is the one part of the proposal these individuals are likely to read. (Helgeson, 1985:60-61)

Who Reads the Executive Summary?

The executive summary is often the only portion of the technical document read in its entirety because it provides a concise overview of the entire document: problem background, objectives, procedures, results, and discussion. It is a "vital part of the report; it will probably be read by more people than read the report itself" (Gould, 1963:168).

Because the executive summary is read by more people than actually read the full technical document it supports, the audience of an executive summary is assumed to be wider than that of the document itself. Included in the audience are many readers who may "lack a strong technical background in the subject, yet they make vital decisions based on the report" (Eisenberg, 1989:427). As Holtz points out, in many cases, it is impractical for executives to read the entire report. Executives will not normally read the main text of the report because they are not often in a position to appreciate and appraise the technical detail present in the body of the report. Even if the executives' background is of a technical nature, "it is an inappropriate and inefficient use of their time to read [it in its entirety] . . . . The typical executive needs only to get a general overview and thus a broad appreciation of [the report]" (Holtz, 1990:224).

One of the most important aspects of the executive summary is the fact that it is read by such a wide audience. "For it to have maximum effect, consideration must be given to who the readers will be, and how they are going to use it" (Hill, 1993:167).

> Most technical writing . . . requires effort on the part of the reader -- such is the nature of the complex information of engineering and applied science. But the way the writer casts the information can help, rather than hinder, the reader. The [executive summary] is one of the author's most useful aids to increase the readability of a technical document. (Eisenberg, 1989:357-358)

As Eisenberg (1989:427) points out, the executive summary "is one of the chief ways the writer has to adjust for audience background." The wide audience of an executive summary is composed of many individuals in different positions who have various specialties and levels of understanding. By understanding this fact, the executive summary may effectively be used to define and describe the more technical portions of the report it precedes. The executive summary is "admirably short and succinct" for peer audiences, but it can and should be broadened for the sake of the nonspecialist when the primary audience will not be peers (Eisenberg, 1989:364). The various audiences can all be addressed "not by finding the lowest common denominator, but by using language, arguments, and methodology that will appeal to each audience" (Hill, 1993:167).

How Does the Executive Summary Achieve Its Purpose?

The executive summary should be a stand-alone document; the reader should get a full understanding of the entire project, its highlights, and its conclusions and recommendations from reading just the executive summary. It should be more informative than descriptive. While a descriptive abstract only tells what the paper it precedes is about, the informative executive summary provides the most important points of the complete report (Hawes and Harkin, 1982:93).

How does the executive summary achieve its purpose of capturing audience attention and both summarizing and 'selling' the report? It does so by including very specific and important items from the report it precedes. The traditional parts of an executive summary are:

- a background of the problem;
- a short synopsis of all major strategies, methods, findings, and conclusions;
- a summary and orientation to the organization of the report.

Executive Summary Section One Contents. The first section of an executive summary gives a background of the problem under investigation. This section identifies the subject matter and presents a "concise orientation to the solicitation, the program, and the technology involved" (Hill, 1993:166-167). It also shows the purpose and scope of the report (Eisenberg, 1989:423; Gould, 1963:168-169).

Executive Summary Section Two Contents. The next section of an executive summary reviews briefly all of the topic sentences found in the body of the report. It incorporates the major strategies, methods, findings, and conclusions reached in the report. There is considerable agreement among the experts about exactly what goes in this section of the executive summary:

- Focus on the most critical or important aspect/s of your main strategy (Holtz, 1990:15)
- Stress various parts of the report: strategies, documents attached, topic sentences (Hill, 1993:169)
- Highlight and substantiate your proposal themes (Keller, 1994:512)
- Show the basic method and procedure followed in carrying out the project (Gould, 1963:169)
- Pick out the salient facts and especially any conclusions and recommendations (Gould, 1963:169)

These items are presented in paragraph form with related descriptive headings. In order to keep the executive summary uncluttered and easy to understand for its nontechnical readers, details are not directly addressed, but rather referred to by section or page number (Hill, 1993:169).

Executive Summary Section Three Contents. The final section of the executive summary contains a brief summary of findings and recommendations as well as an orientation to the organization of the report that follows. This section includes discussions of several important items:

- Conclusions and their implications (Eisenberg, 1989:374)
- Major strategies, features, and benefits to the customer (Hill, 1993:168-169)
- Benefits and proofs addressed in the report (Holtz, 1990:15)

This section is also the true road map to the rest of the report as it describes the report's organization. This description guides the reader to appropriate sections of the entire report should s/he desire more information on a specific strategy, method, finding, or conclusion mentioned in the executive summary.

Because the executive summary has the widest and often most influential audience of any section of the report, it is important to design the layout of the executive summary "to attract the eye as well as to present concise information" (Hill, 1993:169). Most experts agree that it should feature descriptive boldfaced headings, indentions, and bullets to enhance the main points. There should be sufficient white space to give the page an uncrowded look. It should also feature "illustrations which do a particularly good job of demonstrating your main points" (Hill, 1993:169). Any graphics included should be simple, attractive, and vertical in orientation so the reader does not have to strain to understand them.

> The summary should be more than words; it should be a visually appealing and readable document with a mix of text, graphics, and layout features -- none of which should be neglected. I suggest that at least half of the summary spaces should be committed to graphics. This will help you attract and hold the fleeting interest of a browsing reader. In contrast to text, graphics can allow you to explain complex ideas easily and help the reader more easily retain the key points. (Keller, 1994:513)

Final Word on the Executive Summary

An effective executive summary answers many questions that the reader may have about the report it precedes. It provides sufficient insight into the background of the problem to explain why it was deemed important enough to study. It addresses strategies, methods, findings, and conclusions reached in the report. It describes where further information may be found in the body or appendices of the report. It is also the writer's opportunity to capture the readers' attention, to arouse interest in the problem studied, and to sell the report that follows. All of these goals are achieved through careful attention to proper selection of items to highlight, to presenting those items in an aesthetically pleasing way, and to effective, concise, nontechnical wording of the executive summary in order to make its message understandable by the widest possible audience.

III. Hypermedia

As the previous section on paper copies of technical material explained, "readers seldom read from beginning to the end. They skim, they scan, they skip, they flip, they hop, they bounce. They jump all over the place " (Horton, 1994:101).

The reader of a business document typically starts with the executive summary and the table of contents. The reader . . .

> . . . scans down to find a heading of interest, flips to that heading in the text, reads a little, discovers it is too specific, flips back to the start of the chapter and begins skimming forward, gets frustrated, jumps to the index, looks up a subject . . . reads the text in detail, understands, and is satisfied. (Horton, 1994:101)

What if we could automate that flipping back and forth? What if the information we sought from a document on a computer would appear on the computer screen exactly when we needed it to further our understanding of the subject? That is just the vision originated by Mr. Vannevar Bush fifty years ago.

The History of Hypertext

In a 1945 Atlantic Monthly article called "As We May Think," President Roosevelt's director of the Office of Scientific Research and Development, Vannevar Bush, proposed a machine which would be "an enlarged intimate supplement" (Bush, 1945:107) to a person's memory. Mr. Bush's 'memory extender' (Memex) machine was based upon microfilm and photocells that would store all of an individual's books, records, and communications in an organized, mechanized manner "so that it may be consulted with exceeding speed and flexibility" (Bush, 1945:107). What Mr. Bush envisioned was a machine which would automatically jump from point-to-point in one's personal library of information allowing expedient cross-references between documents. "The basic idea . . . is a provision whereby any item may be caused at will to select immediately and automatically another . . . . The process of tying two items together is the important thing" (Bush, 1945:107). Although Mr. Bush's Memex machine was never built, he is traditionally given credit for the original idea of machine-supported linking of information (McLain, 1991:23; McMurry, 1990:9; Nielsen, 1990:29).

Recent Advances in Hypertext

While the conceptual basis for a system which links documents has obviously been around for some time, "the ability to manipulate texts with this technique occurred only recently" (Rubens, 1991:36). The recent revolution making computer systems smaller, more affordable, and more user-friendly has ushered in the beginnings of the realization of Mr. Bush's Memex vision. The modern method of linking two items together as Bush envisioned is through the use of *hypertext*.

Hypertext describes a computerized way of searching for items rather than stopping to use a paper index or table of contents. In a document using hypertext (often called a *hyperdocument)*, it is possible, for instance, to be reading along, find a word in the article you would like to know the definition of, indicate this to the system, and have the definition you sought appear onscreen. When you had finished with the definition, you would 'close' it and continue on with the original article. The entire process of searching for supplementary or related material is automated in a hyperdocument -- exactly as Bush described in 1945.

Nodes and Links in a Hyperdocument

When a hypertext document is displayed on a computer screen, certain words appear on the computer screen either in a different color from the surrounding text or they are underlined, as the words **browsing**, **authoring**, **node**, and **network** in Figures 1 and 2 which follow.

How Does Hypermedia Work?

HIERARCHIES: Structuring the nodes and links

The structure of a hypertext database is a major factor that determines how easy it is to create, use, and update. One way of organizing a hypertext database that simplifies browsing and authoring is a hierarchical structure.

In a hierarchy, each node has a parent (superordinate concept) and a child (subordinate concept) unless the node is a starting point (root) or an end point (leaf). A hypertext database organized as a hierarchy can be drawn as a tree structure with no cross-over links. A hypertext database that allows multiple links between parent and child nodes is not a strict hierarchy but a network.

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Figure 1 Hypertext Document, no link selected.

Adapted from Shneiderman & Kearsley (1989:disk)

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NETWORKS - Computers or workstations in communication with each other can share access to hypertext databases.

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Figure 2 Hypertext Document, 'network' link selected.
Adapted from Shneiderman & Kearsley (1989:disk)

The highlighted words in a hypertext document appear in places where users of the document are likely to want to pause and seek additional information. Rather than having to stop reading to search the index, footnotes, or table of contents for more information on a related subject, the reader merely selects the highlighted word and the information sought is brought up on the screen. This is possible because these words are 'linked' to other areas of the document forming what is called a *hyperlink* (often shortened to *link*).

Linking different parts of a hyperdocument is possible because the entire document is broken down into short topical segments called *nodes* which are connected by the hyperlinks associated with them. As can be seen in Figure 3, hypertext consists of many separate, linked pieces of text or other information.

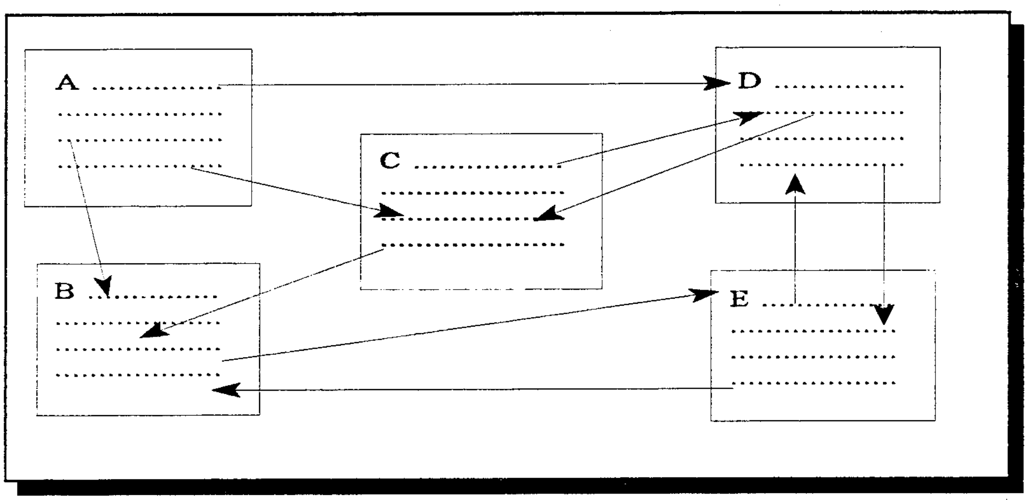

Figure 3 Nodes and Links — Adapted from Nielsen (1990:1)

In Figure 3, each box represents a node and each arrow represents a link. These segments, the nodes, can be computer screens of text, scrolling windows, files, or other bits of textual or non-textual information. Typically a node contains a single topic -- such as an entry in the document's glossary, a paragraph of text, or a table of information. Each node may have links to still more information -- such as a note explaining a table entry. "Some nodes are related to many others and will therefore have many links, while other nodes serve only as destinations for links but have no outgoing links of their own" (Nielsen, 1990:2). The number of links per node is normally not fixed in advance but will depend on the content of each node and how much additional information is likely to be referred to from it. The node containing the outgoing link is commonly called the *anchor node* while the node containing the information sought from the anchor node is called the *destination node*.

How Hypertext Differs from Traditional Text

The information in a hyperdocument is highly segmented and therefore different from traditional texts. The main difference is that the nodes can be read in a variety of different orders to better meet the needs of the individual reader.

One of the simplest way to define hypertext is to contrast it with traditional text:

> All traditional text, whether in printed form or in computer files, is *sequential*, meaning that there is a single linear sequence defining the order in which the text is to be read. First you read page one. Then you read page two. Then you read page three . . . . Hypertext is *nonsequential*; There is no single order that determines the sequence in which the text is to be read. (Nielsen, 1990:1)

Shneiderman & Kearsley (1989:3) claim that "The single most important concept in hypertext is the link." Links are the paths that connect one node -- whether it is a document, an article, or a separate topic -- to another. Each link is placed in the hyperdocument because it makes sense in terms of the semantic contents of the two nodes it connects (Nielsen, 1990:109). Hypertext links can be associated with just a portion of a destination node, or with an entire node (Nielsen, 1990:2), but they should always make sense. That is, they should lead to information the reader is likely to want to refer to *at that particular point in the anchor node*.

Figure 3 shows links as arrows. The base of each arrow represents the location in the anchor node where one finds a link. The head of the arrow represents the point in the destination node that would be brought to the screen when the link is activated. Within a hyperdocument, links are usually denoted by highlighting certain words or phrases to indicate that more information can be obtained about them by following the link to its destination. Though generally denoted by words, links can also be graphics or 'icons.' "For example, each component of a schematic diagram may be a link to a more detailed schematic of that component or a text description" (Shneiderman & Kearsley, 1989:4).

As you may have surmised, links are not unique to hypertext or other online documents. In his book, Designing and Writing Online Documentation, William Horton (1994:131) notes that hyperlinks are really just an automation of common notations such as:

- Page reference in the index, table of contents, list of figures, or list of tables
- Footnote references
- *See also . . .*
- *See* Figure XX
- Bibliographic references
- Hierarchy of headings
- Sidebars or secondary articles that appear on the same page or on a facing page as the main article
- Phrases like *as shown above* or *will be explained later*

Different information results from following each of the above textual notations to their destination. If you follow a footnote number to the footnote at the bottom of the page, you see different text than if you had followed a *'See also'* notation to the page it references. Just as different things happen when you follow traditional textual links, different things happen when you activate different hyperlinks.

A hyperlink is activated by various means including: double-clicking on the underlined words indicating the link (in Microsoft® Windows-based systems), selecting a highlighted letter (MS-DOS®-based systems), clicking on the icon indicating a link, or clicking on portions of a diagram annotated as containing links. When a link is thus activated, you have told the computer system that you would like to see the information contained in the destination node of that link.

Activating links can produce a variety of different results. For instance, they can:

- transfer you to a new topic
- show a reference (or go from a reference to a full article)
- provide ancillary information, such as a footnote, definition, or annotation
- display an illustration, schematic, photograph, or video sequence.
- display an index
- play a sound
- run another program (e.g., a spreadsheet or animation)

(from Shneiderman & Kearsley, 1989:3).

Once a link is selected, several things can happen. The destination node may:

- replace the original anchor node completely on the screen (such as when you jump to a new portion of the hyperdocument),
- appear as a small window over the anchor node (such as when the destination node is a definition of a term contained in the anchor node),
- play over the anchor node for the duration of its length and return you to the anchor node upon completion (such as a sound contained in a destination node -- you don't actually leave the anchor node while the sound is played).

For example, Figure 1 shows an anchor node with links underlined as they appear on the computer screen. When the link to the destination node indicated by the underlined word 'network' is selected, the definition of the word network appears as a small window over the bottom half of the anchor node, as seen in Figure 2.

The intent of hypertext links is to provide readers with a means to quickly gather more information on a topic of interest to them individually. As Grice, Ridgeway, and See (1991:49) point out, links are not meant to "force movement through a series of pieces of information which, although separate, were intended to be used linearly." For instance, if the author of a particular text split that text into nodes but allowed only one path through the material, the resulting document would not be a hyperdocument in the true sense of the word. It would merely be a computerized file with pauses before each 'page' was turned. True hyperdocuments present *several different paths* to the reader through the use of various hyperlinks . . . "and the *individual* reader determines which of them to follow *at the time* of reading the text" (Nielsen, 1990:1-2). Only when the users interactively take control of a set of dynamic links among units of information does a system get to be hypertext (Nielsen, 1990:3; Shneiderman & Kearsley, 1989:3).

The Network Nature of Hyperdocuments

" . . . the entire hypertext structure forms a network of nodes and links" (Nielsen, 1990:2). When properly constructed, a hyperdocument is a veritable web of information which is traversed by following hyperlinks from point-to-point in the nodes. The structure of the web is determined by how the author configures the nodes and their interconnections through the creation of links. This configuration is what determines the paths available to the reader -- that is, which nodes they can reach from any given point. As Shneiderman & Kearsley (1989:49) point out, the problem of getting around a hyperdocument is fundamental to the design of hypertext systems. If the reader cannot locate the information s/he needs, then the system does not meet its goals.

Readers move about the web of nodes and links in a hyperdocument in an activity that is often referred to as "browsing or navigating, rather than just 'reading,' to emphasize that users must actively determine the order in which they read the nodes" (Nielsen, 1990:2). Also, note that it is common to refer to the 'reader' of a hyperdocument as the 'user' to further indicate active participation. Generally there are several ways built into a hyperdocument to assist users in navigating their way to the information they desire. Several of these methods are cited by Shneiderman & Kearsley (1989:10-13) in their book Hypertext Hands On! (paraphrased):

- Browsing is a fundamental technique in which the reader selects links and follows paths of interest from document to document. It is a relatively unstructured retrieval method and is a valuable way to become familiar with a document.
- An automated 'tour' may be constructed by the author when a document is large or there are a number of key nodes which the author feels readers should visit. A tour is typically a separate program that users start which then shows an animation of how to move around in the hyperdocument. Often the tour will highlight certain areas the author feels are worth visiting.
- An index may be used to locate a specific node. Several forms of indices are in general use; some are organized by title, others are topic-oriented.
- Searching techniques are used when the reader wants to locate nodes which have a specific characteristic. This characteristic may be based on keyword descriptors or the content of the node may actually be searched for specific

words or phrases. Once phrases are located, the user is given the option of 'jumping' to the node or nodes which contain them.

Path histories and bookmarks are two other common features of hypertext systems which help keep users oriented as they traverse the web of nodes making up the hyperdocument. When users follow various links around a hypertext network, they often have need to return to some previously-visited node. Most hypertext systems support this by keeping a running list of the order in which the current user has activated links (a 'path history') or by allowing the user to mark a certain nodes as ones they wish to return to (that is, to 'bookmark' them).

A system which 'remembers' the order of link activation by keeping a path history in its memory often allows revisits to sites along that path with what is known as a 'backtrack facility.' Looking again at Figure 3, suppose a user started at Node A, then jumped to Node C, then Node B, then Node E, and finally to Node D. Now suppose the user would like to move from Node D back to Node B to double check some information they had read there. You can see that there is no direct link back to Node B from Node D, but since the user was there once, s/he can use the backtrack facility to 'backtrack' through the links traversed to arrive at Node B. By telling the system to backtrack, the user will see the pages representing Nodes D, E, and finally B, in that order. Notice that the backtrack facility follows the links chosen by the user *in reverse order*. In this case, the forward path through the document was: A > C > B > E > D and the backward path would be D > E > B > C > A. "This example show that backtracking is just as dependent on the individual user's movement as is the order in which the nodes were visited in the first place" (Nielsen, 1990:3). Another user might take an entirely different path through the nodes and thus would have a different path history.[1]

Bookmarking works in a similar manner, but does not require the user to traverse an entire path to an embedded node once it has been bookmarked. Instead, users can jump directly to the previously bookmarked node once they have re-opened the hyperdocument. This feature is especially useful for quick referencing of nodes which can normally only be accessed by traversing a particularly long path.

Along with browsing, tours, indexing, and searching, backtracking and bookmarking are quite common in modern-day hyperdocuments. It is not unusual to find most, if not all, of these features in the same document -- a phenomenon that attests to the general belief that hyperdocuments are meant to give users expedient access to the information they seek.

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[1] It is interesting to note that in his 1945 "As We May Think" article, Bush accurately describes what we now call backtracking: "When numerous items have been thus joined together to form a trail, they can be reviewed in turn, rapidly or slowly" (107). He also correctly predicts that hypermedia will change the way information is presented when he states: "Wholly new forms of encyclopedias will appear, ready-made with a mesh of associative trails running through them" (108).

Hypermedia

I have alluded thus far to the fact that nodes need not contain only textual matter. In fact, it is becoming increasingly common to include things like animations, photos, charts, graphs, sounds, and video clips. This is more common than in the past because of recent dramatic increases in computing speeds and quality at lower costs to consumers: "With the advent of higher resolution screens (displays larger than 640 x 480 pixels) and more powerful microprocessors, it has become possible to improve vastly the display capabilities of computers" (Shneiderman & Kearsley, 1989:67).

The definition of the traditional term "hypertext" now implies a system that deals only with plain text at each node. Since many of the current systems actually include the possibility for working with a variety of media, the term "hypermedia" has been introduced to convey the fact that nodes contain more than just text (Grice and Ridgeway, 1993:429; Nielsen, 1990:5).

Animation, the capability to show short motion sequences which are drawn, not filmed in live motion, is becoming increasingly common in hypermedia documents. There are many hypermedia applications where it is desirable to show dynamic events through the use of animation -- often because the event is easier to demonstrate than to describe, because it is hypothetical, or because it is difficult to film using traditional methods. Examples include: equipment operation, biological processes, and repair procedures (Shneiderman & Kearsley, 1989:67).

Benefits of Hypermedia

The use of hypermedia benefits both the author of the technical material being presented and the user in search of information. The question of who benefits more from effective hypermedia is a difficult one to answer -- the capability of the author to better express his/her message is obviously entwined with the advantage gained by the user who is better able to understand that message.

The author's purpose in technical communication, be it verbal, written, or graphical, is to persuade his/her audience to take an intended action. Technical communication is judged effective only if all of the audience takes the same, specified action. "The burden of effectively communicating this message lies squarely on the shoulders of the author" (Muller, 1994). In order to more effectively meet their audience's demand for quick, easy-to-access, in-depth, accurate information, authors are turning to hypermedia to help them convey their messages. As Hammond and Shipley state: "Technology and science rely on understanding by audiences whose learning modalities and existing knowledge are diverse" (1994:304). By using hypermedia to convey information, the author now has a better chance of picking and incorporating into his/her document the ideal item to trigger the primary learning modality for a particular audience member. The author can incorporate sound, video, animation, color -- "there are many elements critical to scientific information (such as color or motion) that are difficult or impossible to incorporate into a printed piece, but that have important considerations for learning and communication" (Hammond and Shipley, 1994:304).

Another benefit of hypermedia is that it allows the user to linger over particular portions of the electronic text. Hyperlinks "allow us to enrich our understanding of small sections of text in the context of the whole" (Pepping, 1994:5). Hypermedia theorists argue that the non-sequential and multi-medial presentation of information found in hypermedia documents better simulates 'natural' communication. It is more natural than is possible using print alone. The electronic links seem to simulate the links of the human brain where one leaps on demand from one point to another related point (Wickliff, 1993:410). This emulation of the human brain is indeed what lies behind Vannevar Bush's vision -- his machine, you will recall, was to be a 'memory extender.'

As Wickliff points out:

> Hypermedia makes it theoretically possible to connect all the world's recorded knowledge in a vast network of electronic libraries. From this vast library, users could construct texts as inclusions from other digitized texts, including paintings, music, films, and books. In such a network, remote users would have the same access as the more geographically centered users of materials. (1993:411)

By allowing such vast connections, it becomes possible for an individual to access a tremendous amount of information. In fact, some hypertext visionaries, such as Vannevar Bush and Ted Nelson, have envisioned 'universal databases' in which everything is connected to everything else. Ted Nelson has proposed a "docuverse" in his project Xanadu which would "make accessible all documents ever written" (Horton, 1994:2). Each document in the docuverse would be linked to all possible reference and related sources (Horton, 1994:2; Shneiderman & Kearsley, 1989:3, 78).

A final very important benefit of hypermedia is its potential to save great amounts of money in certain applications. Hyperdocuments are not published as traditional documents; that is, they are not printed on paper and distributed. Usually, they are retained as an online file which is either stored at the user's local computer or accessed remotely by the user from his or her local computer. One of the primary means of hyperdocument storage is the laser optical compact disk (called CDs or CD-ROMs) because hyperdocuments tend to be very large and require a fast-access digital storage method. CDs are 4.75 inches in diameter and typically hold approximately 600 megabytes of information -- the equivalent of about 150,000 typed pages. All information stored on a CD is in digital format, including text, photo, audio, and video. "Because CDs are read by a laser beam and involve no mechanical contact, they should never wear out, regardless of the number of accesses made" (Shneiderman & Kearsley, 1989:15). As

Nielsen explains in Hypertext & Hypermedia (1990:14): "The documentation for an F-18 fighter aircraft . . . requires 68 cubic feet of storage space when printed on paper. This statistic should be compared with the 0.04 cubic feet the same information takes when stored on a CD-ROM."

Not only does publishing to CD save money on storage space, it also saves on the cost and difficulty of updating that information post-publication:

> The 300,000 pages of F-18 documentation is not a fixed set of information but changes constantly. Imagine the mailing costs involved in shipping updates to Air Force bases around the world by classified courier service. . . Instead one can just press a new CD-ROM and tell people to destroy the old one. (Nielsen, 1990:14)

Drawbacks of Hypermedia

Along with the benefits of hypermedia, there are some drawbacks which have been noted in the literature. In Designing and Writing Online Documentation (1994:11), Horton points out that it is often not as easy to read an online document. Documents which require careful reading of long passages of text tend to slow readers down when transferred to hypertext -- the reading tends to be less accurate and cause more eyestrain. Horton relates that about once each week he gets a phone call from someone "wanting to know the one scientific study or definitive project that proves online documentation is better than paper documentation. Some want the opposite" (1994:11). He goes on to list nine studies 'proving' paper documents are better than online hyperdocuments and twelve studies 'proving' that online documents are better than their paper counterparts. As he states:

> The only thing these studies really prove is this: Good online documentation is better than poor paper documentation and good paper documentation is better than poor online documentation. Online documentation does not guarantee success or failure. Only good design guarantees success. (1994:15)

A second drawback of online documentation is that it is not always available. Until high-end compact or 'laptop' computers have the features of today's personal computers at a less expensive price, online documentation will not be portable. To use it, you must now have access to a computer. This is not always the case, and it is certainly a drawback when one wants to refer to documentation at a field site, for example.

A final drawback of hypermedia is that people prefer the familiar to the unfamiliar; we prefer concrete objects to abstract concepts. As Horton notes, "Books are solid and tangible and familiar . . . . Acceptance of online documentation will not be instantaneous or unanimous" (1994:11). This is slowly changing, however, as people begin to see the benefits they can reap from using new technologies such as hypermedia. Young people today are getting earlier and earlier introductions to computers . . . . "To the generation that has grown up with television and microcomputers, the evolution toward hypermedia must seem a very natural and expected one" (Wickliff, 1993:410).

Final Word on Hypermedia

Despite its few drawbacks, hypermedia is here and now, and it brings with it many advantages. In conclusion this chapter on hypermedia, I present a review of some of hypermedia's major benefits (in no particular order):

- Links related facts
- Conserves resources
- Saves storage space
- Supports products better
- Reduces publication costs
- Unifies sets of related documents
- Provides instant access to information
- Archives precious documents securely
- Allows authors to better convey their messages
- Enables users to explore areas of personal interest in documents
- Integrates documentation and development of products
- Allows authors to publish rapidly (bypasses printing; can be distributed and updated electronically)
- Has the ability to overcome user disabilities (hypertext systems often provide the abilities to: magnify text, use speech synthesizers to read, color shift for color blindness, turn pages; and adjust style, pace, and order of instructions for the learning disabled)

IV. Analysis of a Wright Laboratory Executive Summary

Before converting a technical document into a hyperdocument, it is important to ensure one has a well-written executive summary. The section of this thesis describing executive summaries noted that the executive summary is often the only portion of the technical document read in its entirety because it provides a concise overview of the entire report including problem background, objectives, procedures, results, and discussion.

It is especially important to have a well-written executive summary when a technical document is to be converted into a hyperdocument. Recall that hyperdocuments, by definition, are designed to be read non-sequentially. The only portion of a hyperdocument the author can ensure users will see is the anchor node appearing on the initial few screens, that is, the hyperdocument section that correlates to a paper document's executive summary.

The executive summary will become the frontispiece of the entire hyperdocument -- not only will it be the first thing seen, but it will be the initial jumping-off point for all other areas of the document. Thus, it is crucial that the executive summary be well-structured and contain the initial hyperlinks for every major path through the hyperdocument. All major areas of the rest of the hyperdocument must be indicated up front if the user is to be aware of their existence -- remember, there is no flipping through the pages of a hyperdocument to scan for what it contains. As Helgeson reminds: "Get everything up front . . . This is not a treasure hunt" (1985:60-61). The user will make decisions on whether this hyperdocument is likely to contain valuable information based on what s/he sees in the first few screens, that is, what is contained in the executive summary.

In this chapter, I compare the executive summary from Pilot's Associate Displays/Controls, Final Report for Period 10/01/90-12/31/92 (Arback and others, 1992) to those characteristics of a well-written executive summary described in the first chapter of this thesis (the full executive summary may be found uncut at Appendix A). I also point out areas where deficiencies in the paper executive summary may cause problems in the ultimate conversion of this report to a hyperdocument. The Pilot's Associate Displays/Controls, Final Report for Period 10/01/90-12/31/92 (hereafter called PADC) was written for the Flight Dynamics Directorate at Wright Laboratory (WL) and is representative of the kinds of technical documents WL is considering converting to hyperdocuments.

Executive Summary Section One

According to the experts, the first section of an executive summary should give a complete description of "what was done, and why; what the results were; and why they matter" (Eisenberg, 1989:427). It should identify the subject matter and present a "concise orientation to the solicitation, the program, and the technology involved" (Hill, 1993:166-167). In this section of the executive summary, therefore, we are looking for:

- Explanation of Project
- Why Project Was Undertaken
- Technology Involved in Project
- Discussion of Results
- Why Results Are Important

Figure 4 shows the first two paragraphs of the PADC executive summary.

To say that design properly begins with the human operator is a simple truism. References to crew-centered designed❖ have become commonplace. Our ability to design for the human operator at the physical level is relatively advanced. There is an extensive data base from which to determine,❖ brightness, resolutions, vibration tolerance, lifting strength, keyboard heights, etc. Furthermore, traditional design methods serve us relatively well for these kinds of problems. While tradeoffs among desirable goals and accommodation to design constraints may be difficult, methods and data are available that allow human factors professionals to identify the ideals and limitations early in the process, when asked to do so.

Conditions are less sanguine when we come to design of the information interface for the human operator. Here we are concerned with the style, timing and context of information presentation, presuming the information content to be identified. To illustrate, if it is known that the cup is 50% full, how are we to decide whether to communicate that it is half full or half empty, or whether to draw a picture, write a sentence or utter a phrase? Is it better to make this information available now, withhold it for a more opportune time, or demand operator attention immediately? Should this information be presented in isolation, or in context with other information? If in context, what context and how should it be presented? Having decided these issues we must determine what picture to draw, what words to use. Brightness, loudness, colors, sizes, we can identify once the medium is known.

Figure 4 Paragraphs One and Two of PADC Project Final Report (1992:1)

❖ This symbol denotes typographical or other errors I noted in the original PADC executive summary. It is important to realize that while such errors may be distracting in a report's paper version, they can be much more detrimental in a hypertext version. In a hyperdocument, the reader has much less surrounding text to use while attempting to derive the actual intended meaning of the flawed text. Additionally, if the error occurs in a phrase that is to be used as a hyperlink, the value of the entire link may be negated if the error causes the text to be misleading.

These first two executive summary paragraphs provide a good explanation of why the Pilot's Associate (PA) Displays/Controls project was undertaken: "we are concerned with the style, timing and context of information presentation." The authors also describe numerous problems to be overcome in the process of conveying information:

- what exactly should be communicated?
- how should the information best be conveyed (graphically, written, or spoken)?
- which methods should be used within the chosen medium?
- should the information be presented immediately or withheld?
- should information be presented alone or in context with other information?
- if presented in context, which information should be combined?

The reason for the researchers' concerns are explained later in the executive summary when we find they are dealing with information presented in a cockpit environment where immediate interruption of the pilot is not always practical or prudent. From this section of the executive summary, we learn that the PADC project looked at how to interrupt pilots, when, and with what information in addition to examining the best medium and methods of information presentation.

Continuing on with Figure 5, we come to a more specific explanation of their project located in paragraph three, early in the executive summary as the experts suggest it should be:

```
The objective of the Pilot's  Associate Displays and Con-
trols (PADC) program was to apply what is known about cog-
nitive psychology, human factors, and design techniques to
design of the information interface for the pilot of a PA-
equipped multi-mission fighter.  The PADC Program developed
and applied innovative methods to drive design of tactical
cockpit display and control methods.  The 28-month, six-
task, program  . . . was structured rigorously to assure
the information interface is developed from the user out-
ward.
```

Figure 5 Paragraph Three of PADC Project Final Report (1992:1)

The third paragraph describes the specific objectives of the PADC program and tells us how long it lasted (28 months), what its major phases were (six tasks which are discussed in detail later), what it achieved ("developed and applied innovative methods to drive design of tactical cockpit display and control methods"), and what its major goal was ("to assure the information interface is developed from the user outward"). Although the authors do not tell us specifically what methods were used in their research, they indicate that they were "innovative" -- a phrase which would likely become the anchor for hyperlinks to more detailed methodology nodes.

To conclude the analysis of the initial portion of the PADC executive summary, I will briefly sum up how well the authors achieved each of the experts' requirements for section one of an executive summary:

Explanation of Project. The authors did a good job of explaining the goals and organization of the PADC project. The original report contains a diagram (adapted below in Figure 6) which expands on the written project explanation. The authors are to be commended for keeping the project explanation non-technical enough to be understood by most readers.

Why Project Was Undertaken. The authors provide an excellent, easy-to-understand description of why the project was undertaken when they describe the difficulties of information communication.

Technology Involved in Project. The authors only hint at the technology involved by saying it involved "innovative techniques." This section of the executive summary deserves more attention. Users specifically interested in methodology should be able to depart directly from this section of the hyperdocument to explore more fully the technologies used and/or developed by this project. The necessary anchor phrases for such an exploration are missing from this section and thus it would not convert well as-is to a hyperdocument.

Discussion of Results. The authors have not yet stated whether they were successful in achieving the goals of the PADC project. This requirement is somewhat met later in the executive summary when they describe the outcomes of each Task.

Why Results Are Important. The authors do a very good job of convincing the reader of the importance of their project when they explain the difficulties of conveying information, especially in a cockpit environment.

According to the experts' opinions of an executive summary, the PADC document is doing very well to this point with the exception of the 'technology involved' requirement. Next, I will continue with the requirements of the second section of a well-written executive summary.

Executive Summary Section Two

The next section of an executive summary should review briefly all of the topic sentences found in the body of the report. It should incorporate the major strategies, methods, findings, and conclusions reached in the report. Thus we would expect to find each of the following in this section:

- Review of Report's Topic Sentences
- Major Strategies
- Major Methods
- Major Findings
- Conclusions

The PADC report is broken down into seven sections: one for the executive summary and six which correspond to the six tasks of the PADC project. Those tasks, listed in Figure 6, were:

```
Task I:   Determine what is needed to LOOK-KNOW-ACT
Task II:  Interface engineered to meet pilot needs,
limits, capabilities
Task III: MCAIR prototype refinement methods produce
final configurations readily ported to full simulation
Task IV:  Select and integrate pilot/PA dialog
Task V:   Evaluate pilot/PA dialog
Task VI:  Documentation includes detailed rationale
derived throughout program
```

Figure 6 PADC Program Structure Tasks

Adapted from Arback and others (1992:2)

Logically, we would expect to find each of these tasks mentioned in the executive summary along with the major strategies, methods, findings and conclusions of each task. Figure 7 shows paragraphs four through six of the PADC executive summary.

Beginning in Task I with an understanding of the information needs of the pilot of a multi-role fighter, and a definition of a full Pilot's Associate capability, the program used several design issue descriptions as a vehicle to convey Task I and results into Task II. The principle❖ role of Task II was to apply fundamental principles of cognitive psychology and human factors to design issues described in Task I. New methods were required and developed to carry out the design process without introducing the technology constraints. Task II culminated in ideal descriptions of controls and displays based on the fusion of partitioned information requirements and design principles.

Task III developed display and control concepts from the ideal descriptions. A part-task study demonstrated success in designing an intuitive display, traceable to principles of human factors and cognitive psychology.

In Tasks 4❖ and 5❖, the PADC program designed, developed and evaluated display/control methods for pilot/PA communication in a flight simulator. The capability of an automated PA system was emulated using experienced fighter pilots with two-way voice communication with the pilot, interface and flight controls, and prepared messages and display formats designed for a specific scenario and dialogue. Seven pilots took part in the simulator evaluation. Each pilot completed a demanding air-to-ground strike mission against multiple targets, overcoming a SAM hit, consequent fuel leak and generator failure, and in flight retargetting to do so. Documentation, including a Human Engineering Design Approach Document describing the display and control methods employed and this Final Report, was prepared in Task 6❖.

Figure 7 Paragraphs Four through Six of PADC Project Final Report (1992:1-2)

In paragraphs four through six of the PADC Project Final Report, the authors are very clear about mentioning the major end-product of each Task. They describe the end-product of each Task as the input to the following Task, with the final output of Task VI being the documentation "including a Human Engineering Design Approach Document . . . and this Final Report" (para. six). These mentions of end-products can be seen as filling the requirement to discuss findings in the executive summary. Their conclusions are clearly stated in paragraph seven as a list of eight "guidelines for the design of a pilot/PA interface" as shown in Figure 8.

Summary --The following guidelines for the design of a pilot/PA interface were developed through the combined design and evaluation efforts of the PADC program.

1. The Pilot's Associate should be an electronic, computerized backseater that can assist the pilot in mission performance.

2. PA should not act on its own or without pilot consent, but it can, for example, make recommendations to the pilot based on mission events, take logical steps to execute a tactic once it has been determined, or interpret pilot commands to manage the display interface.

3. PA can be an intelligent autopilot, able to fly a selected route, altitude or maneuver.

4. Faced with a difficult mission pilots will cede aircraft control to PA, in order to retain the mission management role and maintain their situation awareness.

5. To maintain situation awareness, the pilot must keep his head up, looking out of the cockpit, as much as possible. PA information presented on head down displays does not substitute for staying head up. PA information displays should complement the pilot's desire to stay head up, rather than interfere with it.

6. Therefore controls and displays that can be used with the head up are to be preferred. Pilots indicated a preference for voice for both control and information presentation. Simple pictures that could be processed with a minimum of head-down time were also considered acceptable.

7. A quick, easy, intuitive method for selecting displays for presentation or removal is a necessity in a PA interface with a high rate of information exchange.

8. PA needs some of the capabilities taken for granted in human dialogue. These include a capability to interpret ambiguous communications from the pilot and respond unambiguously. For example, when the pilot asks PA to ▒Say range,▒ PA should respond ▒Range to bandits 40 miles.▒ Similarly, PA must be able to realize a miscommunication has occurred and act to correct it.

Figure 8 Paragraph Seven of PADC Project Final Report (1992:2-3)

Although clear about discussing findings in the executive summary, the authors are rather vague in fulfilling the requirements to discuss major strategies and methods employed during the project. Rather than specific mention of employed strategies and methods, the authors use ambiguous phrases such as:

- "the program used several design issue descriptions as a vehicle" (para. four)
- "The principle role . . . was to apply fundamental principles of cognitive psychology and human factors . . ." (para. four)
- " New methods were required and developed . . ." (para. four)
- "Task III developed display and control concepts from the ideal descriptions" (para. five)
- "the PADC program designed, developed and evaluated display/control methods . ." (para. six)

Paragraph six does, however, provide one shining example of how methodology for each of these tasks should have been described. We get a very clear picture of how Task V was conducted from this sentence:

> The capability of an automated PA system was emulated using experienced fighter pilots with two-way voice communication with the pilot, interface and flight controls, and prepared messages and display formats designed for a specific scenario and dialogue (para. six).

It is very important that strategies, methods, findings, and conclusions be mentioned in the executive summary, especially if it is to become a hyperdocument. As currently written, the user is not able to find information about specific strategies employed, for example, without having to delve beneath the surface of the executive summary into each individual task. A more thorough executive summary would state up-front those strategies and methods used during the project, thus forming excellent anchor nodes for a user specifically wanting to explore methodology.

Before moving on to the final section of a well-written executive summary, I will briefly sum up how the second section of the PADC executive summary compares to the experts' ideal.

Review of Report's Topic Sentences. Because the PADC report is organized into sections that correspond to the PADC Tasks, the authors have met this requirement by mentioning each task in their executive summary. I suggest that each task be given its own paragraph in the executive summaries of future reports. This would allow each of the following areas to be mentioned in sufficient depth:

- Major Strategies
- Major Methods
- Major Findings

Major Strategies, Major Methods, Major Findings. As written, none of these three areas are covered in enough depth to be successfully converted into useful hyperdocument initial links.

Conclusions. The authors have very nicely summed up the eight guidelines for design that came out of this 28-month project in their final summary section. If this executive summary were actually being converted into a hyperdocument, each guideline could quite easily be linked to deeper nodes within the report which more fully explain how it was reached.

Executive Summary Section Three

The final section of the executive summary, according to the experts, should contain:

- Conclusions and Their Implications
- Orientation to the Organization of the Report

The PADC executive summary includes conclusions in the form of the eight guidelines discussed above. The authors do not, however, discuss the implications if the guidelines are not followed. While this may not sufficiently meet the requirements for the experts' paper executive summary, it does suffice to introduce the user to the idea that guidelines were developed. If this document were converted to a hyperdocument, one would expect to find links from each guideline to in-depth discussions of how it was arrived at, as well as the limits and implications of each that were found by the researchers.

The authors do not give any indication as to the organization of the report, but rather rely on the table of contents to convey this information. When dealing with a hyperdocument, this last requirement of a paper executive summary becomes less important *assuming one includes all of the other aspects of a well-written executive summary.* The user of a hyperdocument is not generally aware of the web-like structure of the nodes used throughout the document. Rather, s/he expects the links to be sufficiently well-designed to lead to the exact information sought. If the requirement has been met to include a complete description of what was done and why, the major strategies, methods, findings, and conclusions and why they matter, then all of the necessary anchor nodes will be in place to provide the user a solid surface from which to explore the rest of the hyperdocument.

Thus, I conclude that the final two requirements of an executive summary:

- Conclusions and Their Implications
- Orientation to the Organization of the Report

were not met sufficiently by the authors. While this is a rather large departure from the experts' opinions of what makes a well-written executive summary, it is not such a drawback when one is converting an executive summary into a hyperdocument. If all other areas have been fully introduced in the hyperdocument's executive summary, these two requirements should be transparent to the user who will find the information as they explore the rest of the hyperdocument.

Concluding Comments on the Analysis of a WL Executive Summary

The analysis in this chapter looked carefully at the three sections of the executive summary from Pilot's Associate Displays/Controls, Final Report for Period 10/01/90-12/31/92 (Arback and others, 1992). I have compared the PADC executive summary to those characteristics of a well-written executive summary described in the second chapter of this thesis and have pointed out areas where deficiencies in the paper executive summary may cause problems in the ultimate conversion of this report to a hyperdocument.

This analysis has highlighted some of the weak points found in this executive summary, such as a failure to adequately discuss these required items:

- Major Strategies
- Major Methods
- Major Findings

But also, it has pointed out the strong areas of this executive summary, such as the authors' discussions of:

- Explanation of Project
- Why Project Was Undertaken
- Technology Involved in Project
- Discussion of Results
- Why Results Are Important
- Review of Report's Topic Sentences
- Conclusions

And finally, it compares demands of a traditional paper executive summary to those of a hyperdocument executive summary and notes that two areas,

- Conclusions and Their Implications
- Orientation to the Organization of the Report

are not as critical to include when one is considering conversion of a technical report to a hyperdocument.

V. Conclusions and Recommendations

Chapter Four of this thesis contains an in-depth analysis of a representative executive summary from a Wright Laboratory (WL) technical document. During that analysis, I pointed out several executive summary weaknesses and strong points, as well as areas to be further developed before conversion to an online hyperdocument format. I concluded that the PADC executive summary is very close to the experts' ideal and, as such, could become a solid hyperdocument frontispiece with minimal re-writing.

Where To Go From Here

Before converting any technical document to a hyperdocument, the paper executive summary of the report under consideration must be carefully examined. It should contain each of the following:

- Explanation of Project
- Why Project Was Undertaken
- Technology Involved in Project
- Discussion of Results
- Why Results Are Important
- Review of Report's Topic Sentences
- Major Strategies
- Major Methods
- Major Findings
- Conclusions Reached During Project and Their Implications

If any of these required areas are missing, the executive summary should be re-written to include them in order to make the future hyperdocument more useful. In the PADC executive summary analyzed in this thesis, more attention needs to be paid to the strategies, methods, findings and implications of conclusions areas. Once these areas are included the paper document becomes an effective platform for the hyperdocument: all of the phrases which will become hyperlinks to major paths through the hyperdocument will be in place and users will be able to access any needed information from the body of the report.

Suggestions For Further Research

Much still remains to be researched on technical documentation, hypermedia -- and especially on the combining of the two.

This thesis addresses only a small portion of a technical document -- the executive summary. Before converting any technical document into a hyperdocument, similar research should be done into the remaining sections of a paper technical document. Questions which should be addressed include: What are the primary purposes of each tecnical document section? Who are their audiences? How do they achieve their purposes?

In addition, research needs to be done on the effectiveness of the various methods of comunication used in a typical hypermedia document. Before choosing which to use, authors should have a better idea of which medium will most efficiently convey their intended message to any particular user. Some questions to be considered: Does a sound clip describing an action work better than an animation? Is a diagram hyperlinked to notes more effective than a static one -- or is it better to have the notes always visible alongside the diagram? Does using multimedia actually improve message transmission -- or should authors stick with plain hypertext and avoid the 'distractions' of sounds and moving pictures.

Another area to be looked into is the writing process associated with technical documents. Because hypermedia is relatively new, technical communicators rarely write directly for publication in hyperdocuments. Is that still the most effective way to write -- or is it old-fashioned in the new computer age? Are technical communicators creating more work for themselves by writing first for paper and later transferring their documents to online formats? Should technical communicators be learning the unique requirements of hyperdocument authorship? And what are those unique requirements?

A final area to be researched concerns the transfer of paper technical documents to hyperdocument formats. Paper technical documents still abound in today's technical workplace. Research needs to be done on whether it is worthwhile to attempt to transfer to computer existing documents written specifically for publication on paper. As this thesis has noted, hyperdocuments are *fundamentally different from paper documents on many levels* -- especially in their non-sequential nature. Should we even spend time transferring old, but often-referenced, paper documents to online formats? If we decide to do so, what is the best way to realize that transition?

As the above questions show, this thesis has only skimmed the surface of a large body of research questions relating to technical documents, hypermedia, and particularly the marriage of the two.

Appendix A: Sample Wright Laboratory Executive Summary

Introduction and Summary section (pages 1 - 3) from: Pilot's Associate Displays/Controls, Final Report for Period 10/01/90-12/31/92 [WL-TR-93-3001]. Flight Dynamics Directorate, Wright Laboratories, Air Force Materiel Command, Wright-Patterson AFB Ohio 45433-6553. By Christopher J. Arback, Barbara J. Barnett, Richard W. Lynch, and John L. Olson.

Introduction and Summary

To say that design properly begins with the human operator is a simple truism. References to crew-centered designed have become commonplace. Our ability to design for the human operator at the physical level is relatively advanced. There is an extensive data base from which to determine, brightness, resolutions, vibration tolerance, lifting strength, keyboard heights, etc. Furthermore, traditional design methods serve us relatively well for these kinds of problems. While tradeoffs among desirable goals and accommodation to design constraints may be difficult, methods and data are available that allow human factors professionals to identify the ideals and limitations early in the process, when asked to do so.

Conditions are less sanguine when we come to design of the information interface for the human operator. Here we are concerned with the style, timing and context of information presentation, presuming the information content to be identified. To illustrate, if it is known that the cup is 50% full, how are we to decide whether to communicate that it is half full or half empty, or whether to draw a picture, write a sentence or utter a phrase? Is it better to make this information available now, withhold it for a more opportune time, or demand operator attention immediately? Should this information be presented in isolation, or in context with other information? If in context, what context and how should it be presented? Having decided these issues we must determine what picture to draw, what words to use. Brightness, loudness, colors, sizes, we can identify those once the medium is known.

The objective of the Pilot's Associate Displays and Controls (PADC) program was to apply what is known about cognitive psychology, human factors, and design techniques to design of the information interface for the pilot of a PA-equipped multi-mission fighter. The PADC Program developed and applied innovative methods to drive design of tactical cockpit display and control methods. The 28-month, six-task, program illustrated in Figure 1-1 was structured rigorously to assure the information interface is developed from the user outward.

Beginning in Task I with an understanding of the information needs of the pilot of a multi-role fighter, and a definition of a full Pilot's Associate capability, the program used several design issue descriptions as a vehicle to convey Task I and results into Task II. The principle role of Task II was to apply fundamental principles of cognitive psychology and human factors to design issues described in Task I. New methods were required and developed to carry out the design process without introducing the technology constraints. Task II culminated in ideal descriptions of controls and displays based on the fusion of partitioned information requirements and design principles.

Task III developed display and control concepts from the ideal descriptions. A part-task study demonstrated success in designing an intuitive display, traceable to principles of human factors and cognitive psychology.

In Tasks 4 and 5, the PADC program designed, developed and evaluated display/control methods for pilot/PA communication in a flight simulator. The capability of an automated PA system was emulated using experienced fighter pilots with two-way voice communication with the pilot, interface and flight controls, and prepared messages and display formats designed for a specific scenario and dialogue. Seven pilots took part in the simulator evaluation. Each pilot completed a demanding air-to-ground strike mission against multiple targets, overcoming a SAM hit, consequent fuel leak and generator failure, and in flight retargetting to do so. Documentation, including a Human Engineering Design Approach Document describing the display and control methods employed and this Final Report, was prepared in Task 6.

Summary. The following guidelines for the design of a pilot/PA interface were developed through the combined design and evaluation efforts of the PADC program.

1. The Pilot's Associate should be an electronic, computerized backseater that can assist the pilot in mission performance.

2. PA should not act on its own or without pilot consent, but it can, for example, make recommendations to the pilot based on mission events, take logical steps to execute a tactic once it has been determined, or interpret pilot commands to manage the display interface.

3. PA can be an intelligent autopilot, able to fly a selected route, altitude or maneuver.

4. Faced with a difficult mission pilots will cede aircraft control to PA, in order to retain the mission management role and maintain their situation awareness.

5. To maintain situation awareness, the pilot must keep his head up, looking out of the cockpit, as much as possible. PA information presented on head down displays does not substitute for staying head up. PA information displays should complement the pilot's desire to stay head up, rather than interfere with it.

6. Therefore controls and displays that can be used with the head up are to be preferred. Pilots indicated a preference for voice for both control and informa-

tion presentation. Simple pictures that could be processed with a minimum of head-down time were also considered acceptable.

7. A quick, easy, intuitive method for selecting displays for presentation or removal is a necessity in a PA interface with a high rate of information exchange.

8. PA needs some of the capabilities taken for granted in human dialogue. These include a capability to interpret ambiguous communications from the pilot and respond unambiguously. For example, when the pilot asks PA to "Say range," PA should respond "Range to bandits 40 miles." Similarly, PA must be able to realize a miscommunication has occurred and act to correct it.

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Vita

Captain Alicia M. Williams was born on 30 January 1967 in St. Louis Park, Minnesota. After spending six months as an American Field Service foreign-exchange student in Colombia, South America, she returned to graduate with honors from Hopkins Senior High School in 1985 and enter undergraduate studies at the University of Minnesota. She graduated in 1989 with a Bachelor of Arts degree in Physiology and a minor in Spanish. She received her US Air Force commission on 2 June 1989 upon graduation as a Distinguished Graduate from Air Force Reserve Officers Training Corps, Detachment 415.

Her first assignment was to Grand Forks AFB, North Dakota, as a squadron section commander in the Supply and Air Refueling Squadrons. Her second assignment was to the Inter-American Defense College at Fort Leslie J. McNair, Washington D.C. as the Liaison Officer, and the Inter-American Defense Board, also located in Washington D.C. as the Assistant Chief of Conferences. She entered the Air Force Institute of Technology's School of Logistics and Acquisition Management in May of 1994 and received her Master's of Science in Information Resource Management in December of 1995. Following graduation, she became the Chief of Base Information Management at Hurlburt Field, Florida.

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This research analyzes the purpose and organization of a well-written executive summary, reviews the characteristics of hypermedia, and compares the strengths and weaknesses of a typical executive summary published originally on paper and now under consideration for transition to hypermedia in order to determine which elements of an executive summary are essential before effective transition to hypermedia.

The executive summary of a technical report is a stand-alone description of what was done, how it was done, what the results were, why they matter, and where further information is found in the report body. Executive summaries have a wider audience than the entire report and thus are written in non-technical language.

To use the features of hypermedia (linked text, sound, animation, pictures) to create an effective online executive summary, several crucial executive summary elements must be in place in order for it to serve as a solid hyperdocument anchor node: what was done, how it was done, what the results were, and why they matter. Traditional elements such as implications and an orientation to the body of the report need not be included in an online executive summary.

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