

# Hypertext and Managing Knowledge

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## Abstract

As the world's store of knowledge increases, and knowledge-workers in contemporary organizations face the imperative of consulting that record, and contributing to it, in order to satisfy a diversity of users and uses, we need to find more efficient and effective ways of dealing with the vast volumes, and have strategies, processes, and systems for managing them. Hypertext technology is a good way to structure and access explicit knowledge. The "Dreher Hypertext Development Methodology" is proffered to guide the development of suitably structured and accessible knowledge repositories. The multitude of users – readers and writers, are empowered, and the diversity of uses – finding, accessing, structuring, linearizing (printing), and much more besides, are facilitated.

**Keywords:** Hypertext, Knowledge Repository, Knowledge Worker, Methodology, World Wide Web

## Introduction

The world's store of knowledge is now so vast, the human mind is barely able to cope in consulting the accumulated record. As individuals we have a need to access, archive, re-use, and communicate knowledge. In addition to doing these things, we also want to contribute to the record – that is to generate new knowledge. Contemporary organizations are faced with the imperative of furnishing knowledge for a diversity of uses and users: paper; computer screen; mobile telephone applications; electronic commerce WebSites; verbal reports. The task is formidable. To make progress in our use of the record – in consulting it and contributing to it, we require assistance. The helps envisaged by Francis Bacon (1620), Vannevar Bush (1945) and Ted Nelson (1965) are worthy of consideration.

This article is a contribution to the practice of doing things with the record or archive of knowledge. In this sense, the practical sense, the article offers a way to manage knowledge for the purpose of improving strategies for and thus performance of knowledge workers.

The term knowledge as used here refers to all those things that have been committed to the record as a result of some scholarly activity (often referred to as explicit knowledge), and is to be distinguished from the information and the data that has been assembled in its construction. The knowledge reposes mainly as text in the articles, books and reports that have been published and persist in the record over time – we are not here concerned so much with a philosophical notion but rather with empirical and practical matters. Although it is acknowledged that there are other forms or types of knowledge such as pictures, formulae, and sound, it is contended that these can be (must be?) given a textual representation. We restrict ourselves to textual forms of knowledge.

There is much knowledge that is potentially relevant to any given scholarly enterprise (not to be read in an erudite sense, but rather more implying a serious attempt at learning, illuminating, problem solving and researching), posing considerable challenge in finding, consulting, and assimilating

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that which is necessary for the task. Contemporary organizations are now more than ever before faced with the need to create (in the sense of giving form to and facilitating access) repositories of organizational knowledge.

Much of the work revolves about the Internet, and specifically the Web, with the implication of producing something superior to the linear record or printed materials that have sufficed in the past. In fact, since circa 1994 and the advent of the Web, much available effort seems directed to making Web pages. And these pages must be as good as the printed record in terms of utility, but in addition must facilitate access for a seemingly overwhelming diversity of users and uses. The task is daunting.

We must learn to erect alternate structures for our words, and transcend the linear constraints that the paper medium has imposed on us for centuries. For example, many reports are structured into hierarchies, but we know that a heterarchical form, such as that found in WWW documents (e.g. HTML, XML), and hypertexts in general, can be very useful to our purpose.

The article begins by looking at where the knowledge reposes and the need to augment the intellect in consulting the record. The making of hypertext to create usable knowledge repositories, usable in all the diversity required by the paper-readers and Web surfers alike, is suggested as an improvement over linear paper-based documents. Finally, a 7-step hypertext development methodology is proffered.

## The Locus of Knowledge

Contemporary knowledge reposes in documents – computer documents actually. And in the main, if the knowledge is in textual form, these documents are ‘word-processor’ documents. Since the advent of the Web, a large part of the world has pre-occupied itself with promulgating knowledge in forms demanded by its protocol and language. This entails giving structure to the textual objects (and objects of other type) by the use of HTML (Hypertext Markup Language) and the various extensions representing DHTML (Dynamic HTML) and weaving a web of the multitudinous fragments or chunks of knowledge, but not excluding other hypertext models, notably PDF (Portable Document Format by Adobe). We thus have a ‘container’ in which the knowledge may reside.

Prior to the use of computer repositories of knowledge the medium was paper. The knowledge in paper based documents can be acquired for knowledge management purposes via a number of processes: scanning and OCR; data entry via keyboard; reading followed by voice recognition; or a combination of these. Once the knowledge has been acquired into a form amenable for use with computers, it may be treated as if it reposed in computer documents as above. Whilst it is acknowledged that converting from paper to computer medium is not simple in practice, theoretically it is a straightforward step.

## Consulting the Record

Some three and a half centuries ago Francis Bacon was keenly aware of the need for ‘instruments’ or ‘helps’ to support ‘understanding’ (Figure 1).

Neither the naked hand nor the understanding left to itself can effect much. It is by instruments and helps that the work is done, which are as much wanted for the understanding as for the hand.

And as the instruments for the hand either give motion or guide it, so the instruments of the mind supply either suggestions for the understanding or cautions.

(Francis Bacon, *Novum Organum* (1620) Bk.1.Sect.2

### Figure 1 - Francis Bacon's Instruments and Helps

The furnishing of means by which the record is consulted has not escaped the attention of thinkers over the ages. Footnotes, marginal notes, PostIt notes, and an array of like devices constitute the valiant at-

tempts of writers and readers to break out of the linear constraints imposed by pre-computer era containers of knowledge (the paper manuscript).

With the advent of computers we discovered that the form and structure of knowledge could be, indeed must be, separated from the knowledge itself. The thing created by giving knowledge structure could be considered as knowledge about the knowledge – that is ‘meta-knowledge’. Contemporary repositories of knowledge are thus a construction of knowledge and meta-knowledge.

## Perspectives on Knowledge

Alavi and Leidner (2001) articulate six perspectives on knowledge: knowledge vs. data and information; state of mind; object; process; access to information; and capability. Among these, and for our purposes, consideration of the “object”, “process”, and “access” orientations may be fruitful. These three views suggest that we explore the role of IT in gathering, storing, transferring, linking and structuring, locating, searching, and retrieving knowledge. If we do these things one can say we are ‘managing’ knowledge, that is we are engaging in KM.

Obviously, there must be more than just the facility to ‘contain’ the knowledge. We must, as Bush (1945) implores us, facilitate the consulting of the record. Structure and form become important considerations, in addition to content. Linear paper based documents are inadequate to the task. The knowledge is locked away, and accessible only to those with vast natural cognitive processing capability. *Idea processing* systems (e.g. Fisher Idea Systems 1988-1992, Young 1989) and *outlining* systems permitted the structuring of linear knowledge into hierarchies. The problem soon emerged – which hierarchy? That is to say, that one particular compartmentalization of knowledge conceived in the mind of one researcher (user) was not necessarily best suited to the needs of another. This phenomenon accounts for the well known difficulty experienced by all Web users in finding that which is sought, and contributes to increased user frustration: “I know it’s there, but where? If only ...”. Clearly we must provide as many ‘views’ of the knowledge as suit the diversity of users and uses creating and consulting the record.

## The Hypertext

The concept of heterarchy is useful in progressing the thinking - multiple overlapping hierarchies form a heterarchy. The modern expression for such a structure is a hypertext. The Web is a hypertext.

A hypertext facilitates combining or juxtaposing objects of varying type (text, still and motion picture, and sound for example) so as to admit a fresh perspective on them and this essential element forms the center of the author’s definition of hypertext (Dreher 1992 p3):

A hypertext is a society of knowledge-containing objects of varying type (text, graphic, sound, motion picture, simulation, and composites). These objects are stored in a computer readable memory to which access is provided via a network of embedded associative links: hypertexts are non-linear and provide direct access to knowledge-containing objects and structures.

Hypertext permits doing ‘other’ things with what is read than has been possible (for most of us) hitherto. It admits an additional dimension of perception and conceptualization for the knowledge-worker. Woodhead (1991 p71) refers to this as “A new information paradigm” which is “needed to manage the growth of information in general. Hypermedia can provide both the framework for production and the (online) means of distributing the finished products”.

Woodhead (1991 p93) sees hypertext/hypermedia as having “the potential to become the dominant software paradigm of the 1990’s”. The problem of which term to use, hypertext or hypermedia, is one faced by all authors writing on this subject. Woodhead (1991 p2), amongst others, sees hypermedia as subsuming hypertext, and reserves the latter for text-based contexts. On the other hand, Nielsen (1990 p5) says he “would like to continue using the traditional term “hypertext” for all systems since there does

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not seem to be any reason to reserve a special term for text only systems". This author's preference coincides with that of Nielsen. The general approach to perceiving and conceptualizing the vast quantities of information accessible in computer information systems worldwide, particularly unstructured textual data, is here termed a hypertext paradigm.

To ensure an adequate grasp of the hypertext concept, it may be useful to distil out its essence – the essential elements of hypertext are (Figure 2):

1. Nodes or chunks of knowledge which are the units of information in the hypertext;
2. Links between these units of information;
3. A navigation or browsing facility which keeps a history of nodes visited, and may be used for subsequent backtracking;
4. A dynamic indexing system to keep track of the body of knowledge which is currently in 'scope'; and
5. A full text search function.

**Figure 2 - the essential elements of hypertext** (after from Conklin 1987, Nielsen 1990)

The common thread running through the various characterizations of hypertext is the ability to augment the thinking of the human knowledge-worker, largely through the ability to make links or, in some sense, to juxtapose knowledge. This juxtaposition, the "unique coming together of previously unconnected thoughts, processes, mechanisms, technologies, or philosophies" (Thorne 1992 p124) is required for innovation, a point also recognized by Rickards (1974 pp13-14): "Creativity is a mysterious process which can give rise to heated arguments among psychologists. It is sufficient here to regard the process as one which gives rise to novel combinations of concepts which have significance to the solver or his environment".

### **Constructing Hypertext**

Drawing on a period of intense hypertext development of the late 80s and early 90s, resulting in, for example, the *Prototype Hypertext Operating Manual for LNG Plant Dehydration Unit* (Dreher, 1991), among many other hypertexts, a method began to emerge and served as a useful guide to building hypertexts in general (Figure 3). Whilst these knowledge repositories were built using the *HyperShell hypertext development system* (Taylor, 1991), it was found that the method used in individual construction projects could be meaningfully given more general form as a platform independent methodology. It was appropriate regardless of the particular technology being used for implementation. Support tools were constructed to guide and facilitate the various stages.

The methodology was provided to students of the unit Hypertext 211 in 1995, and has since then guided the hypertext development activities of scores of students working on HTML-type hypertexts and more recently as the technology has permitted, the creation of hypertexts in Microsoft Word and Adobe PDF..

1. Knowledge Acquisition
2. Knowledge Analysis
3. Knowledge Consistency
4. Hypertext Design - determine the elements the hypertext is to contain and reflect
5. Hypertext Implementation - Insert hypertext markups, codes or tags (links)
6. Usability - Navigation Support Functionality
7. Promulgation

**Figure 3 – Dreher's 7-step methodology to create hypertext**

Organizations with a substantial knowledge-worker cohort, grapple with the issue of acquiring, structuring, and facilitating access to the vast repositories of knowledge which form part of their raison d'être.

Paper records no longer suffice, although from a legal standpoint they may still be required. We must seek ways to break out of the linear constraints that the paper form implies.

Today, the master repository of knowledge is no longer the manuscript but rather the computer document which is amenable to all manner of structuring to empower users to do ‘more’, ‘better’, and ‘faster’ things with the knowledge. Word-processor documents permit the development of a hierarchy at least. This is superimposed on the linear structure, and, for example through use of the *Outline* feature, and the *Document Map* in MS-Word, views alternate to the linear may be created and juxtaposed with segments of the linear text.

Vannevar Bush (1945) conceived the Memex in his now famous article “As We May Think”. This device (never built as the technology of the time was inadequate to the task) permits the user to make ‘trails’ through the web of information stored in the Memex, much like we do with the HTML hypertexts so prevalent on the Web. Apart from the specialized hypertext systems of the mid 1980s and early 1990s the ‘world’ has been preoccupied with creating computer readable documents mainly with the use of word-processors.

Today, we still do this but we now have the added challenge of making the knowledge that reposes in these documents available on the Web. Many issues arise from this new demand: what form is the master? – the form in which the knowledge was created (captured or acquired) or the form in which it is promulgated (HTML hypertexts); how do we maintain the knowledge; can we still print it (linearize the hypertext); and which hypertext model (platform) do we implement and standardize on.

Fortunately, the tools (even if somewhat rudimentary) are now to be found in modern word-processors, enabling us to make our documents just as we are used to, with familiar tools. In addition, we provide the features that augment the user’s capability and capacity to use the knowledge.

Despite the serious problems regarding Web page development and maintenance, with which issues the world’s organizations are struggling, the master-repository-of-knowledge-question is, in my view, is paramount, and is mostly not considered. Unless it is settled, progress is jeopardized.

## **The Process of Making Knowledge**

It should by now be evident that we want both the knowledge and the meta-knowledge. And we want the paper version and the hypertext too. But which is the master? That is, which form of knowledge container or knowledge repository is to be the authoritative master? If we have a methodology, preferable automatic or semi-automatic, to generate alternate forms from a master, we are able to proceed effectively and efficiently and with confidence. Here follows the suggestion.

Make the knowledge (i.e. emerging from cognition) as usual but strictly apply a *style-set* using the in-built features of Word. From the embedded mark-ups (applied *styles*) use the functions of Word (or suitable alternate) to automatically and possibly via the use of macros, process the mark-ups to construct the *meta-knowledge*. Because much of the meta-knowledge is also knowledge it will be inevitable that considerable effort needs to be directed to the application of the mark-ups (i.e. deciding what knowledge to mark-up, including the making of links or defining rules for making links).

The result of this creative effort will be a consistent body of knowledge, consistent content, and consistent structure. It is done but once. And it results in the master repository of knowledge that appears as an elegant Word document. It will be of high grade and quality. It is marked by precision, neatness, simplicity, and refinement. It can be printed, just as we do so often (too often?). It can be viewed on the screen.

This work can be usefully guided by steps 1 to 3 (and a little of 4) of the *7-step methodology*. At this juncture in the creation of the hypertextual knowledge repository we are still at liberty to choose the par-

ticular hypertext implementation. The remainder of the steps may be largely automated, depending on the hypertext model and particular implementation being targeted. Unfortunately, for all the many advantages of HTML-type hypertexts, there will be very considerable effort involved where this option is chosen. That is, where HTML is chosen, much work remains to be done at step 4. More and more projects now turn to other types of hypertexts, notable among which is the PDF technology, and indeed a combination of this with HTML, DHTML, and XML.

## Conclusion

In order to advance the enterprise of consulting the record of the world's knowledge, the human intellect needs help. Augmenting the intellect for both reading and writing the record is done through hypertext, which may be constructed by following the seven steps (given in **Figure 3**) of the "Dreher Hypertext Development Methodology". The multitude of users – readers and writers, are thus empowered, and the diversity of uses – finding, accessing, structuring, linearizing (printing), and much more besides, are thus facilitated. The knowledge has been made manageable.

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## Biography

Heinz Dreher has been working in the Information Technology Systems domain for 33 years. His first position was as computer programmer. This was followed with a move into the tertiary education sector in 1972 as senior tutor in Electronic Data Processing (EDP). Currently he is a senior lecturer in the School of Information Systems at Curtin University of Technology, Perth, Western Australia. Dr Dreher has expertise in Hypertext/Hypermedia systems and textual-knowledge-based systems, Computer Supported Co-operative Work (CSCW), Computer Mediated Communications (CMC), Project Management, Prototyping systems, Human Problem Solving Strategies, Decision Support Technologies, Knowledge Management, WWW and Electronic Commerce applications development and technologies, and Information Systems Research Methods. The Hypertext Research Laboratory, whose aim is to facilitate the application of hypertext-based technology in academe, business and in the wider community, was founded by him in late 1989.