Toward Augmenting the Human Intellect *and Boosting our Collective IQ*

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It is a pleasure to play opposite Ted Nelson; much different from waving to each other across the wide, very sparsely populated frontier spaces of old.

How did I wander into that frontier? I became motivated (committed) in 1951 to improving mankind's capability for dealing with its pressing problems, especially those over-taxing our collective capability to cope with complexity and urgency. I visualized people collaborating interactively on visual displays connected to a computer complex. I'm not "numerically oriented;" my vision has always facilitated discursive thinking and collaboration.

By 1962, after a Ph. D. in Electrical Engineering/Computers at Berkeley and in my fifth year at the Stanford Research Institute (SRI), I developed a "Conceptual Framework for Augmenting Human Intellect." Its fundamental concepts still guide my pursuit. The hypermedia design principles I concentrate on here are but secondary derivatives of that larger-goal conceptual framework. In fact, all our computer developments into the 1970s (synchronous distributed shared-screen conferencing, windowing systems, outlining tools, the mouse, among others) and since are secondary derivatives of this conceptual framework; I view the computer merely as a supportive tool. Other major framework elements include a "bootstrapping" strategy fostering networks of organizations collaborating on capability infrastructures, explicit co-evolution of tool-systems and human-systems (skills, knowledge, procedures), and the key integrative paradigm: Concurrent Development, Integration and Application of Knowledge (CoDIAK).

My goal for this short piece is to encourage the further development of the framework's technological cornerstone—an open hyperdocument system (OHS), an integrated, seamless multi-vendor architecture in which knowledge workers share hyperdocuments on shared screens. Hyperdocuments are multimedia files supporting linking and multiple object types. The hyperdocument system should enable flexible, on-line collaborative development, integration, application, study and reuse of CoDIAK knowledge.

My hypermedia design notions evolved from the OHS concept, and were further shaped by years of development and real user application experience since the early '60s: the oN-Line System (NLS) developed at SRI over a 13-year span and AUGMENT, its subsequent 12-year commercial form. Peak usage saw more than 20 mainframe servers networked across the country, supporting significant pilot implementations in many organizations that truly transformed how people performed knowledge work.

And, now that World-Wide Web (WWW) has opened people's eyes to (a small portion of) hypermedia's potential, we should expect active penetration into the hypermedia frontier—towards widely used OHS. In the limited space here, I'll express some design thoughts (actually selected AUGMENT features) for the WWW's continued evolution. The references describe a more complete set, including very important non-hypermedia aspects for system architectures.

Everything in the Work Environment is Live Hyperdocument Stuff: All knowledge products, such as email, notes, source code, to-do lists, work breakdown structures, status reports, design documents, user guides, trouble reports, and others are inherently hyperdocument objects. The infrastructure provides knowledge products with all the hyperdocument capabilities described here.

Integrated Applications: A tool system using a universal knowledge base replaces the standard application or function-based paradigm. Individual application subsystems (graphical editors, program language editors, spreadsheets) work with knowledge products, but do not "own" hyperdocuments in the sense of being responsible for their storage or representation. For instance, one could create a Gantt chart within a project management system, and manipulate it as a graph in a charting application or as mail in an email application. An integrated core application package provides base capabilities of composing, reading, annotating, linking and manipulating knowledge products. All knowledge workers—authors and users—modify and incorporate other knowledge products into their own information bases and knowledge products (much as Ted Nelson advocates in Xanadu).

Explicitly Structured Documents: Objects within a hyperdocument have an explicit structure in which structural and logical substructures may be addressed and manipulated. For example, one can manipulate any statement in a hierarchical structure as an aggregate branch of all its substatements (with each maintaining its individual identity). This greatly extends the notion of manipulating sections and subsections in today's outlining tools.

Every Object Intrinsically Addressable (Linkable to): Every knowledge object—from the largest documents, to aggregate branches, down to content units such as characters—has an unambiguous address, understandable and readable by a user, and referenceable anywhere in the hyperdocument system. Such intrinsic addressability should be integrated deeply into commands for editing, structuring, jumping. Intrinsic addressing options not only are natural to learn and embed in links, but serve as parameters for direct, user-invoked jumping and manipulation commands. This addressing scheme allows direct or indirect addressing (absolute or relative, and through aliases; indeed we allow unlimited indirect address chaining) and working with objects not currently displayed. For instance, one can copy a structure without finding and opening the file containing it. Meta-level referencing (addresses on links themselves) enables knowledge workers to comment upon links and otherwise reference them.

View Control of Form, Sequence and Content: A structured, mixed-object hyperdocument may be dis-

played with a flexible choice of viewing options: selective level clipping, filtering on content, truncation or other transformation of object content, new sequences or groupings of objects including those residing in other documents, etc. Links may specify views so traversal retrieves the destination object with a prespecified presentation view (e.g., display as a high-level outline or display only a particular statement). View specification becomes a natural and constantly employed part of a user's vocabulary.

Hyperdocument Library System: Hyperdocuments may be submitted to a library-like service (an administratively established, AUGMENT Journal) that catalogs them, and provides a permanent, linkable address and guaranteed as-published content retrieval. This Journal system handles version and access control, provides notifications of supercessions and generally manages open-ended document collections.

Open hyperdocument software concepts are but a small part of a larger Bootstrapping Initiative, currently underway. We are fostering a cooperative community of organizations interested in strategically improving their collective improvement capabilities, and thereby augmenting each organization's—and indeed, society's—potential to excel in our rapidly changing world. ◪

References
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