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BRIEFING PAPER </title>

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Domains of Learning Materials

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Domains

Domains are many things to many people. In biology it's the highest rank in the classification of organisms above kingdom. In geography it's an area owned or controlled by a single person or organisation.

Vannevar Bush, US President Roosevelt's science advisor during World War 2, imagined that a holistic knowledge domain which he referred to as *"the sum of all human knowledge"*, would be essential to improving the way future scientists and researchers work. Before personal computers were invented, and using the latest microfilm technology of that time, Bush envisioned that this knowledge would be indexed and retrieved using a smart desk called "Memex" (Memory IndEX).
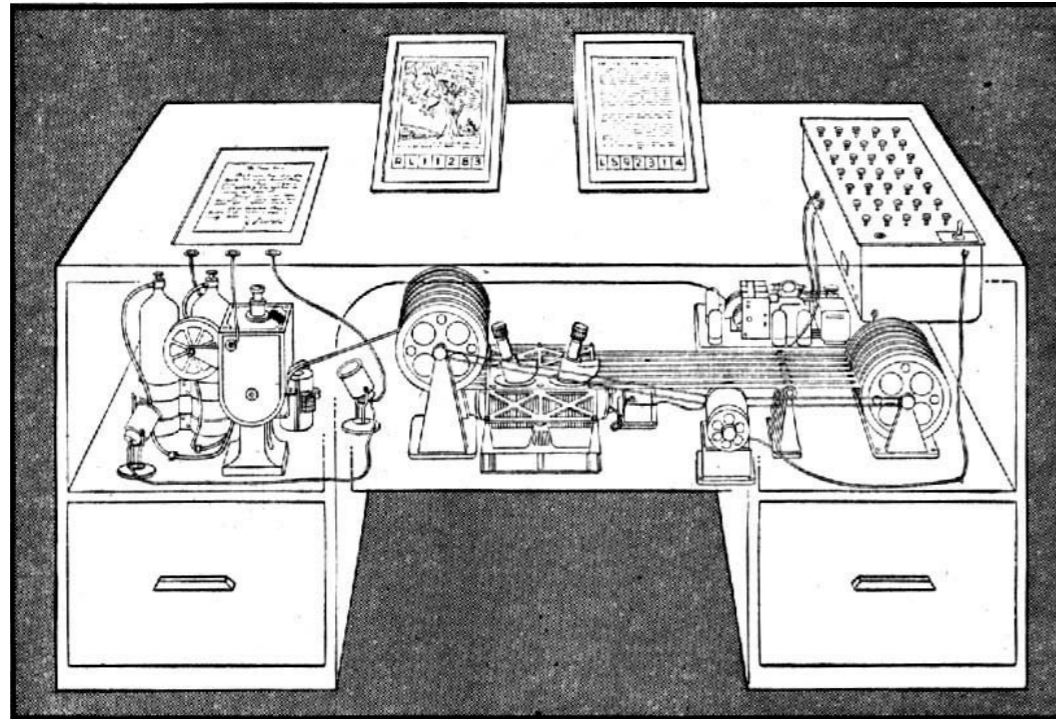
**Figure 1: Bush's Memex. On the right hand-side, all of mankind's knowledge is captured on microfilm and recalled onto a screen by the researcher using an Identifier based keypad retrieval mechanism. On the left, a personal annotation and bookmarking solution again captured into microfilm.
Source: "As We May Think" Atlantic Monthly, 1945**

Other researchers have envisioned large and more useful domains of human knowledge. One of the largest has been Ted Nelson project Xanadu started in the 1960's, and which explored concepts in non-sequential writing in which the reader could choose his or her own path through an electronic document.

So why should we bother thinking about domains in education, and why put any effort into creating or maintaining them ourselves?

Creating Meaningful Domains

If you put your learning materials into Microsoft Word for print, or HTML format for your website, you spend a lot time encoding it in formats that can't retain the meaning the author had when the materials were created. A 'question' becomes a dumb paragraph or list. A 'mark' becomes an item of text. Do this more than once, say because you want to print the same materials on paper and load them into your online learning environment, and you get two or more master versions and lots of duplicated publishing effort around them. This is what is currently happening in many academic and professional institutions.

Instead, if you mark up your learning materials using non-proprietary text labels called 'tags', and then use a publishing solution that can easily convert from those tags into both MS Word and Web formats, you will have a single master source to work with and batch production tools that are much quicker and more efficient.

If you use a consistent set of tags across all of your course components and courses, and you have the beginnings of your domain. The set of tags and their details that you choose to adopt and apply, forms your information architecture. The more tags and details you add to your single masters, the more useful they are and the richer your domain becomes.

```
<recipe name="bread" prep_time="5 mins" cook_time="3 hours">
        <title>Basic bread</title>
        <ingredient amount="8" unit="dL">Flour</ingredient>
        <ingredient amount="10" unit="grams">Yeast</ingredient>...
        <instructions>
                <step>Mix all ingredients together.</step>
                <step>Knead thoroughly.</step>
        </instructions>
</recipe>
```

Figure 2: Example set of tags for meaningfully labelling the elements of a recipe perhaps for a food preparation domain

It is important to base your domain on the right tags from the start. By 'right' we mean tags that properly label your information usefully and with meaning. For example, if you are an aircraft manufacturer you will use specific tags for part numbers and installation or removal procedures.

If you are in education, you will need tags for questions, answers, references, and learning objectives to name just a few. You will probably also need specific attributes for each tag you use too, like 'mark value' for an answer tag, or perhaps 'Harvard' for an academic reference tag

Tagging learning materials with attributes that have real meaning for you is a process called semantic mark-up. Do it right first time, and you never have to do it again. Do it using open information standards like XML, and you make your learning materials much more reusable and healthily independent of your current Virtual Learning Environment (VLE/LMS) system.

By all means use someone else's tags if they mean something to you. Such 'plagiarism' actually helps to improve interoperability and ease information exchange, particularly if it comes from like minded communities of practice. In education, there are many sets of tags you could adopt for the industry, but very few are actually any good for basing your domain on. Many are too complicated or have been created for a single process only.

Domain Management

We have touched upon good reasons for creating meaningful domains, including capturing your knowledge semantically for future reuse, and enabling more efficient working practices that save time, money and improve quality. There is no point in doing this however, unless you maintain the investment you have made in creating your domain.

Domains need to be kept up-to-date and cherished by authors as well as developers. Authors need to work in whatever format they can be most creative in, and usually that means a Word processor format. How can this be achieved when the domain is tagged up in XML?

In practice this turns out to be less of an issue that most think. Many edits and changes are already accommodated today in traditional publishing workflows, by submitting changes as marked-up drafts in print or electronically in Microsoft Word or annotated PDF. With careful preparation, this works equally well with XML based domains. In cases where substantial edits are required, outputting RTF/MS Word documents from the XML masters and tracking author's changes in MS Word usually works, and often the bulk of the new content capture into XML can be automated if templates are adopted first.

The key point to note with re-authoring though is that a domain of materials needs to be managed by developers who will ensure the changes don't invalidate all products to come form the domain – not just print ones. In other words, the authors are no longer the sole stakeholder involved in maintaining the value of the domain, and in managing its ongoing use and improvement.

For large domains of learning materials, perhaps comprising hundreds of online courses, a team of information/learning support specialists is required. They need to be equipped with a relevant information architecture to start with; semantic tools like Courseworker to develop with; and trained and supported to use them to cherish and develop your own domain of knowledge. You probably have this team already – it's just that they are probably very busy hand crafting your courses multiple times in MS Word and HTML/web formats for imprisonment in your current VLE.

Shared Responsibility

We all have a bit of a legacy burden to overcome when it comes to passing on "the sum of all human knowledge" as Vannevar Bush has requested.

Much of our knowledge today is by and large held in lamentably poor forms and formats. People come and go in more ways than one. Papyrus doesn't scale and neither do tablets and songlines, though I'd quite like to see us try scaling the latter. Printed matter fades, rots, gets burned by accidents at work or single-minded despots. In truth, the forces of chaos and information degradation are alive and still destroying knowledge today.

You might be forgiven for thinking that computers and the Internet are the solution too, and they are, but only in part, and not how we have them implemented today. The constant process of backing up computer based information continuously to cost efficient storage media, requires constant refreshment of the storage media and adoption of new more efficient media. This is not a certain process either but it is better than what has gone before and the Internet does now allow us to globally distribute tacit knowledge and information assets around the World.

The trouble is, what we are backing up and inheriting in the future, generally isn't very good quality. It isn't semantic. It's usually poorly managed if at all.

We have a shared responsibility to get the knowledge we are responsible for creating and maintaining into a healthy state – semantically marked-up with non-proprietary information standards and in a consistent information architecture. If we all sort out our own information assets semantically, the sum of human knowledge will gain.

Summary

More and more institutions are beginning to see that their domain of learning materials is held to be *a body of knowledge disciplined under a single information architecture.*

Creating it takes collaborative effort, and an ongoing commitment to cherishing both the materials and their architecture. The most useful domains are flexible ones, which can be used to satisfy any teaching and learning application. Flexibility comes most from adopting international standards to format the information openly and with useful meaning. Adopting international standards liberates your domain from having to use proprietary vendors and formats, and imbues your learning materials with long-term value and reusability.

Well architected knowledge domains bring the strategic rewards of higher quality teaching and learning experiences, produced and maintained more easily and at less cost than traditional preparation approaches. They increase stakeholder value by establishing tangible assets which can be secured, shared and exploited for the long term. They are a necessary part of the future learning environments Bush envisioned in 1945, and again in 1959:

"Professional societies will no longer print papers...they would maintain a 'master Memex' containing all papers, references, tables "intimately interconnected by trails, so that one may follow a detailed matter from paper to paper, going back through the classics, recording criticism in the margins.

Vannevar Bush, Memex II, 1959[1].

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[1] Nyce, James M.; Kahn, Paul (eds.) "From Memex to Hypertext: Vannevar Bush and the Mind's Machine". San Diego, London (...) 1991. [A reprint of all of Bush's texts regarding Memex accompanied by related Sources and Studies].