



With Open Source Tools

Fred Brown

The index can often be the most heavily used "chapter" in any publication and helping the user find an answer is the key to fulfilling the technical document's mission, justifying the effort and expense for its creation. Yet, indexing facilities in open source packages for document creation remains largely unexplored, offering a marvelous opportunity to do it right!

This article provides a generic specification—with reasons—to open source developers for creating useful indexing facilities in packages such as OpenOffice and Scribus. It also informs writers about what to look for and what to ask for in any indexing tool. Finally, the article demonstrates the need for software developers to work closely with practitioners and users.

"An index is not an outline, nor is it a concordance. It's an intelligently compiled list of topics covered in the work, prepared with the reader's needs in mind."¹

The open source world provides the opportunity to develop embedded indexing systems that promote and facilitate indexing. Creating an effective index that guides a reader quickly is both an art and a potential source of some frustration. Creating the "search map" that an index is, demands considerable skill and intellectual effort and coding the index in a machine-readable format can drive a writer to abstraction. A computer tool needs to both facilitate the intellectual work and ease the pain of dealing with the computer.

This article looks at open source packages such as LaTeX, MOM (and groff), OpenOffice and Scribus, along with standards such as OpenDocument Format and DocBook, while drawing experience from proprietary software including Adobe FrameMaker, IXgen, DEXter, and Microsoft Word as well as dedicated indexing software. But first we need to understand the business of indexing before we can design or evaluate tools for its accomplishment.

Indexing Process

Creating an index follows a general process:

1. Reading the document.
2. Analyzing the text and writing the initial index entries.
3. Editing the index entries.
4. Final formatting of the index to meet required style guidelines.

In step 2, the writer figures out what index entries to create while at the same time coding the entries correctly. Because of the intellectual work effort required to define effective index entries, it is essential that the coding method be as simple and as intuitive as possible. And remember that index consists of topics², concisely and clearly named, not simply words appearing in the text. So just clicking on a word in the document and popping it into the index is of limited value. Worse still, using a concordance file of index

¹ Quote and criteria are from the *Indexing Evaluation Checklist*, American Society of Indexers <<http://www.asindexing.org/site/checklist.shtml>>

² To understand how indexers analyze topics, see *Facing the Text: content and structure in book indexing* by Do Mi Stauber.

words just results in meaningless headings in the index and many valueless page references.

Step 3, editing, is as important in creating an index as it is in writing. An effective indexing tool needs to make it as easy as possible to locate and change the desired index entries. Tools for grouping index entries and for checking "See" and "See also" cross-references can be helpful.

And finally in step 4, publishers can have a myriad of different style requirements from alphabetization schemes, to capitalization and fonts. An indexing tool should allow the writer to set these parameters independently of the index entries themselves. This approach saves time when indexing and permits last minute formatting changes.

Index Structure

The following extract³ illustrates the main structural elements of an index⁴:

Galaxies, 5 ,7 ,8, 191, 246–56, 264–5
 barred spiral, 247, 249, *illus.* 7, 249
 black holes in, 249, 255
 Centaurus A (NGC 5128), *illus.* 251
 clusters of, 247–8, *illus.* 2, 4
 ...
 See also M31; Milky Way
 M31, Great Galaxy, 8, 191, 193, 198, 207,
 247, 265, *illus.* 246
 Milky Way, 7, 8, 10, 24, 181, 198, 226,
 243, 247, *illus.* 8, 10, 166, 192, 243
 core of, *illus.* 10
 edge-on and face-on, *illus.* 234
 estimated number of advanced technical
 civilizations in, 298–302
 ...
 NGC, galaxy numbers, See Galaxies

Main headings such as “Galaxies” and “M31” form the primary topics or access points for the index. Some main headings are broken down into further detail using subheadings. The subheadings are both descriptive and concise, requiring more intellectual effort than just highlighting a single word in the text.

Note that even when a main heading is broken down into subheadings, there may still be some page references off the main heading itself. In some indexes these may be references that were too minor to be

³ Sagan, Carl. *Cosmos*. New York: Random House, 1980. *Cosmos* won the American Society of Indexers H. W. Wilson Award for excellence in indexing <<http://www.asindexing.org/site/WilsonAward.shtml#recip>>.

⁴ For a full discussion of all aspects of an index, see *Indexing Books* by Nancy Mulvany.

worth making a subheading or they may point to where the main discussion of a topic takes place.

In this index, page references to illustrations are identified separately; note the formatting requirement.

The “See also” cross-reference for the “Galaxies” main heading points to where further detail related to the main heading can be found in the index itself. The “See” cross-reference “NGC, galaxy numbers, See Galaxies” provides vocabulary control by directing the reader from a more technical term to a more general one used for indexing the information. Some indexes will have “See” references coming off subheadings as well. Note that “See” and “See also” cross-references do **not** have page references because they link to other locations in the index, not to pages in the main text.

As we can see from just looking at the cross-references alone, the internal structure of the index is more complex than an alphabetized list of unrelated terms. An index’s structure is more like an interconnected web. When you change one part of an index you almost inevitably find it necessary to adjust other parts of the index as well. This interconnected web structure underlying an index makes it more complex and fundamentally different from the hierarchical structure typical of most technical writing.

Indexing Functions and Features

Creating a basic working index requires a small, but essential set of functions. Missing one or more of these features severely affects the ability to create an effective index. A functional indexing capability allows the writer the freedom to create a competent index.

Essential Functions and Features

The following are some of the essential functions and features required for effective indexing.

Main headings and subheadings

Main headings form the primary access points in an index. Subheadings provide additional detail related to the main heading. Many software packages will

automatically insert a word from the text into either the main heading or subheading. Because many headings, especially subheadings require more than one word to be clear to the reader, this feature is not as handy as it might first appear. Index entries have to do with discussions of specific topics in the text, not simply the appearance of particular words.

Main headings form the primary access points in an index. Subheadings provide additional detail related to the main heading.

Page ranges

Page ranges give the reader a sense of how much material is discussed in a particular reference. Some indexers only enter page ranges when they are three pages in length or longer. Three schemes are typically used for coding index ranges:

1. **Concatenation.** The indexer enters an index marker on each page that discusses a specific topic and the software automatically calculates the range.
2. **Index markers at the beginning and end of a range.** Only two index markers are required, a “start” marker at the beginning of the range and an “end” marker at the end of the range.
3. **Bookmarks.** Create a bookmark for the range and then link the index marker to the bookmark.

When many pages are covered in a range, the concatenation method is very slow because index markers have to be entered on every page. And then if you need to edit the index heading, finding and changing each of the index markers in the range can become exceedingly tedious. Bookmarks work well, but require an extra step to setup the bookmark. Some software packages offer concatenation along with options 2 and 3.

As in any written work, an index needs to be edited. An initial draft of an index represents an analysis of the text. Much of the art of indexing lies in reworking this analysis into a final index.

“See also” cross-references

“See also” cross-references are used primarily to direct the reader to other index headings that have further detail about the topic in the main heading, such as “vehicles, *See also* automobiles; trucks; vans.” “See also” cross-references can also be used to refer the reader to other terms in the index that may have a similar meaning. In some cases, “See also” cross-references can be used to help fix a situation where the page references in a subheading need to be broken down further and sub-subheadings are not being used.

Note that both “See also” and “See” cross-references are completely internal to the index, and as such do not have page numbers. And because they do not have page numbers, the index markers can be placed anywhere in the text. Some software will automatically combine cross-references entries for the writer. For example, the index markers “vehicles, *See also* trucks,” “vehicles, *See also* automobiles” and “vehicles, *See also* vans” would be combined in the generated index as “vehicles, *See also* automobiles; trucks; vans”.

“See” cross-references

“See” cross-references are used for vocabulary control. For example, “removing. *See* deleting.” As with “See also” cross-references, some software will automatically combine cross-references.

Note that main headings with “See” cross-references do not have subheadings; if they do, then a “See also” cross-reference is used instead. Often a writer will not know until an index is completed whether to use a “See” or a “See also” cross-reference in a particular situation.

Editing index entries

As in any written work, an index needs to be edited. An initial draft of an index represents an analysis of the text. Much of the art of indexing lies in reworking this analysis into a final index. Thus a writer needs to be able to easily access and edit individual index markers embedded in the text. Just finding the right index marker can sometimes be a challenge. FrameMaker allows you to click on the page reference following an index heading and go right to the index marker itself. Search and replace is a useful feature when editing indexes as well.

Once you’ve changed one or more index markers, you need to be able to see the effects in the index itself. Because of the index’s interconnected structure, a change in one place often requires adjustments elsewhere in

the index. FrameMaker and Microsoft Word require the writer to regenerate the index in order to see the changes. Dedicated indexing software, used in the book publishing industry, allows the indexer to see the changes instantly.

Alphabetization and sorting

There are two basic methods for alphabetizing⁵ an index: word-by-word and letter-by-letter. Articles, prepositions and conjunctions such as “the”, “of”, and “and” are not usually sorted in subheadings. When subheadings reflect historical dates, they may be sorted in date order rather than in alphabetical order. Other alphabets, such as Cyrillic, have their own alphabetization schemes. Adobe FrameMaker allows you to define how each letter in the alphabet is sorted. Numbers at the beginning of entries should be sorted by their value rather than by their ASCII codes, for example, “4800 bps modems” comes before “28,000 bps modems”. Some software allows you to specify how an individual entry is to be sorted. Dedicated indexing software have a list of words that are ignored when sorting subheadings.

⁵ For a full discussion of alphabetization and sorting, see *Indexing Books* by Nancy Mulvany.

Enhanced Functions and Features

The following are some other desirable functions and features.

Word search and concordance

Sometimes when you are part way through indexing a document you realize that some seemingly small item is really an important topic and you have not got time to go through the entire document again to find all the references to it. In this situation, a word search feature is really handy—especially if you cannot decide whether a mention of a particular term represents a significant enough discussion to put it in the index.

A concordance file works by putting all the indexable terms in a list. Then the software goes through the document and creates an index marker automatically each time an indexable term is used. It's easy and it's quick! However, a large number of insignificant page references end up in the index leaving the reader to sort through them. Furthermore, index entries represent topics, not simply the occurrence of a given word. Analyzing a text for topics of discussion and writing concise meaningful headings requires a human mind. In my view, the concordance feature is an invitation to give the reader nothing but frustration.

Bad breaks

A bad break⁶ can occur when a subheading is orphaned at the bottom of a column or widowed at the top of a column. Using “continued” when a list of subheadings spans two columns increases readability.

author (*continued*)
 names and terms preferred by, 18-21, 32-33, 129, 144
 reconciling language of, with reader's needs, 38, 101
 review of index by, 27-28, 32, 33-34, 215-16, 226-28

Checking cross-references

The text in each cross-reference must exactly match the text in the index heading it refers to. In the following example, the index headings, “Mitigation” and “Protection, legal,” are quoted exactly in the “See also” cross-reference.

Habitat, protection, 25, 221, 232
 See also Mitigation; Protection, legal
 ...
 Mitigation, 183, 193-204, 206-207
 ...
 Protection, legal, 24, 26-28, 31, 194-195

Check for circular cross-references. In the following example, the “See also” cross-reference under “annotations” is circular and should be removed.

annotations, 203
 See also commentary
 annotating authoritative works 179
 letting users talk back 201
 linking to comments 129, 136, 165, 179
 for pictures 301
 ...
 commentary. See annotations

Also ensure that cross-references go directly to a heading, not to another cross-reference. In the following example, the “See also” reference under “weight control” should be changed to go directly to “fitness”.

exercise. See fitness
 ...
 fitness, 21-25, 81, 124
 ...
 weight control, 16, 45-48
 See also exercise

Hypertext linking

It is convenient if you can click on the page reference in the index and go straight to the page or to the location of the index marker on the page. This feature is handy in both the original document file and in PDF. FrameMaker does both. It would also be helpful if the “See” and “See also” cross-references were hypertext linked within the index as well.

Annotated page references

Some publications will put the page references to the main discussions in bold. Some indexes also indicate if the page reference refers to a note, illustration, figure or map⁷.

Formatting options

Indexes can be formatted as indented or as run-in. The run-in style is used by book publishers to save space, but this style reduces the readability of the index, a key issue for harried computer users.

Example of a run-in index:

Africa: 108, 123, 124, 139, 144, 290;
 education, 369; independence for states,
 332; Italian ambitions, 202; nationalism
 344; in nineteenth century, 123 *map*,
 Portuguese possessions 200. See also East
 Africa; North Africa; South Africa; West
 Africa

Example of an indented index:

Russia, 45-52. See also Soviet Union
 sells Alaska to United States, 159

⁶ See *Indexing Books* by Nancy Mulvany, p 211-213

⁷ See *Indexing Books* by Nancy Mulvany, p 95-98

Asian advances, 143
 and Austria, 194, 208, 218
 and Balkans, 204
 and Bismarck, 102
 and Black Sea, 40
 and British, 144
 and China, 172
 Civil War, 237-40
 First World War, eastern front, 231 *map*
 ...

The placement of “See also” cross-references can be at the beginning or at the end of the subheadings.

Wish List

The following are some desirable features and functions that could add more value to your index.

Grouping

It is handy to be able to list all the entries in an index that use a particular term and then make any desired changes to the index. For example, a term may appear in a number of scattered entries and you may feel it is important enough to gather all the references together under a single main heading. Dedicated indexing software offers this feature. The following example shows all the headings in an index that use the term “cost”.

business, storage management costs, 52
See also cost; small and medium sized business
 cost, and business integration products, 46, 49
 per transaction, 42
 of printing, 61-63
 and server blades, 27, 28-29
 and server consolidation, 11-12, 34
 of storage management, 52, 57-58, 59
 variable computing cost, 38
 and virtualization, 7-8, 25
 server consolidation, cost savings of, 11-12, 34
 small and medium-sized business, *See also* cost
 variable computing cost, 38

Fonts and formatting

It would serve as a useful guide to the user if standard formatting conventions⁸ were followed by default. Typically, an index is printed using the same font as the body text and with a font size two points smaller. Indents for turnover lines are different from the indents for subheadings. “See” and “See also” text is set in italics. Punctuation conventions are followed, for example a comma is used before a list of page references in a main

heading or subheading, en-dashes in page ranges, and semicolons in between index terms in a “See” or “See also” list:

Allergic contact dermatitis, 113-131
 and cashew, 118-131
 and clothing, 129-130
 ...
See also Atopic dermatitis; Contact dermatitis; Irritant contact dermatitis

Delayed double-posting

When an index entry is double-posted, all the page references should match.

general relativity
 ...
 Newton and, 101-102, 119
 ...
 Newton, Issac
 ...
 and general relativity, 101-2, 119

It is all too easy to double-post one page reference and then miss double-posting the other. Manually checking that all double-postings are consistent can be time consuming. A simple solution is to initially create only one index heading with all the page references and mark it to be double-posted later, during the editing phase. This method, known as delayed double-posting, ensures that page references in double-posted entries always match. Dedicated indexing software provide this feature.

Proprietary software with great ideas

It is worthwhile taking a look at existing proprietary software⁹ to see what tools are required for writing effective indexes and what features can make the job easier and faster. If copying is the greatest form of flattery, then giving out a few compliments does not do the open source movement any harm.

FrameMaker

FrameMaker offers a powerful and flexible indexing facility. Features to look at include alphabetization, formatting and page ranges.

IXgen

IXgen provides an interface to FrameMaker index markers that increases productivity. IXgen is particularly useful for editing indexes.

⁹ See Mulvany, "Software tools for indexing: revisited", *The Indexer*. Oct. 1999. <<http://www.bayside-indexing.com/tools.pdf>> for a comparative review.

⁸ See Mulvany, *Indexing Books* p.183-210

DEXter

Similar to IXgen for FrameMaker, DEXter provides an easy-to-use interface for indexing in Microsoft Word. Index entries are kept visible and editable at all times in a separate table. “See” and “See also” cross-references are combined automatically and are sorted alphabetically.

Dedicated indexing software

Macrex, Cindex and Sky Professional provide indexers with extremely efficient and flexible tools to meet the demands of the book publishing industry. Check out the quick short cuts, alphabetization options, cross-reference checking, formatting, grouping, custom macros, and other features.

Open Source Packages and Standards

In this section, we look at the indexing capabilities of some open source standards and packages.

OpenOffice and OpenDocument Format

OpenOffice uses the OpenDocument Format (ODF) and thus shares both its strengths and weaknesses with regard to indexing. While OpenOffice covers much of the basics and also offers some desirable features, some significant issues remain:

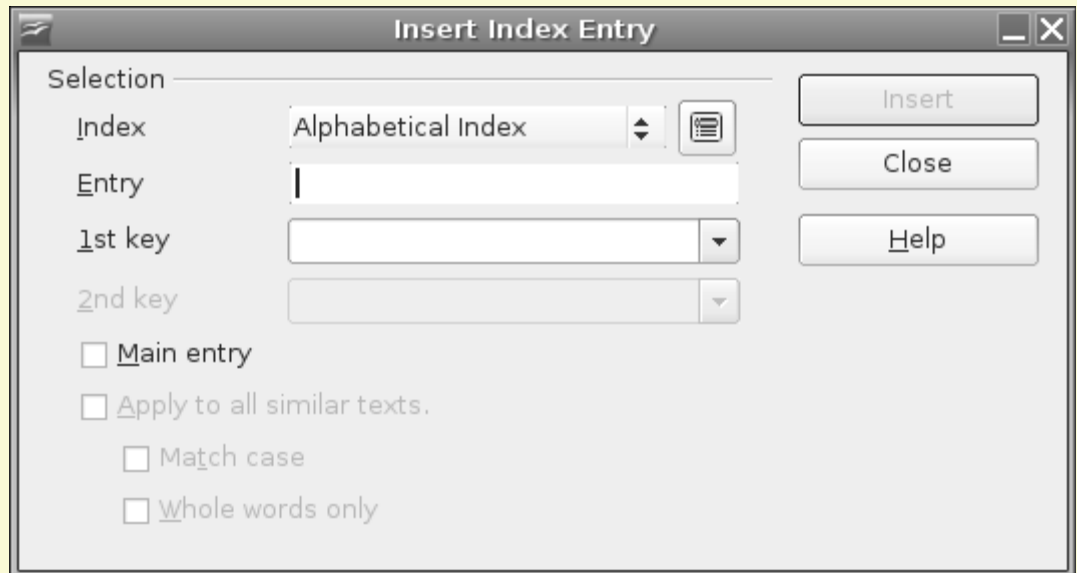
1. There seems to be no provision for “See” and “See also” cross-references. This omission could be rectified by borrowing the “See” and “See also” elements in DocBook.
2. The only method for creating a page range is to concatenate a series of index markers. In practice, such a method is extremely tedious and makes the index almost impossible to edit.
3. ODF allows for different sorting by country, language and algorithm. However, OpenOffice makes no distinction between word-by-word and letter-by-letter sorting. It fails to ignore leading prepositions and conjunctions when sorting subheadings. OpenOffice also lacks the ability to specify how specific index entries are sorted,

although special provisions are made for sorting Asian languages phonetically.

4. Font handling can be an important issue for some indexes. Titles of books are usually printed in italics. Often the names of computer commands are shown in a mono-spaced font.

Figure 1 shows how to insert an index entry into an OpenOffice document.

Figure 1. Inserting an index entry into an OpenOffice document.



The “1st key” refers to the main heading and “2nd key” to subheading. This terminology may be confusing to writers familiar with conventional indexing terminology. Typically, OpenOffice will enter a word from the text itself automatically into “Entry”. You can modify this selection. If you enter text into the “1st key”, the Entry becomes a subheading and the 1st key becomes the main heading.

The “Main entry” check box is used to flag the page reference as the most significant discussion of the topic and so the page reference appears in bold — a useful feature. Do not, however, confuse OpenOffice’s concept of “Main entry” with “main heading”. Again, Open Office has selected terminology that could be confusing for writers familiar with conventional indexing terminology.

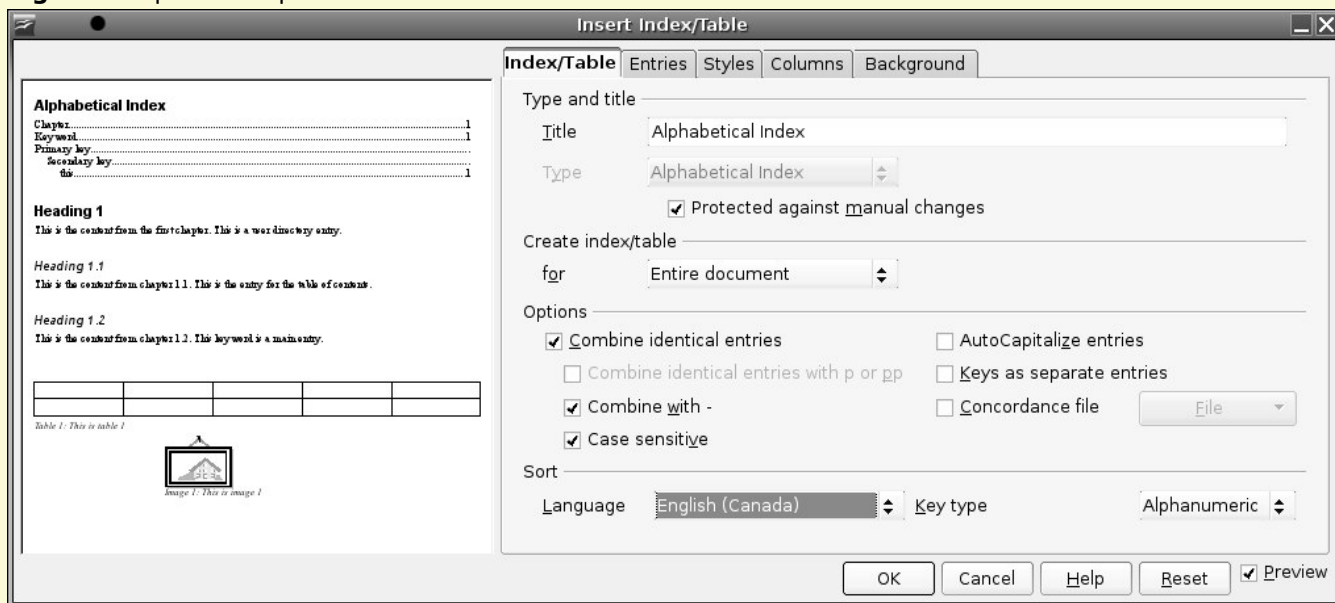
The last three check boxes give the option of applying the index heading to all text in the document using the same Entry text. As discussed earlier, this feature, while perhaps helpful in special circumstances, can lead to a large number of trivial index entries.

OpenOffice stores the parameters for the index as a whole in a tabbed dialog box, as shown in Figure 2. Many formatting and layout options are provided. Both indented and run-in styles are supported. You can protect the generated index from being changed, making it necessary

to make any updates permanent by changing the original index markers themselves. OpenOffice uses a hyphen in page ranges instead of the conventional en-dash. You can set the page reference to a main discussion in bold.

- “Main heading” and “Subheading” instead of “Key” and “Entry”
- “Substantial discussion” instead of “Main entry”

Figure 2. OpenOffice parameters for index.



You can automatically capitalize all index headings. All index headings are changed — main headings and subheadings. Traditionally, if index headings are capitalized, it is only the main headings, not subheadings. Be aware that many computer terms, such as commands, are defined as lowercase and that capitalization can affect meaning. Also note that capitalizing index headings reduces readability.

The OpenOffice indexing facility could be significantly improved with support for “See” and “See also” cross-references¹⁰. Other indexing conventions could also be supported:

- En-dashes in page ranges
- Capitalization of main headings only (if automatic capitalization is used)
- Word-by-word and letter-by-letter alphabetization
- Ignoring leading articles, prepositions and conjunctions when alphabetizing subheadings
- The ability to specify the alphabetization for specific entries
- Indentation of turnaround lines in the generated index

It would be more helpful if OpenOffice adopted conventional indexing terminology familiar to the writing profession:

If one issue was to be given the highest priority, it would be supporting “See” and “See also” cross-references. “See” and “See also” cross-references are key structural components of an effective index.

DocBook

DocBook is a document type definition, largely for scientific and technical publishing¹⁰. DocBook supports main headings, subheadings and sub-subheadings along with “See” and “See also” cross references. DocBook is used in conjunction with XSL style sheets and XML tools¹¹.

DocBook contains elements for both the embedded index markers and the generated index. In this article, we look primarily at the elements for embedded index markers.

Example¹² of a main heading and subheading embedded in a paragraph:

```
<para>The Tiger<indexterm>
<primary>Big Cats</primary>
<secondary>Tigers</secondary></indexterm>
is a very large cat indeed.
</para>
```

¹⁰ See Walsh, Norman and Leonard Muellner. *DocBook: The Definitive Guide* <<http://docbook.org/tdg5/en/>>

¹¹ See Kosek, Jirk *Mastering DocBook Indexes* <<http://www.xml.com/pub/a/2004/07/14/dbndx.html>>.

¹² DocBook examples are extracted from *DocBook: The Definitive Guide* <<http://docbook.org/tdg5/en/html>>.

Page ranges are handled through either bookmarks or inserting index elements at the beginning and end of the range. Example of a page range with index elements at the beginning and end:

```
<para>
The tiger<indexterm id="tiger-desc"
class="startofrange">
<primary>Big Cats</primary>
<secondary>Tigers</secondary></indexterm>
is a very large cat indeed...
</para>

<para>
So much for tigers<indexterm
startref="tiger-desc" class="endofrange">.
Let's talk about
leopards.
</para>
```

Example of a page range using a bookmark (text object with an id value):

```
<indexterm zone="tiger-desc">
<primary>Big Cats</primary>
<secondary>Tigers</secondary></indexterm>
```

Example of a “See” cross-reference:

```
<indexterm><primary>Extensible Markup
Language</primary>
<see>XML</see></indexterm>
<indexterm><primary>Extensible Markup
Language</primary>
<secondary>definition of</secondary>
</indexterm>
```

Example¹³ of a “See also” cross-reference:

```
<indexterm>
<primary>vehicles</primary>
<seealso>automobiles; trucks; vans</
seealso>
</indexterm>
```

LaTeX

LaTeX is a powerful text publishing software package. Like DocBook, LaTeX supports main headings, subheadings and sub-subheadings along with “See” cross references. LaTeX uses *MakeIndex*¹⁴ to generate the index.

¹³ Author’s example.

¹⁴ Leslie Lamport. *An Index Processor for LaTeX* <<http://tex.loria.fr/bibdex/makeindex.pdf>>.

Example of a main heading and subheading:

```
\index{file!size of}
```

Example of a page range:

```
\index{maple tree|()}
...
\index{maple tree|)}
```

Example of a “See” cross-reference:

```
\index{WEP|see{weak equivalence
principle}}
```

MakeIndex does not support “See also” cross-references directly, but they can be created using macros. The following example¹⁵ shows how.

```
\def\subsee#1#2{{\em see also\} #1}
\def/seealso#1#2{%
/index{#1!zzzzz@\subsee{#2}nosee}}
....

\seealso{vehicles}{ automobiles; trucks;
vans}
```

MakeIndex supports annotated page numbers for tables and illustrations, and special fonts (e.g., bold or italics) for substantial discussions. *MakeIndex* alphabetizes spaces in index headings before letters, which conforms to word-by-word alphabetization. *MakeIndex* uses only page numbers, not chapter numbers or paragraph numbers.

Scribus

Scribus, a page layout package, at the time of writing (May 2006), provides no indexing facility at all. In a way, this situation provides the best opportunity to create a great indexing facility from scratch.

MOM (groff)

MOM is a set of macros for the groff typesetting package. At the time of writing (May 2006), the author, Peter Schaffter, is looking at different options for adding an indexing facility.

Conclusions

The index can often be the most heavily used “chapter” in any publication. In large volumes of technical documentation, an effective index remains key to the investment paying off in terms of the user finding an answer to his or her problem. Yet despite its importance, the art of indexing remains an enigma to most. Developing a workable specification for an indexing facility means spending considerable time studying existing indexes from many

¹⁵ See Harold Thimbleby <<https://www.tug.org/TUGboat/Articles/tb12-2/tb32thim.pdf>>.

ources, reading the reference material on indexing, talking to practitioners, and learning from past efforts.

OpenOffice and OpenDocument Format have showed an effort to redefine indexing as keywords with database keys. While such new concepts can be integrated with traditional back-of-the-book indexing, the basics still need to be covered fully. Hypertext, for example, has not eliminated essential writing structures such as sentences and paragraphs. Similarly, any new indexing facility needs to encompass “See” and “See also” cross-references. Open source is all about freedom and choice, including the ability to choose which paths to follow— old and new.

The problem of how to create an effective indexing facility for OpenOffice, Scribus, MOM and other open source publishing tools offers a “hidden” opportunity of immense magnitude. In a world of rapidly expanding information, just finding it has become the central problem. Creating the tools for “finding” can bring users, practitioners and developers closer together.

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Fred coauthored *Index It Right! Advice from the Experts* (Vol. 1). He is also a recipient of the Australian and New Zealand Society of Indexers (ANZSI) Web Indexing Award (see <http://www.aussi.org/prizes/webindexawards.htm>) for the Writer's Block web index (see <http://www.writersblock.ca/common/index.htm>).

Fred is writing an article series on information retrieval—from back-of-the-book indexes to digital libraries—with special attention to open standards and open source for KnowGenesis International Journal for Technical Communication (IJTC).

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