# Potential of Bibliographic Tools to Organize Knowledge on the Internet: The Use of Dewey Decimal Classification Scheme for Organizing Web-based Information Resources

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**ABSTRACT**: Possibilities are being explored to use traditional bibliographic tools, like Dewey Decimal Classification (DDC), Library of Congress Classification (LCC), Library of Congress Subject Headings (LCSH), and Universal Decimal Classification (UDC), to improve the organization of information resources on the Internet. The most recent edition of DDC, with its enhanced features, has greater potential than other traditional approaches. A review of selected Web sites that use DDC to organize Web resources indicates, however, that the full potential of the DDC scheme **for** this purpose has not been realized. While the review found that the DDC classification structure was more effective when compared with other knowledge organization systems, we conclude that DDC needs to be further enhanced to make it more suitable for this application. As widely reported in the professional literature, OCLC has conducted research on the potential of DDC for organizing Web resources. Such research, however, is experimental and should be supplemented by empirical studies with user participation.

**KEYWORDS:** Internet Information Resources; Information Organization; Knowledge Organization Systems; Dewey Decimal Classification

## Introduction

The Internet and other telecommunication and information technologies have made possible unprecedented opportunities for creating and distributing information. The standards, tools, and systems for the presentation and organization of information on the Internet, however, have not developed accordingly. As noted by Peter Gillman (1997), while the Internet has grown, effective information retrieval has correspondingly decreased. Despite the usefulness of Web search engines and their associated features, significant weakness remain (Hudson, 2000; Koch, 1996; Webster and Paul, 1996, and Vellucci, 1996). In an effort to improve retrieval effectiveness, some libraries and librarians are exploring the application of library knowledge organization systems to organize electronic resources. Such applications are employing term lists, indexing thesauri, and traditional classification systems, notably the Dewey Decimal Classification (DDC) system and the Library of Congress Classification (LCC) scheme. There appears to be a trend toward the use of such tools by some in the library community. Diane Vizine-Goetz (1996) and Traugott Koch et al. (1997) maintain that classification schemes have a long tradition of use for organizing information resources in libraries and therefore they can also be used to effectively organize Internet resources. A number of Web sites have indeed applied library classification schemes and controlled vocabularies to manage Internet resources (McKiernan, 2000) and their popularity indicates their potential for facilitating information retrieval for electronic resources (Koch, 2000). The OCLC Office of Research has investigated the application of DDC for this purpose (Vizine-Goetz, 1996). While some library organizational methods may provide more efficient and effective access to Internet resources, this claim has not yet been extensively evaluated by empirical research. In this paper, we review several studies that describe the use of traditional library organizational schemes and approaches to manage access to Web resources. We focus on the use of the Dewey Decimal Classification scheme and discuss the use of its enhanced features such as supplemental terminology, revision of captions, and use of controlled vocabulary (Vizine-Goetz, 1997). We conclude with a recommendation that empirical research be conducted to ascertain the effectiveness of DDC for enabling effective identification and retrieval of Internet resources.

## Use of Traditional Organizational Approaches in the Internet Environment

In one of the first reviews of its type, David G. Dodd (1995) examined the structures and principles of various hierarchical lists used by a variety of Web sites and compared these with the Library of Congress Classification (LCC) scheme, the Dewey Decimal Classification system, and the Library of Congress Subject Headings (LCSH). This study focused on the dichotomy between the hierarchical 'browse' and the analytic 'search' approaches for locating Internet resources. He reviewed the principles of categorization and terminology for a select subset of available subject-oriented Web directories (Yahoo!, Magellan, and the Whole Earth Catalog) and search engines (Lycos and InterCat). Dodd concluded that search capability is optimal for known items; however, when items were not known, browsing was more effective. He observed that the categories within Magellan were similar to those of the Library of Congress.

Vizine-Goetz (1996) compared 1-10 and 35-45 of Yahoo's top most popular categories with that of DDC and LCC. The results are shown in Table 1. All but four Yahoo categories (7, 36, 41, and 45) mapped to explicit DDC or LCC numbers or ranges. Although DDC and LCC both contain provisions for subdivision by geographical area within topics and a geographical breakdown for historical works, no direct mapping could be made for categories 36 and 45 which are essentially geographic areas subdivided by topic. For category 7 (Magazines) all three schemes provided a topical breakdown. Category 41 (Humor, Jokes, and Fun) was the most disperse when translation to DDC or LCC was attempted. The mappings of the categories indicated that DDC and LCC had sufficiently wide topic coverage for classifying Internet resources. This result was not surprising given that DDC and LCC numbers had been successfully assigned to well over 1.5 million items by the Library of Congress alone, resulting in more than 340,000 unique LCC classes and 280,000 unique DDC classes. A comparison of categories used by three main systems is shown in Table 1.

Koch et al. (1997) reviewed major classification schemes that are used on the Internet. These include DDC, UDC, LCC, Nederlandse Basisclassificatie (BC), Sveriges Allmama Biblioteksforening (SAB), Iconclass, National Library of Medicine (NLM), Engineering Information (EI), Mathematics Subject Classification (MSC), and the ACM Computing

*Table 1: Comparison of Yahoo Categories with DDC and LCC*

| Yahoo | DDC | LCC |
|---|---|---|
| 1. Entertainment | Performing arts (791-792) and by subject | Performing arts (PN) and by subject |
| 2. Computers and Internet | Computers; Internet (004-006) | Computer Science; (QA76+) & Telecommunication (TK 5105) |
| 3. News | News media; Broadcast media (070.1+; 302.23+) | Newspapers (AN), Journalism & Broadcast news (PN4699-5648) |
| 4. Recreation | Recreation (793-799) | Recreation. Leisure (GV) |
| 5. Business and Economy | Economics (330-390) | Economics (H-HJ) |
| 6. Society and Culture | Religion (200), Social groups (305) & Culture and Institutions (306) | Religion (BL-BX), Sociology (HM), The family. Marriage. Women (HQ), Social and Public welfare (HV) |
| 7. Entertainment: Magazines | General periodicals (050) and by subject | General periodicals (AP) and by subject |
| 8. Entertainment: Movies and Films | Motion pictures (791.43) | Motion pictures (PN1995.5) |
| 9. Education | Education (370) | Education (L) |
| 10. Arts | The Arts (700-799) | Fine arts (N) and by topic |
| 35. News: International | International news (070.4332) | Newspapers (AN) and by place, event |
| 36. Regional: Countries | No direct mapping; geographical; treatment by subject or historical treatment by geographical area | No direct mapping; geographical; treatment by subject or historical treatment by geographical area |
| 37. Arts: Photography | Photography (770) | Photography (TR1-1050) |
| 38. Computers and Internet: Multimedia | Multimedia systems (006.6) | Computer Science (QA76+) and by subject |
| 39. Entertainment: People | Performers (Entertainers) (791.092) | Fine arts: Performing arts (NX1-820) |
| 40. Society and culture: Relationships: Dating | Social Sciences: Customs: Life cycle: Dating (306.7+; 392.6; 646.7+) | Social Sciences: The Family. Marriage. Woman: Dating (HQ801-801.83) |
| 41. Entertainment: Humor, Jokes, and Fun | No direct mapping by literary form and, subject | No direct mapping by literary form and subject |
| 42. Business and Economy: Markets and Investments | Finance and investments | Social Sciences: Finance (HG) |
| 43. Social Science | Social Sciences (300-399) & History (900-999) | Social Sciences (H-HX) & History (D-DL, DS, DT, E-F) |
| 44. Entertainment: Television: Shows | Television (791.45) | Drama: Television: Broadcasts (PN1992.8) |
| 45. Regional: U.S. States | No direct mapping; geographical; treatment by subject or historical treatment by geographical area | No direct mapping; geographical; treatment by subject or historical treatment by geographical area |

*Source: Vizine-Goetz (1996)*

Classification System (CSS). Projects that attempt to apply classification in automated services were also described including the Nordic WAIS/WWW Project, Project GERHARD, and Project Scorpion. The study examined the topology of classification schemes, extent of use in Internet services, integration between classification schemes and other systems (e.g. controlled subject headings), their strengths and weaknesses, linking to third party classification data, digital availability, copyright issues, and development efforts of the schemes. DDC was found to be the most widely used scheme in Internet services. Both LCC and DDC were integrated to some extent with LCSH. Other schemes were integrated with relevant subject schemes, such as NLM to MeSH and Ei to the Ei thesaurus. Most of the schemes were available in some type of digital format. It was also found that the use of classification scheme depends upon the scope of the Internet service.

Nancy J. Williamson (1997) investigated the knowledge structure of the Internet by focusing on the services that were using classification schemes for organization. Thirty-eight sites were using classification systems for organization. Each of these sites was accessed and data were recorded on the following: name of the classification system used, presence of an index to the classification online, nature of trees, level of division applied, adaptations to the system, method of display, and any special characteristics of the application. A total of nine sites (three each from LCC, DDC and UDC) were selected and searches were carried out under the following topics: art, history, health information, and travel. These same topics were also searched on sites that were not organized using classification structures. The data collected were used to determine the characteristics, trends, and problems with application of these systems. It was revealed that in most cases the use of a classification system was fairly superficial. Most sites used only the first two levels of division from a scheme. After level two or three, classified order was usually abandoned in favor of alphabetical order or some order whose rationale would not be readily apparent to a searcher. The larger the database the less satisfactory was the organization. However, notable experiments were CYBERDEWEY using DDC, WWW Virtual Library using LC, and BUBL's early experimentation with UDC. The study concluded that classification systems, if used properly, provide a framework to organize the Web resources and improve retrieval at the topical and site level.

Gerry McKiernan (1998) reviewed the various frameworks, features, and functionality of selected sites that have adopted standard library classification schemes or controlled vocabularies to enhance access to WWW resources. The common elements reviewed were site characteristics, navigation, presentation format, selection, features, and participation. A series of queries were posted to several *listservs* and *newsgroups* in order to identify Web sites that had applied a structured framework for organizing Internet resources. *CYBERSTACKS*, *CYBERDEWEY*, and EELS were found to be among the increasing number of quality sites that had applied standard schemes to provide enhanced access to Internet resources. It was common for many sites to display secondary and tertiary classifications with their associated resources as a continuous listing (Morton Grove Public Library). The structure required users to scroll through entire lists to locate sources of interest. A number of sites were hierarchically organized and required users to navigate levels of classes and subclasses (Utah State Library, *CYBERSTACKS*). ARIADNE had a unique display option that permitted users to view not only entries for a selected sub-category within a sub-class, but a complete listing of all entries within the broader sub-class, on demand, as well. Sites that made use of the controlled vocabulary typically displayed an A-Z index (Colorado Alliance of Research Libraries, University of Texas at Arlington) or displayed the broader headings within a scheme as the initial page display (Oregon Health Science University Library). Navigation within sites ranged from explicit broader or narrower hierarchical level, to collection-wide browsing, single subclass navigation only.

A number of Subject-based Information Gateways (SBIGs) are also using a browseable classified structure in addition to a searchable index. These subject gateways emerged in response to the challenges of 'resource discovery' in a rapidly developing Internet environment in the early and mid-nineties. More frequently reported among these are SOSIG (Social Science Information Gateway), EEVL (Edinburgh Engineering Virtual Library), OMNI (Organized Access to Medical Networked Information), ADAM (Art, Design, Architecture and Media), Biz/Ed, BUBL Link, CYBERDEWEY, CYBERSTACKS, etc. (Dempsey, 2000). These gateways are using different types of classification tools to provide subject structures. Notable among the sites using Universal Decimal Classification (UDC) are: GERHARD, NISS Information Gateway, OMNI, SOSIG, Nordic WAIS, Informazioni Classificate per Discipline, and Tampereen Yliopiston Virtuaikirjasto: Aiheet UDK-Jarjestyksessa. Since the scheme has certain shortcomings, as described by Koch et al. (1997), its use has been limited. The BUBL Link started with UDC and later changed to DDC. SOSIG and OMNI also plan to stop using UDC. The use of LCC has also been reported by several sites including: CYBERSTACKS, the WWW Virtual Library, Cooperative Online Resource Catalog (CORC), Library of Congress Classified Guide to Astronomy, On-line Books Page: Call Numbers, Reference on the Internet, Scout Report Signpost, and T.F. Mills Home Page. LCSH is being used in NetFirst, NISS, and INFOMINE. Table 2, from McKiernan (2000), shows the sites using UDC and LCC.

McKiernan (2000) reported 19 sites that were using DDC for organizing the Internet resources. We added five more sites to the list and reviewed the use of

*Table 2: Use of UDC and LCC in Subject Gateways*

| *UDC* | **LCC** |
|---|---|
| Directory of Networked Resources: UDC "Shelfmark" Order (NISS Information Gateway) | Cooperative Online Resource Catalog (CORC) |
| GERHARD: German Harvest Automated Retrieval and Directory | CyberStacks(sm) |
| Informazioni Classificate per Discipline | ICRC: Internet Collegiate Reference Collection |
| Tampereen Yliopiston Virtuaalikirjasto: Aiheet UDK-järjestyksessä | On-Line Books Page. Call Numbers / Subjects |
| WWW Subject Tree of WAIS Databases (Nordic WAIS/World Wide Web Project) | Ready Reference Using the Internet |
| | Scout Report Signpost |
| | Web Resources Arranged by the Library of Congress Classification System |

*Source: McKiernan (2000)*

DDC by these sites. The list of sites using DDC is given in Table 3. The review was restricted to the information available on the respective Web site. Most of the sites reviewed were using DDC at a basic level, displaying notation corresponding to its caption(s). Captions had not been revised to make these more understandable for the end-user. For example, CYBERDEWEY has used 000 (Generalities) in its traditional context. It does not have a caption for *computer science* or *Internet* at its first hierarchical level. As a result, a context for subjects like computer science cannot be established. In some instances, for example, in the case of Dewey Browse, the captions used do not represent the whole class. We have also observed that the treatment is at a minimal level. In certain cases, the user cannot employ DDC beyond the second or third level of hierarchy. Most of the sites provide only browsing capabilities and no searching option is made available. Sites like ADAM and BUBL provide only a limited searching facility along with browsing. Generally, these services did not go beyond the structure and terminology found in the earlier editions of DDC. Their use of enhanced features of DDC appears to be limited thus preventing them from exploiting DDC to its fullest potential. The flexible structures and enhanced terminology that are available in the electronic version of DDC can improve the organization of Web-based resources for effective and efficient retrieval, if the capabilities provided through enhanced DDC features are fully utilized.

We also compared the categories in the area of *Business and Economy* of DDC with the Yahoo categories and found significant differences in terminology used to represent categories. Subject categories provided by DDC seem to be more general as compared to Yahoo! Sub-categories of Yahoo! that do not belong to the main category are represented by using an @ sign just after the term (e.g. Law@). This shows that a relationship between two categories exists. Some of the categories in DDC belong to economics whereas Yahoo! has categorized these under Business & Economy (e.g. Cooperatives). DDC captions are based on literary warrant whereas Yahoo uses its own directory structures and new categories are added when required. The larger topical hierarchy makes Yahoo! harder to navigate. In addition, users might not know where to start. Our observations are in accordance with Jakob Nielson's (1998) assertion that as the Web grows, Yahoo!'s usability will ultimately suffer unless better classification methods are discovered. Table 4 shows categories in Yahoo! and DDC in the area of Business and Economics.

## Future Prospects of DDC

While DDC has been in use for a long time as a book classification scheme, its enhanced features have made it a promising candidate for use in the network environment. The 21st edition of the DDC, published in both print and electronic versions, exhibits several major enhancements, including expansions of the Dewey knowledge base, changes in structure, and revision and updating of terminology. Recent experiments and research studies on the use of DDC as a browsing tool in the Web environment have also shown encouraging results.

OCLC is conducting research to determine what additional features are needed to make DDC more

*Table 3: Use of DDC on the Web*

| Name/Acronym | URL | Status | Controlled Vocabulary | Search Options | Subject | Level |
|---|---|---|---|---|---|---|
| ADAM: Art, Design, Architecture & Media Information Gateway: Index+ Dewey Search | http://adam.ac.uk/advanced/dsearch.html | Operational | ADAM Thesaurus & ADAM Subject Headings | Browse & Keyword | Art & Architecture | N.A. |
| Blue Web'n Browse by Subject Area | http://www.kn.pacbell.com/wired/bluewebn/ | Operational | None | Browse & Keyword | Education | First |
| Browse LINK by DDC (BUBL) | http://link.bubl.ac.uk/ISC2 | Operational | LCSH | Browse & Keyword | All | First |
| Canadian Information By Subject (National Library of Canada) | http://www.nlc- *bnc.ca/caninfo/esub.htm* | Operational | LCSH, CSH, RVM | Browse & Keyword | Canadian Information | Fourth |
| Cataloguer's Virtual Reference Shelf | http://vrl.tpl.toronto.on.ca/internet/01net_f.html | Operational | None | Browse & Keyword | All | N.A. |
| Co-operative Online Resource Catalog (CORC) | http://www.oclc.org/news/oclc/corc/index.htm | Operational | LCSH | Browse & Keyword | All | |
| CyberDewey | http://ivory.lm.com/~mundie/CyberDewey/CyberDewey.html | Operational | None | Browse | All | Fourth |
| Internet Public Library Online Texts Collection | http://www.ipl.org/reading/books/ | Operational | Dewey Captions | Browse & Keyword | All | Third |
| The Internet Resource (Napier University) | http://www.napier.ac.uk/depts/library/intres/ir000999.html | N.A. | - | - | - | - |
| Mt. Laurel Hartford School's Library Without Walls (Resources for Students) | http://209.27.186.150/mc/index.html | Operational | None | Browse | All | First |
| Net Sites by the Numbers (Tempe Public Library) | http://www.tempe.gov/library/netsites/ | Operational | None | Browse & Search | All | Second |
| New Athenaeum: Internet Resource Guides Developed by Libraries | http://members.spree.com/athenaeum/mguide1.htm | Under Reconstruction | - | - | - | - |

(continued on next page)

suitable for organizing large collections of electronic documents, especially on the Internet. These projects are focusing on increasing the terminological data bank and providing links to other access systems. In this regard, adding LC subject headings to DDC indexes seems to be a step forward. The Dewey editorial staff review newly approved LC subject headings and pair them with candidate DDC numbers and then post them to the Dewey home page. The second kind of linking between DDC class number and LC subject heading is based on statistical associations between the classification number and first occurring subject heading in metadata records (Vizine-Goetz, 1997).

Significant progress has also been made in the revision of DDC captions into end-user language. Vizine-Goetz (1999) has reported that in a recently completed study, 1,848 DDC captions have been reviewed and revised. It was designed to test the ability of library school students to navigate the DDC summaries to find Internet resources on a wide variety of topics.

*Table 3: Use of DDC on the Web* (continued from previous page)

| Name/Acronym | URL | Status | Controlled Vocabulary | Search Options | Subject | Level |
|---|---|---|---|---|---|---|
| PICK: Quality Internet Resources in Library and Information Science: Full Text Documents (Thomas Parry Library, University of Wales, Aberystwyth) | http://www.aber.ac.uk/~tplwww/database/archives.html | Operational | None | Browse & Search | Library & Information Science | Sixth |
| Science Net: Subject (Toronto Public Library) | http://www.kirjasto.sci.fi/lindex.htm | Terminated | - | - | - | - |
| SORT: School's Online Resources for Teachers: Browse | http://www.campus.ort.org/Library/frame.asp?Page=resources/browse.asp | Operational | Dublin Core | Browse & Search | Education | N.A. |
| xmlTree: Directory of Content | http://www.xmltree.com/ | Operational | None | Browse & Search | Extendable Markup Language (XML) | Second |
| WWLib Browse Interface (Wolverhampton Web Library) | http://www.scit.wlv.ac.uk/wwlib/browse.html | Operational | None | Browse & Search | All | Sixth |
| **DewPoint** | http://ivory.lm.com/~mundie/DDHC/DDH.html | Operational | None | Browse | All | First |
| Iowa Virtual Library | http://iowa-counties.com/libraries/index.htm | Operational | None | Browse | All | First |
| Dewey Browse | http://www.sau29.k12.nh.us/library/Dewey/dewey_browse_2.html | Operational | None | Browse | All | Sixth |
| Dewey Decimal Home Page | http://mailer.fsu.edu/~thart/dewey/ | Operational | None | Browse | Education | First |
| The Mathematical Atlas | http://www.math.niu.edu/~rusin/known-math/index/DDC.html | Operational | None | Browse | Mathematics | First |
| Webrary | http://www.Webrary.org/ref/Weblinksmenu.html | Operational | None | Browse & Search | All | First |
| United States Embassy, Israel | http://www.usis-israel.org.il/publish/vir_lib/links/dewey/dewey.htm | Operational | None | Browse | All | First |

The study resulted in a number of recommendations for improving end-user understanding of DDC captions and some prototype displays of a restructured DDC. Enriching the DDC with additional subject terminology greatly enhances its potential for retrieval without demanding changes to its structure.

The development of the NetFirst database is another step forward in making DDC more suitable for organizing the Web-based information. Mitchell and Vizine-Goetz (2000) have reported that a Dewey Web Browser has also been developed by OCLC. It is based on the classification structure of DDC using 14 main categories for knowledge representation. The main interface has been launched on the Web (*http://www.oclc.org/%7Evizine/Dewey_Browse)* and the prototype is still under development.

Several studies have described projects that demonstrate the potential of use of DDC's enhanced features

*Table 4: Comparison of DDC and Yahoo*

| **DDC (Economics 330 & Business 650)** | **Yahoo (Economics)** | **Yahoo (Business & Economy)** |
|---|---|---|
| Labor Economic (331) | Accounting and Auditing **(DDC 657)** | Business Libraries |
| Financial Economics (332) | Agricultural Economics@ | Business Schools@ |
| Economics of Land & Energy (333) | Calendars | Chats and Forums |
| Cooperatives (334) | Central Banks | Classifieds |
| Socialism & Related Systems (335) | Commentaries | Consortia |
| Public Finance (336) | Conferences | Consumer Advocacy and Information@ |
| International Economics (337) | Currency | Conventions and Conferences |
| Production (338) | Economics Policies and Regulations | Cooperatives **(DDC334)** |
| Macroeconomics & Related Topics (339) | Economists | Directories |
| Business, General (650) | Education | Economics@ |
| Office Services (651) | Environmental Economics@ | Education |
| Processes of Written Communication (652) | Expert Witnesses@ | Electronic Commmerce |
| Shorthand (653) | Finance | Employment and Work |
| Accounting (657) | Finance and Investment@ | Ethics and Responsibility |
| Management (658) | Game Theory | Finance and Investment |
| Advertising & Public Relations (659) | Government | Global Economy |
| | History | History@ |
| | Institutes | Intellectual Property@ |
| | Journals | Labour **(DDC 331)** |
| | Libraries | Law@ |
| | Management Science@ | Magazines |
| | Nobel Prize in Economic Sciences@ | Management Science **(DDC 658)** |
| | Organizations | Marketing and Advertising **(DDC 659)** |
| | Papers | News and Media@ |
| | Political Economy | Organizations |
| | Poverty | Quality Standards@ |
| | Statistics and Indicators | Real Estate |
| | | |
| | Utilitarianism | Small Business Information |
| | Web Directories | Statistics and Indicators |
| | Usenet | Taxes@ |
| | | Television@ |
| | | Trade |
| | | Transportation |

in the Web environment. They have described the development of a DDC Taxonomy Server that is expected to offer a publicly accessible automatic metadata creation tool that returns metadata encoded in XML. Ardo, et al. (2000) have provided details about an experiment being carried out by NetLab and OCLC to explore simple methods of automatic classification to provide subject browsing. Olson and Ward (2000) have described a vocabulary mapping project related to *A Women Thesaurus (http://www.ualberta.ca/~holson/femddc/)*. Koch and Ardo (2000) have given details of the DESIRE II project of automatic classification and content navigation support for Web services. These studies demonstrate a promising future regarding the use of DDC in the network environment. But all these projects are still in the experimental stage and need to go through objective testing.

## Conclusion

Organizing information on the Internet has been a challenging task. The latest enhancements in DDC and the experiments being conducted to study its use

in the Web environment demonstrate the great potential of DDC for providing an effective support in organizing Web-based information. A review of the sites that are currently using DDC, however, has not painted a promising picture. These sites do not seem to be exploiting the capabilities of DDC in an innovative manner. One would have expected this trend to change after the extensive enhancements into DDC. Compared to other bibliographic tools, DDC seems to have better potential for Internet resource discovery. The information available from research studies and still uncompleted experiments on the use of DDC to organize Web based resources does not permit one to confidently conclude that this tool will solve most of the problems related to the organization of Internet information resources. The present literature dealing with the assessment of the use of classification schemes in general and DDC in particular gives only a broad overview of the way it is being used by various Internet organizations. There is a need to conduct studies to evaluate the use of DDC from the end user perspective, where contents are becoming more important than documents in the indexing and organization of resources. Also, empirical data is needed to objectively assess the capabilities of DDC to handle dynamic documents presented on the Web. User studies of respective domains on the Internet will also be helpful toward this end.

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