

Using Combined Metadata Sources to Visualize a Small Library (OBL's English Language Books)

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Abstract

Data from multiple knowledge organization systems are combined to provide a global overview of the content holdings of a small personal library. Subject headings and classification data are used to effectively map the combined book and topic space of the library. While harvested and manipulated by hand, the work reveals issues and potential solutions when using automated techniques to produce topic maps of much larger libraries. The small library visualized consists of the thirty-nine, digital, English language books found in the Osama Bin Laden (OBL) compound in Abbottabad, Pakistan upon his death. As this list of books has garnered considerable media attention, it is worth providing a visual overview of the subject content of these books—some of which is not readily apparent from the titles. Metadata from subject headings and classification numbers was combined to create book-subject maps. Tree maps of the classification data were also produced. The books contain 328 subject headings. In order to enhance the base map with meaningful thematic overlay, library holding count data was also harvested (and aggregated from duplicates). This additional data revealed the relative scarcity or popularity of individual books.

Introduction

Information Visualization has the potential to reveal the structure, dynamics, properties, and idiosyncrasies of knowledge organization systems (*see* (Börner et al., 2007)). Visualization also has the ability to utilize data from multiple knowledge organization systems to provide global overviews of the content holdings of libraries. The authors use a small, personal library, to demonstrate proof of concepts related to the combined use of subject headings and classification data to effectively map books in topic space. While harvested and manipulated by hand, the work reveals issues and potential solutions when using automated techniques to produce content maps of much larger libraries.

Related Work

Knowledge organization systems (KOS's) have been used to visually enhance the result list in a literature database search (Doms & Schroeder, 2005; "gopubmed,"). Also, KOS's have themselves been visualized. *LCSH Galaxy* utilized the subject authority records for the Library of Congress Subject Headings to visualize the node-link network of its syndetic structure (Gleich, 2009; Stanford University's

CADS & LOC's Office of Strategic Initiatives, 2009a). Absent other associative hooks to make the content manageable, the group limited the subject headings shown to “only headings used over 500 times or that have more than 150 related headings” (Stanford University's CADS & LOC's Office of Strategic Initiatives, 2009b). Polley and Marshall used LCSH data and node-link diagrams to visualize the circulation frequency of books in eighteen subject areas of a small college library (Polley & Marshall, 2015). Wikipedia's category structure and the Universal Decimal Classification system have been visualized in their entirety and compared (Salah et al., 2011). Ahn, Lin, Khoo and their collaborators have automatically assigned Dewey Decimal Classification (DDC) numbers to various digital libraries and have then visualized the DDC landscape based on co-assignment of class numbers between documents (Lin et al., 2015; Lin et al., 2017). This is an example of going beyond linked and hierarchical data and using an additional associative hook (co-assignment of class numbers) to more rigorously map a KOS. Klingemann used crowd-sourced tags from Flickr of images in books taken from the Internet Archives to create The Internet Archive's Map of Book Subjects (Klingemann, 2014). Benenson maps the overlap of cultural figures based on shared books they found influential (Benenson, 2012).

Data

On May 2, 2011, United States special forces killed Osama Bin Laden (OBL) in his compound in Abbottabad, Pakistan. In his possession were digital editions of English language books (BBC News, 2015). Amongst many other types of documents (letters, software and technical manuals, “Materials Regarding France,” etc.), thirty-nine English language books are listed by Office of the Director of National Intelligence as having been found in the OBL compound (Office of the Director of National Intelligence, 2015). As this list of books has garnered considerable media attention (Boyer, 2015; Jacobson, 2015; Worland, 2015) *but see also* (Hersh, 2015; Sankin, 2015), it is worth providing a visual overview of the subject content of these books—some of which is not readily apparent from the titles. (E.g. *The Taking of America 1-2-3*, applicable subject heading: Kennedy, John F. (John Fitzgerald), 1917-1963 -- Assassination.). *See* complete OBL English language bibliography in Appendix 1. Thirty-six of these items have entries in WorldCat with accompanying subject headings and Library of Congress and Dewey Decimal classification numbers. *See* Appendix 2 for the three works without sufficient WorldCat data.

This combined data was used to create book-subject maps and tree maps of the English language books in OBL's possession. Thirty-six works produced 328 subject headings. *See* **Table 1** for a breakdown of the subject types. In order to enhance the base map with meaningful thematic overlay, library holding count data was also harvested (and aggregated from duplicates).¹ This additional data revealed the relative scarcity or popularity of individual books.

¹ Count data limited to the search categories: Books, Computer Files, Internet Resources, and Microforms (Archival Materials) (Excluded: Visual Materials, Serial Publications, Sound Recordings, Continually Updated Resources, Articles, Musical Scores, and Maps.)

Table 1: Count of Subjects by Type

Subject Type	Count Of Subject Type
Descriptor:	205
Geographic:	71
Time:	15
Named Corp:	13
Named Conf:	10
Genre/Form:	8
Named Person:	6

Methods

Disparity as to Amount of Subject Headings

Not all WorldCat entries for the same work include the same amount of, or the same subject headings. Except as noted, subject headings were harvested from the WorldCat entries with the largest amount of “Libraries worldwide that own item.” Similarly, different OCLC entries for the same work might have different metadata such as Library of Congress classification number. For instance, in the following case with *Project MKULTRA*, subject headings were harvested from the more expansive OCLC entry:

Accession No: OCLC: 3735254 (*Project MKULTRA*)

Descriptor: Behavior modification -- Research -- United States.
 Behavior modification -- Research.
 Named Corp: United States. Central Intelligence Agency.
 United States. Central Intelligence Agency.
 Geographic: United States.
 LC: KF26.5

Accession No: OCLC: 808515317 (*Project MKULTRA*)

Descriptor: Behavior modification -- Research -- Moral and ethical aspects -- United States.
 Descriptor: Human experimentation in psychology -- Moral and ethical aspects -- United States.
 Descriptor: Abuse of administrative power -- United States.
 Descriptor: Psychological torture -- Moral and ethical aspects -- United States.
 Descriptor: Psychotropic drugs -- Research -- Moral and ethical aspects -- United States.
 Descriptor: Brainwashing -- Research -- Moral and ethical aspects -- United States.
 Descriptor: Informed consent (Medical law) -- United States.
 Descriptor: Official secrets -- United States.
 Descriptor: Medical ethics -- United States.
 Descriptor: Behavior modification -- Law and legislation.
 Descriptor: Behavior modification -- Research.
 Named Corp: United States. Central Intelligence Agency. Office of Scientific Intelligence -- Corrupt practices.

Named Corp: United States. Central Intelligence Agency.
Geographic: United States.
LC: HV8599.U6

Omitted Subject Headings

All non-English language subject headings were omitted. As to Genre/Form subject headings, “form” type subject headings (“Electronic Books”; “Interviews”) were omitted but “genre” type subject headings (“History”) were retained.

Deduplication

Geographic: USA. **Use:** United States. Whenever there were more than one variants of a Named Person, the more specific one was retained and used (Perkins, John, 1945- **Use:** Perkins, John M., 1945-).

Treemaps

In addition to the subject headings on WorldCat, both Dewey and Library of Congress classification numbers were harvested in order to produce Treemaps (Shneiderman, 1992) of the hierarchical classification data for the OBL network. Treemaps at three differing levels of specificity in the hierarchy were produced with the analytical and visualization software tool, Tableau.

Original Book/Subject Network

Figure 1 shows the Bin Laden book/subject network in its entirety as visualized using the network visualization software, Pajek (Batagelj & Mrvar, 1998, 2017). The visualization was produced using the draw window and the original layout energy of the spring-force algorithm, Fruchterman-Reingold 2d (Fruchterman & Reingold, 1991). To minimize subject and book nodes from occluding one another, nodes were repositioned by hand to make the image more legible. Yet, the network remains cluttered. However, it is interesting to see the six books that do not share subject headings with other books. These are referred to as isolates and there are six of them: (1) *2030 Spike*, (2) *Guerrilla Air Defense*, (3) *Handbook of International Law*, (4) *Necessary Illusions*, (5) *Secrets of the Federal Reserve*, and (6) *Unfinished Business*. Ideally, these isolates will be connected in a principled manner to the main body of the map (greatest connected component) through either subsequent refinement of the subject headings or inclusion of the classification hierarchical structure.

Subsequent Refinements

Given, the unwieldy bulk of the original book/subject network, the authors propose the following principled steps to reduce the clutter while still preserving the subject matter insights provided by the metadata. (1) All periods “.” should be removed as these are unnecessary to display on the map. (2) All near equivalent subject headings should be standardized. The similar, but non-identical subject assignments most likely resulted from different subject heading methodologies used by libraries around the world. The variants are interesting in a study of subject heading origin and use, but unnecessarily clutter the map. Consequently, they should be unified and controlled. *See Table 2.* This process was assisted by an alphabetical sort of the subject headings. (3) Subjects that appeared in all capital letters should be standardized to the appearance of the other subject headings (e.g. CENSORSHIP became Censorship).

Table 2: Near Variants of Subject Headings that were Unified and Controlled

Preferred Subject Heading	Original Node Number	Eliminated Subject Heading	Original Node Number
Afghan War, 2001-	45	Afghan War (2001-)	43
al-Qaida	48	Qaida (Organization)	207
		Qaida.	208
Cold War (1945-1989)	72	Cold War	73
Conspiracies	75	Conspiracy	76
International law	132	Law -- International	153
September 11 Terrorist Attacks, 2001	214	September 11 Terrorist Attacks (2001)	213
War on Terrorism, 2001-2009	277	War on Terrorism (2001-2009)	276

Perhaps most importantly, the faceted subject headings should be broken down into their individual nodes. This includes incidences in which the facets are separated by double hyphens “--” or by periods “.” Additionally, use of “American” should be replaced by the separate node, “United States.” *See Table 3 and Figure 2.*

Table 3: Examples of Unpacking the Faceted Subject Headings

Book ID	Book Implicated	Original Faceted Subject Heading ID	Original Faceted Subject Heading	Implicated Subject ID 1	Implicated Subject Heading 1	Implicated Subject ID 2	Implicated Subject Heading 2
1	2030 Spike	221	Social Science -- Future Studies	282	Future Studies	221	Social science
1	2030 Spike	221	Social Science -- Future Studies	282	Future Studies	1	2030 Spike
25	Necessary Illusions	154	Mass media -- Censorship	62	Censorship	156	Mass media
25	Necessary	155	Mass media --	281	Political	156	Mass media

Book ID	Book Implicated	Original Faceted Subject Heading ID	Original Faceted Subject Heading	Implicated Subject ID 1	Implicated Subject Heading 1	Implicated Subject ID 2	Implicated Subject Heading 2
	Illusions		Political aspects		aspects		
25	Necessary Illusions	155	Mass media -- Political aspects	281	Political aspects	25	Necessary Illusions
35	Unfinished Business	160	Military bases, American -- Foreign countries	283	Foreign countries	264	United States
35	Unfinished Business	160	Military bases, American -- Foreign countries	264	United States	160	Military bases
35	Unfinished Business	240	United States -- Armed Forces -- Foreign countries	283	Foreign countries	284	Armed forces
35	Unfinished Business	240	United States -- Armed Forces -- Foreign countries	284	Armed forces	264	United States
35	Unfinished Business	240	United States -- Armed Forces -- Foreign countries	283	Foreign countries	35	Unfinished Business
35	Unfinished Business	240	United States -- Armed Forces -- Foreign countries	284	Armed forces	35	Unfinished Business
35	Unfinished Business	240	United States -- Armed Forces -- Foreign countries	264	United States	35	Unfinished Business

During the unpacking of the faceted subject headings, the need for two rules became clear. **Rule 1:** When all components of a faceted subject heading already exist as individual subject headings associated with the same work, merely delete the entire faceted subject heading. See **Figure 3**. **Rule 2:** When unpacking faceted subject headings, each of the individual facet nodes should be fully connected (forming a clique) with all of the other facet nodes in the original faceted subject heading AND connected to the work to which they have been assigned. See **Figure 4**. This insures that all of the component nodes are associated with each other and the work to which they were assigned in faceted form.

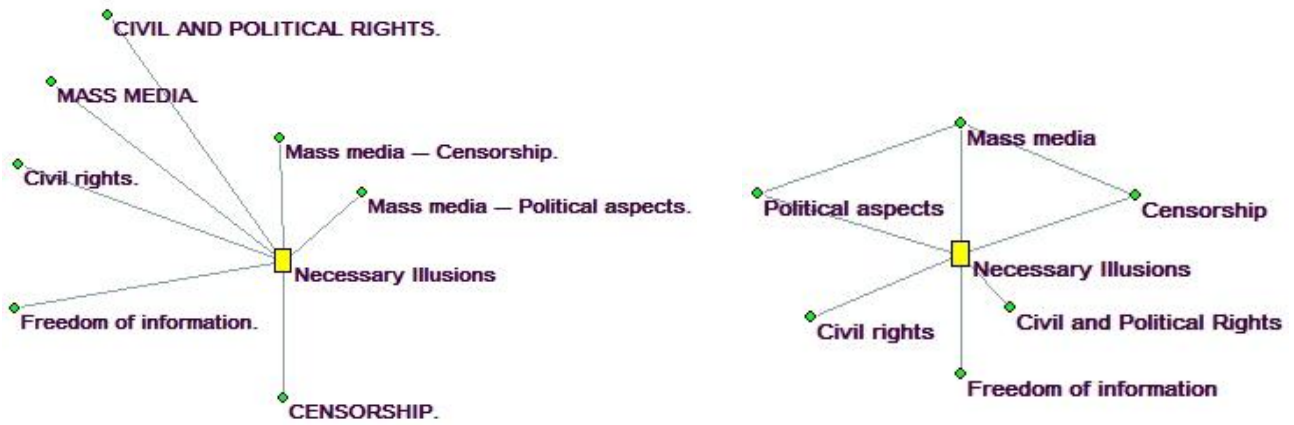


Figure 2: Modification of the Subject Headings Associated with *Necessary Illusions*



Figure 3: Modification of the Subject Headings Associated with *2030 Spike*

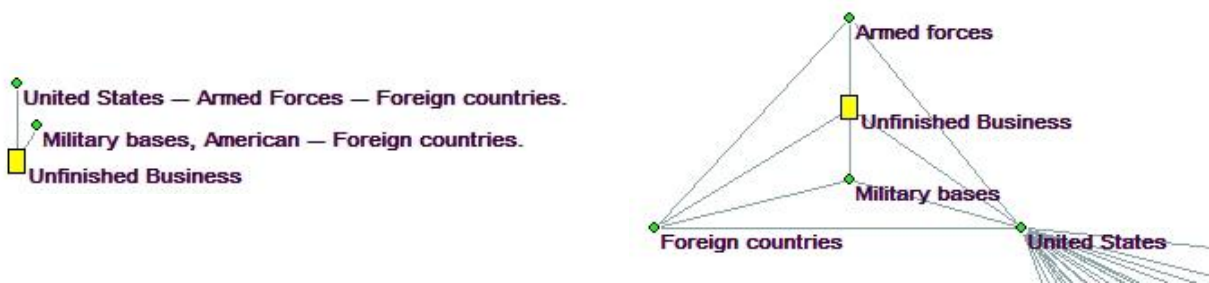


Figure 4: Modification of the Subject Headings Associated with *Unfinished Business*

Visualizing the Classification Hierarchy

In addition to subject heading assignments, both Dewey Decimal and Library of Congress classification numbers were harvested for all thirty-six works that appeared in WorldCat. Schedules freely available over the Web were used to convert the class numbers to hierarchical breakdowns and then visualized using the Treemap (Shneiderman, 1992) algorithm as implemented in Tableau. The treemaps were enhanced with images of the front covers of the books obtained from *WorldCat* and *Google Images*. See **Figures 5** through **7** for Dewey treemaps. See **Appendix 3** for Library of Congress treemaps. Color has been maintained throughout based on the first level of the hierarchy.



Figure 5: Dewey 22 Treemap First Summary



Figure 6: Dewey 22 Treemap Second Summary



Figure 7: Dewey 22 Treemap Third Summary

Converting the Classification Hierarchy to Node Link Diagrams

It is possible to conceptualize the hierarchy of classification systems as node link diagrams. As seen below in **Figure 8**, the first three summaries of the Dewey Decimal system are represented as nodes with the directional arrows pointing higher up in the hierarchy. The OBL books are placed at the end of these node link chains and represent the most specific instantiation of a particular concept. Additionally, the subtitles of the books (after the colon) are also linked to the book. Space limitations do not allow for long title strings to appear on the map. However, the subtitles appearing as separate subject nodes allow for this rich information to be conveyed in the compact space available on the map.

Metrics as to the Frequency Held

Table 4 conveys how popular or rare the books are in the OBL library. Sometimes OBL acquired best sellers. At other times, he acquired scarce or niche items that are not widely held by WorldCat participating libraries. This data is one element that can be thematically overlain on the final OBL book / subject map by varying the size of the book nodes.

Table 4: Amount of Libraries Worldwide that Hold the OBL Works (According to WorldCat)

RANK	TITLE	TOTAL HOLDINGS ON WORLDCAT
1	Rise and Fall of the Great Powers	4893
2	Obama's Wars	2955
3	Best Democracy Money Can Buy	2888
4	Confessions of an Economic Hit Man	2877
5	Imperial Hubris	2347
6	Civil Democratic Islam	2092
7	2030 Spike	2042
8	Hegemony or Survival	1898
9	New Political Religions	1803
10	America's Strategic Blunders	1341
11	Necessary Illusions	1322
12	Oxford History of Modern War	1263
13	Crossing the Rubicon	1218
14	Secret Teachings of All Ages	1107
15	International Relations Theory	1083
16	New Pearl Harbor	896
17	Handbook of International Law	865
18	U.S. and Vietnam 1787-1941	683
19	Secrets of the Federal Reserve	678
20	Rogue State	475
21	Killing Hope	465
22	Checking Iran's Nuclear Ambitions	335
23	Bounding the Global War on Terrorism	322
24	Fortifying Pakistan	316
25	Christianity and Islam in Spain	308
26	Military Intelligence Blunders	262
27	Project MKULTRA	204
28	Black Box Voting	164
29	America's "War on Terrorism"	88
30	Conspirators' Hierarchy	71
31	Understanding Islam	70

32	Best Enemy Money Can Buy	46
33	Taking of America, 1-2-3	12
34	Guerrilla Air Defense	7
35	Bloodlines of the Illuminati	6
36	Unfinished Business	5
37	Al-Qaeda's Online Media Strategies	1
38	In Pursuit of Allah's Pleasure	0
38	Website Claims Steve Jackson Games Foretold 9/11	0

Conclusions and Future work

The metadata for the works reveal that OBL was very interested in his chief adversary, the United States. Presuming the books were actually read by him, he read about himself and the War on Terror. He read about the past international dealings of the United States. He read about conspiracy theories and the occult. He read about military science and international law. The book / subject network maps, the treemaps, and the node link diagrams of the works' embedded location in the classification structure serve to provide a quick overview to the library and reading interests of OBL that goes far beyond the list of works that appears on the Office of the Director of National Intelligence's website.

The proposed modifications of the OBL book / subject network must still be completed based on the principles and procedures outlined above. Additionally, the isolates have to be fully integrated into the knowledge map using the addition of the classification network. As to the representation of the classification network, the node size should be varied to reflect the level of the hierarchy—first summaries being the largest nodes. This pilot study has uncovered methodologies and best practices to produce large scale, integrated book / subject knowledge maps using the rich metadata of more than one knowledge organization system.

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Appendix 1 – English Language Books OBL's Bookshelf

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Appendix 2 – English Language Books Without WorldCat Entries or WorldCat Entries with Insufficient Metadata

Website Claims Steve Jackson Games Foretold 9/11. (2004). Retrieved Dec. 12, 2016, from <http://icv2.com/articles/games/view/4738/website-claims-steve-jackson-game-foretold-9-11> (Not a book but a website.)

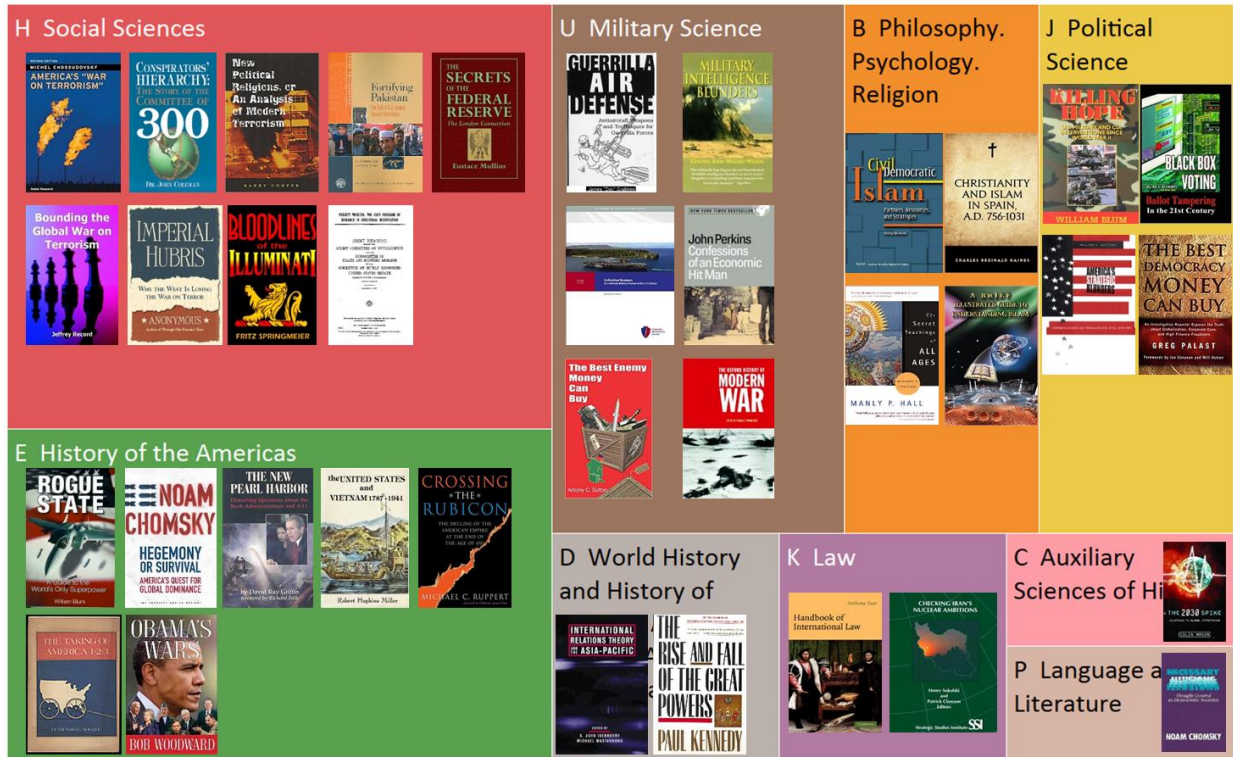
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“This book, *In Pursuit of Allah's Pleasure*” is the translation of a book titled: *Al-Meethaaq Al-Aml Al-Islami* (The Charter for Islamic Work) written by three scholars: Dr. Naajeh Ibrahim, Asim Abdul-Majid and Esaam-ud-Deen Darbaalah and released from behind the bars of Liman Turrah Prison, Egypt, in February 1984. The checking of this book was carried out by Dr. Sheikh Umar Abdur Rahman, currently serving a life sentence in the USA, for no other reason than upholding the truth.” (P. 2).

Rogan, H. (2007). *Al-Qaeda's online media strategies: from Abu Reuter to Irhabi 007*. (Master's Thesis), University Of Oslo. Retrieved from <https://www.ffi.no/no/Rapporter/07-02729.pdf>

“**Abstract:** This study examines the online media campaign of the global jihadist movement. It seeks to determine whether al-Qaeda has developed a strategy for its media operations, and to what extent the jihadist media operators adhere to such a strategy. Drawing on primary sources from jihadist websites, the study identifies a number of recommendations about the use of media offered by jihadist strategists. The study goes on to examine the jihadist media companies and the material they produce and distribute online. Analyzing online jihadist media material including text, audio and video the study seeks to identify primarily the modus operandi of the media campaign, target audiences, and strategic goals of communication. The study finds that the Internet, which allows the jihadists to exercise ownership and control over mass media outlets, has a wider functionality than mainstream media. Allowing dispersed groups and individuals to participate in the media jihad, the Internet also provides for increased quantity, diversity and decentralization of the campaign. While the jihadist online media campaign so far seems to have targeted mostly supporters of the global jihadist movement, a current trend points to increasing efforts to reach new groups, and specifically the West. This study offers a comparison between the jihadist strategic recommendations and the actual jihadist use of the Internet as a media channel, and finds a certain degree of coherence between the two. Yet, as both recommendations and media activity are multi-faceted, the study concludes that there in fact exists a number of strategies, leading to a host of jihadist online media campaigns cohabitating the web. Although the study shows that the jihadists use also other media channels than the Internet, the online jihadist media campaign is in fact growing and frequently opening new fronts, thus pointing to a jihadist perception of the Internet as a purposeful vehicle for strategic communication. (OCLC: 702141365).”

Appendix 3 – Library of Congress Treemaps with Book Images



Library of Congress Basic Classes



Library of Congress First Subclass



Library of Congress Third Level