Experts' annotation behavior in relation to audiovisual content: a case study of the film domain

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ABSTRACT
In this paper we describe a proposal for researching the annotation behavior of experts in the audiovisual domain, more specifically in relation to cinema. It gives particular focus to tagging behavior, but explores also other film annotation practices used by scholars in their own research, as well as standards and behavior adopted by indexing experts. The main research problem that this thesis addresses is developing an understanding of the role of social annotations for film content in relation to those other indexing and annotation perspectives, in order to look into how film archives can support different user communities and facilitate both experts and novices' annotation interaction with film heritage. Experts include "indexing" experts, such as archivists or cataloguers, and "domain" experts, in this case film specialists. The proposal describes the research question, the theoretical framework, the main background research, the methodology and method, as well as the data collection techniques. Finally, the current status and the expected outcomes are discussed.

Categories and Subject Descriptors
H.3.1 [**Information Storage and Retrieval**]: Content Analysis and Indexing. H.1.2 [**Models and Principles**]: User/Machine system, *Human information processing*.

General Terms
Experimentation, Human Factors.

Keywords
Social tagging, Expert tagging behavior, Annotation behavior, Time-based metadata, Video labeling games, Moving images, Film.

INTRODUCTION
The problem of intellectual access to images, both in non-digital and in digital collections, represents a bigger challenge than that of textual collections, because the transmitted or represented information is not codified in symbols which meaning is commonly shared or understood by a community of people. In textual documents, the linguistic sign, the words, are units that belong to a common given language, and thus can be used for segmentation and retrieval. Images cannot be segmented in a unique way, and giving access to their content or subject is, as Matusiak pointed out in 2006, a largely unsolved problem [1].

In the case of moving images, more problems are added, because of the time dimension and the presence of sound. The current research trends in giving access to moving images could be summarized in two perspectives (which are evolving and finding ways to complement each other): one is concept-based image retrieval –basically relying upon indexing made by humans-, the second one is content-based image retrieval –based on algorithms that identify images' features-. In the first perspective, indexing experts have focused mostly on describing the audiovisual objects or documents from the "aboutness" [2] point of view, while content-based techniques' starting point is to identify what is in the images (i.e. a boat, a car) based on low-level features or intrinsic technical aspects such as colors or shapes from which that information can be derived. Hence, the focus is on the "ofness" [2] of the images. In this regard, there is a semantic gap between the information that can be derived from content-based data and the interpretation that users have of moving images. On the other hand, social tagging, one form of human-based computation which relies upon the contributions of large amounts of persons assigning keywords or tags could be applied in both ways. It has been recently used as a way to generate what is called "time-based metadata" [3] through user participation in the television heritage domain. This was achieved through the use of a serious game as motivation factor, called *Waisda?* The first pilots showed that, besides obtaining a great amount of tags, social tagging can be also a good way to engage the audiences with the collections while obtaining content descriptors that can enhance retrieval [4]. However, not only in the audiovisual domain, but also in other areas, there is consensus in that socially generated tags have quality problems [5]. For that reason, there is an emergent area of study on how to improve the quality of tags by involving domain experts as annotators. One important initiative in this direction is called *nichesourcing* which, as opposed to *crowdsourcing* in which taggers are the general public with no specific knowledge of a given domain) [6], targets specific niches of specialists on given subjects.

This thesis intends to explore how domain experts with high knowledge level about moving images behave as taggers and annotators. By annotation we understand any kind of text created by a user, reader or indexer, which is derived from the source at hand for the purpose of analysis or further access. These annotations can be for instance para-texts [7] or metadata.

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For this purpose we have selected the film domain, where moving images make intensive use of cinematographic language with the purpose of communicating meaning [8]. The main interest is to investigate how domain experts' understanding of a domain could help to increase the quality of the annotations and contribute in enhancing access to moving images, especially to motion pictures. A second aim is to derive from these observations guidelines about the use of social tagging in the audiovisual (film) domain, mostly to be used by film archives.

This proposal is presented in six parts: first we introduce our research questions, followed by the theoretical framework and background literature in the main related areas, and then we briefly explain our research design, including the methodology, the method and the data collection techniques. Afterwards, we describe the status of this thesis and its expected contributions.

RESEARCH QUESTIONS

Indexing, as well as film itself, is in transition (from analog to digital) [9]. Emergent indexing practices from different perspectives promise solutions, but several questions arise: how are these solutions incorporated into film archives? Is there guidance from international associations on moving images on how to integrate these new possibilities? Which indexing methods are possible and effective for describing films' content? What features / structures should be indexed, and how? How can film archives provide better access to content based on current practices of humanities scholars to serve their user communities? Are there possible ways of engaging and modeling user participation in content description? How to use socially generated annotations by film experts and novices in relation to film heritage online? From these questions we chose two research questions to be explored in this thesis, each one with different actors as the center:

RQ1. How to characterize experts and novices' annotation behavior?

To address this question we consider two types of actors according to their expertise: domain expertise and indexing expertise. In relation to the first group, we try to identify and understand the annotation practices that film experts and scholars develop during their research or professional activities in relation to moving image sources, what types of annotations/descriptions of the content they make, and which are the attributes that they find more relevant when they annotate films for analysis vs future access (description tasks). In relation to the indexing experts, we intend to identify in great level of detail all different ways of indexing moving images, both looking at current research and standards as well as to the actors' indexing behavior at a specific film archive. This question is settled by two studies (1 and 2), and a background literature study (described in the research design section).

RQ2. How do film experts' annotation practices and behavior relate to their information needs?

In the previous question we explored the attributes that the actors find relevant when they annotate or describe moving images. In this question we look first into the characteristics of experts –and, to a lesser extent, novices– information needs and seeking behavior in relation to film sources; the main focus is on film scholars' research questions, their use of different sources around moving images and the types of queries that take place both in an academic setting and at a film archive. Second, we look into whether the attributes utilized in users' queries correspond to those attributes they found relevant for annotation/description purposes. This question is settled by two studies (3 and 4, described in the research design section).

THEORETICAL FRAMEWORK

There could be basically two ways of approaching our research problem: in a simplified view, following Saracevic, we could focus on people and social context in relation to information use and needs (what is called "human information behavior"), or on the techniques, systems, and technologies (which is covered under the name "information retrieval")[10]. Since our interest is on attributes (subject metadata) not as a decontextualized output, but on how it is created and could be used and supported in specific contexts, we chose the first approach. In this sense, we look at indexing as a kind of cognitive work [11].

Within Information Behavior (IB) research there are several models. Fisher, for instance, identified 72 conceptual constructs (metatheories, theories, and models) coming from different disciplines (computer science, the humanities, the social sciences and library and information science), mostly developed in the last three decades [12, p. 283].

Among these, we chose Ingwersen & Järvelin integrated Information Seeking & Retrieval framework, which extends Ingwersen's cognitive model of IR interaction, Belkin's episode model of interaction with text and Saracevic's strafied model [13].

It is a conceptual model in the sense that it provides the conceptual and methodological tools for formulating hypotheses and theories [14], and a macromodel (the most comprehensive model of information –seeking and retrieval from the cognitive view according to Xie [13, p. 187].

Even though IB is interested in information use and all possible interactions of humans with information, its focus has been on information seeking and retrieval and not on annotation [15].

Our reasons to adopt Ingwersen & Järvelin integrated IS&R framework are twofold: 1) its focus is on the different types of human actors and 2) it has the possibility to include annotation behavior as one kind of information behavior [15].

BACKGROUND RESEARCH

Social tagging in the audiovisual domain

Social tagging has been used in a variety of contexts: for general purposes in broad social bookmarking sites, for academic reasons in specific reference sharing services, for annotating and finding pictures and videos in dedicated systems, and as an alternative to traditional ways of organizing and categorizing information, such as the Steve Museum project in the cultural heritage domain [16]. Social tagging has been one of the earliest implemented collaborative practices for sharing content online. Since in 2005 services like Furl, Flickr, and Del.icio.us started offering their users the option to add labels or tags to organize and share content [17], many web sites have incorporated social tagging services, and research has not ceased in discovering new theoretical and practical approaches to this way of indexing digital information.

So far, this crowd-driven annotation technique has proved to be successful, not only in a variety of ways for accessing content, but also for engaging users with online collections [18]. The cultural heritage sector has embraced this practice and is progressively

incorporating it, together with other crowdsourcing initiatives, as part of their workflows [19].

In the audiovisual domain, social tagging has been used for describing movies (for instance in the service "Movielens", or in the "IMDB" plot keywords), and videos (as in "Youtube" or "Vimeo"). The tags in these systems mostly describe the movie or video as a whole, that is, they are not tied to a specific time fragment within them. Recently, there has been an experiment for studying how social tagging could be used for generating "time-based" or "time-related" metadata [3] added by users while watching the videos. One significant initiative in this direction is *Waisda?*, a video labeling system that uses the idea of games-with-a-purpose to motivate users to contribute. It was launched in 2009 by the Netherlands Institute for Sound and Vision. There have been two pilots to date. In the first one the site received more than twelve thousand visits, and had over 2,000 people playing, contributing with up to 420,000 tags for 604 items [20]; [3]. In the second pilot, called "woordentikkertje": word tag) approximately 750,000 tags were collected for about 5.000 video fragments [21].

Given the success of this crowdsourcing initiative, questions arise about the possibility of film archives for engaging users in annotating film content in similar ways. But also together with it, there is a need to understand what would be the outcome and usefulness of those time-based annotations for this type of content. Could it be perhaps the future "creative re-use of, or inspiration by archival material" as suggested by Fossati [9]? Or a better support for users of film archives in finding specific scenes or shots? To our knowledge there are no specific studies exploring how time-based metadata could be used in the audiovisual domain by film archives.

Subject access in the film domain

Accessing audiovisual content (and specifically film content) is the concern of different (but growingly inter-related communities).

In a traditional cataloging perspective worldwide film cataloguing and identification is pursued in the form of standards or guidelines. The rules for cataloging film materials have been derived from the traditional cataloging rules (AACR, nowadays RDA) and are authored by the International Federation of Film Archives (FIAF), who in 1970 issued the first version of these rules. In the 1991 updated edition, it is recognized that "the international standardization of subject access for moving image archives remains an issue for discussion and future work by the Commission and other interested moving image archivists" [22]. The current guidelines indicate the use of content description in the form of subject headings, keywords and/or synopses [23], [24]. The catalog record created in the libraries or archives for each film, can eventually provide content notes, or summaries, and rarely contain *shot-listings* that can be retrieved using full text search [22].
These cataloguing rules had not yet settled when the arrival of the World Wide Web brought radical challenges to them [25]. Current work in film cataloging includes the update of the FIAF rules [26] and adaptation of the FRBR model to these type of sources [27].

Another way of addressing film materials description is done by the metadata communities through the use of standard schemas and vocabularies. In this area, Filmstandards.org[1] promotes the study and use of metadata for moving images and the description of audiovisual works and their derivates. An important achievement in this direction was the publication in 2001 of the "Dublin Core Application Profile for Digital Video" [28], the PB Core (Public Broadcasting Metadata Dictionary), initially developed in 2005 to serve the U.S. public broadcasting community, but nowadays widely used by different institutions in the audiovisual domain. Also METS (Metadata Encoding and Transmission Standard) has been used for audiovisual records, as a wrapper for connecting PB Core data to structural and technical metadata [29].

However, the previous two perspectives (traditional cataloguing and metadata) are mostly focused on describing the audiovisual works themselves. In practice, important film initiatives such as the European Film Gateway (EFG)[2] or Europeana, which are the main metadata aggregators in the film heritage domain, offer access to short movie clips, or even to entire movies on their websites basically through genre or keywords that apply to the complete film work. The recent effort of the World Wide Web Consortium (W3C) on fragment access seems to be promising in terms of normalizing sequences or clips descriptions.

Including user contributed tags for annotating moving images in the cultural heritage domain is not explicitly considered in any of the previous perspectives, but is starting to be explored, for instance in practical applications such as the Europeana Multimedia Annotation suit[3], or in research looking specifically at how to model crowdsourcing for films[30]. In practice, writing *shot-listings* is a time-consuming and costly activity [31] and it is not widely done in traditional archival practices, but it is extensively done in film research. In the Digital Humanities context, new tools are being developed to support this analysis, for instance "Cinemetrix"[4] or "Videana" [32].

Most active related research for accessing audiovisual content itself comes from the multimedia information retrieval community, which base their perspective on developing a framework and related retrieval techniques rather than element sets (such as the used in cataloging practices). In this context, access to audiovisual content is made possible through "content based and concept based methods. These methods are slowly entering the workflows of audiovisual archives, mainly in television broadcast settings due to the high volume of news content [33], though researchers claim that they are "maturing to the point where they can be used in real-world retrieval practices" [34] However, in film archives the situation is different, and there is no experience of using CBIR techniques reported in the literature to date. Researchers though are exploring the possibilities offered by these methods for film analysis using special visualization techniques inspired by media and new media art [35].

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[1] http://filmstandards.org/fsc/index.php/Main_Page

[2] http://www.europeanfilmgateway.eu/

[3] http://pro.europeana.eu/thoughtlab/user-generated-content#EConnect

[4] http://www.cinemetrics.lv/

There are also other problems related to indexing images such as the lack of general agreement on what attributes of an image should be indexed [1]. This is where experts (domain film experts) can also come into play.

Expert and novices tagging behavior

Tagging behavior, as defined by Peters [36], comprises the studies of the relationships between users and tags (p.184). This relationship can be explored from different perspectives, such as tagging motivations; tagging competences; the influences of familiarity with tagging, of the content being tagged and the system used to tag; the different word forms and tag categories used by the taggers; the use of guided tagging to enhance the quality of the tags; or the overlaps of the tags with the terms coming from controlled vocabularies.

Since one of the key factors of the success of social tagging in engaging different types of users is the reduction of intermediary steps that are followed in traditional indexing practices, saving the user from the need for first thinking on a concept and then representing it through the correct term from a controlled vocabulary [37], tags are a spontaneous way to associate words to digital content, which reflect the users' personal understanding on a topic or their own intentions with the digital resources [38]. According to Tsai et al. [38] "unlike metadata assigned by authors, or by professional indexers in libraries, each end-user's tags reflect that end-user's personal understanding of the content." (p.272). For that reason it could be possible to hypothesize, from a cognitive point of view, that film experts could eventually contribute better quality annotations.

In the scientific fields, for instance, it is already common to have domain experts contribute their tags as a way to organize their resources and share them online. Academic social tagging systems such as the now defunct Connotea, or CiteUlike, are examples of them. Most studies in this area have tried to understand how these "expert" tags differ from professionally created metadata [16]; [39]; [40], that is, if the domain experts' annotations (the tags and their resulting folksonomy) relate somehow to the descriptions created by the authors or by indexing trained professionals (through the use of taxonomies, classification systems, or thesauri). These studies have found little overlap between the terms used by taggers and the ones used by authors and indexers.

In the cultural heritage domain, the Steve Museum project, which started in 2005, found also a low overlap between these two types of vocabularies [16], but pointed to new possibilities for user tags as a way to include different views. Gligorov et al. [3] also compared the tags collected during the first pilot of *Waisda?* with formal vocabularies (a thesaurus and a lexical semantic database) finding likewise a small overlap between the tags and the thesaurus, but a higher number of matching tags with the lexical database.

Since certain types of content require highly domain-specific descriptions, a general user's understanding of a topic is not enough, and domain experts are needed to guarantee quality and consistency in the annotations. For that reason, recent initiatives such as *nichesourcing* [6] are emerging as a specialization of crowdsourcing, using the strengths of this existing technique, but utilizing instead of the general "crowd", the small and specific contribution of experts for specific tasks. *Nichesourcing* not only presents solutions but also raises questions about how to involve domain experts in the tagging process and, if that is done, about how domain experts behave as taggers in a real *nichesourcing* setting and how their annotations could coexist with those of novices within the same "shared information space" [41].

To our knowledge, few studies focus on understanding the differences between novices and experts' tagging behavior. Those have been done in domains different than cultural heritage. For instance, Wang et al. [42], explored in the radiological domain how novices, intermediates and experts would describe medical images, finding that "experts employed more high-level image attributes which require high reasoning or diagnostic knowledge to search for a medical image [...] than do novices; [and that] novices are more likely to describe some basic objects which do not require much radiological knowledge to search for an image they need [...] than are experts". Also, Tsai, Hwang & Tang [38] studied whether experts can provide a more consistent and representative set of tags for academic and scientific documents than novices can generate, in this case in the area of nanomaterial technology, finding that tags chosen by experts yielded better similarity and relevance values in all analyses, and that tags chosen by experts reflected better understanding of the content.

RESEARCH DESIGN

Research methodology

The adopted methodology is qualitative, since most issues involved in the case study are highly dependent on the context and domain (in this case film) and subject to participant interaction of the researcher with the reality studied; also the main focus is on exploration and description, and not on testing or measuring [43].

Research method

According to our research questions, we have decided to use a case study as research method. A case study can be defined as "an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident, and in which multiple sources of evidence are used" [43]. Our case study is both "instrumental" (since we try to investigate a phenomenon: expert tagging/annotation behavior taking film as a "vehicle" for our study); and "intrinsic" (since we intend to investigate how social annotations can be used specifically for indexing film content by film archives). One of the consequences of this chosen method is that we won't intend to generalize the conclusions. Also, we will combine different perspectives for data collection techniques, as we explain in the next sub-section.

Data collection techniques

For answering our research questions we have designed four independent but interrelated studies as sub-case studies with their own data collection techniques:

Background research (literature review)

Since the focus of this thesis is on the relation of social annotations with other indexing/annotation perspectives to support scholarship, we do a detailed literature review on the current indexing problems for moving image and the perspectives that try to solve those. We also look in detail into studies on (moving) image attributes from a semantic perspective trying to conclude what are the specific content structures of films as moving images that call for content representation.

Study 1. Tagging behavior in a video labeling game

This is a small-scale experiment which includes the participation of film experts and novices in the aforementioned video labeling game (*Waisda?*) in order to observe the effect their types of tags and the effect that guidelines on which types of tags to use have on their tagging behavior. It combines quantitative analysis with qualitative analysis of users' responses to a questionnaire.

Study 2. Task-based analysis of film experts' annotation behavior

In this study we intend to apply methods already used for studying information behavior, such as "work tasks" [44] [14], to observe how experts annotate film content (description tasks as named by Fidel [45]), and how they select search terms in different settings: a general video tagging platform (such as Youtube), a database or catalog, and a movie specific database (for instance, IMDB).

Study 3. Information needs and usage of audiovisual archival material

This includes an onsite study at the media studies department of a university. By interviewing film, television and media scholars and PhD researchers, we look into their information needs and information seeking behavior, as well as the characteristics of their queries and annotation styles during film analysis.

Study 4. Indexing practices and users' queries at a film archive

This study tries to look for answers to the questions: which are the main types of information requests/needs that external users have when they look for information in a film archive? What do the internal manuals, procedures and indexing structures indicate in relation to content access levels? What do employees of archives actually do when they describe film content? Do user requests, indexing policies and practices match? Which are the perceptions, visions, ideas that the curators and indexers have on the new indexing perspectives (CBIR, social tagging)? To approach this issue we collected data from two years of user queries to a film archive (the EYE Film Institute Netherlands), interviewed different actors and performed participant observation during a three month stage at that institution.

PRELIMINARY RESULTS

Some of the aforementioned data collection strategies have been already used or are in development. For instance, study 3 is finished: we did an experiment using *Waisda?* with five film clips, inviting film experts and novices to participate. There were 22 participants who contributed 1711 tags to the game. We are analyzing those tags by using different models for image analysis, and a paper is submitted and under revision in an Information Science journal. Moreover, studies 2, 3 and 4 have finalized the data collection stage: we counted with the participation of 10 scholars for study 2, 14 scholars and PhD researchers for study 3, and a sample of 2 year queries and 28 interviews for study 4. These data is currently being analyzed.

EXPECTED CONTRIBUTIONS

The author of this proposal expects to contribute with specific guidelines on how film archives could implement crowdsourcing and nichesourcing initiatives for indexing moving images online, by investigating the possibilities that different perspectives (metadata, cataloguing, social tagging, content-based information retrieval) offer to the film heritage domain. It extends the initial approaches for accessing television heritage through socially generated tags, which began with the *Waisda?* project, to the film domain. It is also expected to gain and disseminate conclusions on how experts behave as taggers, contributing with this to the new area of *nichesourcing*. From the theoretical point of view, this thesis explores the concepts of tagging and annotation behavior more in depth, and tries to integrate them into one existing Information Behavior framework.

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REFERENCES

[1] K. K. Matusiak, "Towards user-centered indexing in digital image collections," *OCLC Syst. Serv.*, vol. 22, no. 4, pp. 283–298, 2006.

[2] P. Ingwersen, *Information retrieval interaction*. London: Taylor Graham, 1992.

[3] R. Gligorov, M. Hildebrand, J. van Ossenbruggen, G. Schreiber, and L. Aroyo, "On the role of user-generated metadata in audio visual collections," New York, NY, USA, 2011, pp. 145–152.

[4] R. Gligorov, M. Hildebrand, J. van Ossenbruggen, L. Aroyo, and G. Schreiber, "An Evaluation of Labelling-Game Data for Video Retrieval," in *Advances in Information Retrieval*, P. Serdyukov, P. Braslavski, S. O. Kuznetsov, J. Kamps, S. Rüger, E. Agichtein, I. Segalovich, and E. Yilmaz, Eds. Springer Berlin Heidelberg, 2013, pp. 50–61.

[5] M. Guy and E. Tonkin, "Folksonomies: Tidying up Tags?," *-Lib Mag.*, vol. 12, no. 1, Jan. 2006.

[6] V. De Boer, M. Hildebrand, L. Aroyo, P. De Leenheer, C. Dijkshoorn, B. Tesfa, and G. Schreiber, "Nichesourcing: Harnessing the Power of Crowds of Experts," presented at the EKAW, Ireland, 2012.

[7] V. Pellatt, Ed., *Text, Extratext, Metatext and Paratext in Translation - E-book | Krisostomus*. Newcastle upon Tyne, UK: Cambridge Scholars Publishing, 2013.

[8] D. Bordwell and K. Thompson, *Film Art: An Introduction*, 7th ed. Mcgraw-Hill College, 2003.

[9] G. Fossati, *From Grain to Pixel: The Archival Life of Film in Transition*. Amsterdam University Press, 2009.

[10] T. Saracevic, "Information Science," *Encyclopedia of Library and Information Sciences, Third Edition*. Taylor & Francis, pp. 2570–2585, 2009.

[11] K. E. Fisher, S. Erdelez, and L. McKechnie, *Theories of Information Behavior*. Information Today, Inc., 2005.

[12] R. Fidel, *Human information interaction an ecological approach to information behavior*. Cambridge, Mass.: MIT Press, 2012.

[13] I. Xie, *Interactive information retrieval in digital environments*. Hershey: IGI Pub., 2008.

[14] P. Ingwersen and K. Järvelin, *The Turn - Integration of Information Seeking and Retrieval in Context*. 2005.

[15] P. Ingwersen, "(personal communication)," 31-May-2013.

[16] J. Trant, "Tagging, Folksonomy and Art Museums: Early Experiments and Ongoing Research," *JoDI J. Digit. Inf.*, vol. 10, no. 1, Jan. 2009.

[17] G. Smith, *Tagging: People-powered Metadata for the Social Web*, 1st ed. New Riders Press, 2007.

[18] S. van Hooland, E. M. Méndez Rodríguez, and I. Boydens, "Between Commodification and Engagement: On the Double-Edged Impact of User-Generated Metadata within the Cultural Heritage Sector," *Libr. Trends*, vol. 59, no. 4, pp. 707–720, 2011.

[19] J. Oomen and L. Aroyo, "Crowdsourcing in the cultural heritage domain: opportunities and challenges," New York, NY, USA, 2011, pp. 138–149.

[20] Images for the Future, "Waisda? Video Labeling Game: Evaluation Report," *Images for the future – Research blog*, 2009.

[21] M. Hildebrand, M. Brinkerink, R. Gligorov, M. van Steenbergen, J. Huijkman, and J. Oomen, "Waisda? Video Labeling Game," presented at the ACM Multimedia, Barcelona, 2013.

[22] H. W. Harrison, Ed., "The FIAF Cataloguing Rules For Film Archives." Fédération International des Archives du Film (FIAF), 1991.

[23] A. L. Martin, *AMIA Compendium of Moving Image Cataloging Practice*. Association of Moving Image Archivists, 2001.

[24] International Federation of Film Archives, "FIAF Moving Image Cataloguing Manual (working draft)." Filmstandards.org, 2014.

[25] J. M. Turner, "From ABC to http: The Effervescent Evolution of Indexing for Audiovisual Materials," *Cat. Classif. Q.*, vol. 48, no. 1, pp. 83–93, 2010.

[26] M. A. Pimpinelli and T. Ross, "Revising the FIAF Cataloguing Rules: an update," presented at the FIAF Congress, Beijing, China, 2012.

[27] K. McGrath, "Finding Movies with FRBR & Facets," presented at the Code4Lib Conference, Seattle, WA, 2012.

[28] G. Agnew and D. Kniesner, "ViDe User's Guide of a Dublin Core Application Profile for Digital Video." 2001.

[29] J. Riley, "Metadata for audiovisual materials and its role in digital projects," presented at the OLAC (Online Audiovisual Cataloguers)/MOUG (Music OCLC Users Group) Conference. Rocking the Metaverse: A/V Cataloguing in a Web X.0 Environment, Cleveland, OH, 2008.

[30] G. Geisler, G. Willard, and C. Ovalle, "A crowdsourcing framework for the production and use of film and television data," *New Rev. Hypermedia Multimed.*, vol. 17, no. 1, pp. 73–97, 2011.

[31] C. Wilkie, *Managing Film and Video Collections*. Aslib and Information Management International, 1999.

[32] R. Ewerth, M. Mühling, T. Stadelmann, J. Gllavata, M. Grauer, and B. Freisleben, *Videana: A Software Toolkit for Scientific Film Studies*.

[33] B. Huurnink, C. G. M. Snoek, M. de Rijke, and A. W. M. Smeulders, "Content-Based Analysis Improves Audiovisual Archive Retrieval," *IEEE Trans. Multimed.*, vol. 14, no. 4, pp. 1166–1178, 2012.

[34] B. Huurnink, C. G. M. Snoek, M. de Rijke, and A. W. M. Smeulders, "Today's and tomorrow's retrieval practice in the audiovisual archive," New York, NY, USA, 2010, pp. 18–25.

[35] L. Manovich, "Visualizing Vertov." .

[36] I. Peters, *Folksonomies. Indexing and Retrieval in Web 2.0*, 1st ed. De Gruyter, 2009.

[37] H. Halpin, V. Robu, and H. Shepherd, "The complex dynamics of collaborative tagging," in *Proceedings of the 16th international conference on World Wide Web*, New York, NY, USA, 2007, pp. 211–220.

[38] L.-C. Tsai, S.-L. Hwang, and K.-H. Tang, "Analysis of keyword-based tagging behaviors of experts and novices," *Online Inf. Rev.*, vol. 35, no. 2, pp. 272–290, 2011.

[39] B. M. Good, J. T. Tennis, and M. D. Wilkinson, "Social tagging in the life sciences: characterizing a new metadata resource for bioinformatics," *BMC Bioinformatics*, vol. 10, pp. 313–313, 2009.

[40] C. Lu, J. Park, and X. Hu, "User tags versus expert-assigned subject terms: A comparison of LibraryThing tags and Library of Congress Subject Headings," *J. Inf. Sci.*, vol. 36, no. 6, pp. 763–779, 2010.

[41] J. Oomen, L. Belice Baltussen, S. Limonard, A. van Ees, M. Brinkerink, L. Aroyo, J. Vervaart, K. Asaf, and R. Gligorov, "Emerging Practices in the Cultural Heritage Domain - Social Tagging of Audiovisual Heritage," presented at the Web Science, Raleigh, NC: US, 2010.

[42] X. Wang, S. Erdelez, C. Allen, B. Anderson, H. Cao, and C.-R. Shyu, "Role of domain knowledge in developing user-centered medical-image indexing," *J. Am. Soc. Inf. Sci. Technol.*, vol. 63, no. 2, pp. 225–241, 2012.

[43] A. J. Pickard and S. Childs, *Research methods in information*. Chicago: Neal-Schuman, 2013.

[44] M. Skov, "The Reinvented Museum: Exploring Information Seeking Behaviour in a Digital Museum Context," Royal School of Library and Information Science, Denmark, 2009.

[45] R. Fidel, "The image retrieval task: implications for the design and evaluation of image databases," *New Rev. Hypermedia Multimed.*, vol. 3, 1997.