

# eTagging in Context: Information Management across Community Networks

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## ABSTRACT

In this chapter, we examine the history and theory underlying social tagging as annotation: first from the perspective of classification research; and second from the perspectives of knowledge representation and knowledge management. Using the context meta-model of the annotation, we demonstrate that the model is adequately represented in existing KR theory: specifically, from the perspective of socially constructed meaning in community networks. Furthermore, the set of tagging representations (triadic networks of individual, object and annotation) are well explored throughout the knowledge representation domain. In contradistinction to many commentators, we conclude that social tagging may effectively be explored via a multidisciplinary approach linking knowledge representation and classification research and creating an open domain network.

## INTRODUCTION

Inter-site and intra-site variation certain aspects of tag production, content and patterns of use has recently begun to attract attention by commentators in knowledge management (KM) as well as in classification research (CR). Examples include variation in the semantic, syntactic and pragmatic context of tags, as well as in the patterns of production and use of tags within and between individuals and larger social communities. It is conjectured that variation in features of tagging systems such as user-interface concerns are at the root of much of these variations, but there is also a great deal of variance within and between tag sites and communities that relates to the topic and character of the discussion, the nature of social tagging as a speech act, or as a performance that reflects on the identity that speakers construct for themselves. This variation may be seen through comparison of research results within and across various tagging systems, but the subject has not yet received large-scale, thorough investigation.

The term *social tagging* appears to suggest that the process of tagging - annotating a resource with a free-text keyword or phrase - is understood to be connected to some form of underlying “community” or “network” structure. As a result, some perceive a dichotomy between semantic annotation or knowledge management, and the use of social tagging to aggregate opinions (Mika,

2007), in which a distinction exists between well-formed semantic annotations that enable the development of efficient computational methods for analyzing and interacting with information, and the free tags of social networks, that are weakly defined and incompletely interpretable. Reflected is a historical bias towards a characterization of knowledge management systems as representative of consensus within a research community or other closed domain, whilst user classifications generally exhibit partial consensus within a loosely defined community.

There is significant disagreement about the forms that this social dimension may take, just as there is a great deal of discussion about the uses of tagging that are considered valid and should be encouraged. The analysis of social tagging has been approached via a number of dimensions, of which the perspective of existing research into areas, such as classification research, is perhaps the most common, with the casting of the tag into broadly-researched existing forms, such as keyword, label and annotation. Application of existing research perspectives and theory often highlights valid links with prior and related work and hence leads to productive research avenues at a cost perhaps of casting the data into a mould in which it fits uncomfortably.

In this chapter, we bring together a set of perspectives on social tagging and cast them into existing models and theory drawn from the knowledge management domain, with the aim of demonstrating the sound theoretical basis for a rapprochement between the two domains. The familiarity of knowledge management research with systems thinking and knowledge as a socially-constructed resource (Good, Kawas & Wilkinson, 2007) suggests that bridging this gap provides the classification researcher with a rich set of tools and resources to complement existing approaches to research in this area; knowledge itself is considered a manifestation of information in social systems, a result of interpretation of data (Fuchs, 2004). Many recent tools and techniques focus on exploring aspects of the connection between social tagging and the underlying community, in particular the role of tagging as a means of shared informal annotation. We summarize relevant research results, bringing together areas of investigation linked to various aspects of the process of authoring, reading and making use of tags, including facets of tag use other than the well-known model of personal or shared resource management. A broad, multidisciplinary view allows for more realistic models of tag generation and use and hence provides a means to make more effective and varied use of existing research tools in the analysis and reuse of social tagging and networking data.

## **BACKGROUND**

Social tagging inherits from previous work on non-hierarchical file systems, designed to solve issues first identified by Barreau and Nardi (1995) that limit the usability and intuitiveness of the hierarchical file system paradigm. Barreau and Nardi found that hierarchical file organization suffered due to the variety of roles for information in the workplace, resulting in difficulty defining an appropriate filing scheme and increasing the cost in terms of time, and also noted that hierarchical filing schemes were perceived as complex to understand and use, points which may also be seen as valid criticisms of formal, particularly hierarchical, approaches to classification. Historical examples of attempts to solve these issues include MIT's 1991-1992 Semantic File system project (Gifford, Jouvelot, Sheldon, & O'Toole, 1991) and XEROX PARC's Placeless Documents initiative (Dourish et al., 2000). Social tagging is also often linked to work on keyword systems, in particular into intra-indexer and inter-indexer consistency (Leonard, 1975). Such pilot projects explored approaches to simplifying and reducing the cost of classification, and often bear many similarities to the social tagging systems of today with one significant

dissimilarity being the intended audience and scale of each system; these systems were not in general used by large and varied communities, but were limited to personal information management or information management within the small office setting.

Services made available to the internet can quickly attain a large user base. As the number of users increases, so does the opportunity for many forms of collaborative use to take place; that is, there is a possibility that users no longer consider the service to be entirely for the purpose of personal (single-user) information management. It is reasonable to suppose that the user might then choose to treat the system as a channel for information exchange between colleagues or user groups, as a means of persuasion, performance, or developing a public identity or online profile (Zollers, 2007; Tonkin et al., 2008), or make use of any of the subtler approaches to situating the written word within a socio-cultural context. In practice, tags are often employed to convey information beyond their primary use as symbols representing the theme or content of an object. As such, they may contain keywords, interpretative data, reactions, and functional/action tags (Golder & Huberman, 2006; Kipp, 2007).

Several models of social tagging have been proposed that concentrate more closely on the network, system, and community interactions that underlie many social tagging services and their uses. For example, Zhdanova (2006) describes folksonomies via a model that is based upon existing models for semantic social network representation. Yeung et al (2007) begins from a tripartite graph of users, tags and resources (see Figure 1), describing the effect of this linking as 'mutual contextualization'; that is, through association with other elements, semantics are acquired.

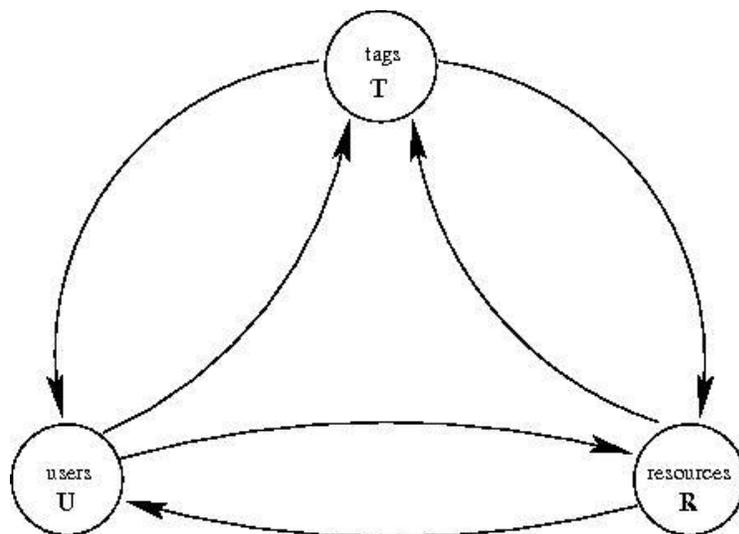


Figure 1:  $A$  is a set of annotations:  $A \subseteq U \times T \times R$ . Adapted from Yeung's poster version of paper.

At the basis of this discussion, and particularly visible in Yeung's work, is the assertion that the processes involved in tagging depend upon the same processes that govern lexical choice and pragmatic interpretation in natural language. When this is the case, the author of the annotation may be expected to apply a model of the perceived audience during that process, whilst the reader interprets the result in a similar manner, via a model of the speaker's knowledge and intentions.

Such a process is consistent with a view of natural language as a ‘noisy information channel’ rather than the commonly applied model of stylized natural language in classification, applied as a lossless conduit, through which information is encoded, transmitted, and received without error.

Precedent for this appears in classification research, in particular in discussion of inter-indexer consistency and intra-indexer consistency, the variation in term use by one or several individuals. Indexing and tagging are similar in the sense that in most circumstances, the expectation by system designers is that the user will attempt to find the term that most accurately conveys the intended semantic; the user is attempting to describe the resource so that others looking for a resource on that topic will be able to retrieve it. However, the individual classifying a web page in a social context seeks the term that is most likely to convey the correct image in a situated context, or indeed the term that reflects most appropriately on the individual, whilst formal indexing replaces this social context with a presupposition of joint adherence to a standardized set of definitions. Message formation occurs within a common ground framework (Krauss & Fussell, 1991), meaning that in order to maximize his or her chances of being understood, the individual encoding information – writing an annotation or description, for example – must guess at the most appropriate encoding. In order to do this, the author must look for background knowledge (common ground) that is likely to be shared by the reader.

In constructing an analogous description within a knowledge management context, social contexts can be seen as ontologies, where hierarchies and relationships are the abstract elements of an ontology (Pfeiffer, 2007). This 'ontology' is a synonym for the arrangement of a generalization hierarchy that classifies the categories or concept types of the hierarchy – formally, the term refers to *the study of being* (Sowa, 1991). The ontology also provides an encoded description of the relationships, operations, and constraints that are essential to help define the nature (knowledge) of our world or reality (Russell & Norvig, 1995). A general ontology defines an informal list of concepts that are part of the domain. Such concepts are seen as tags within the ontology and are defined by categories in which they are members.

Individuals, however, may have differing levels of familiarity with a large set of social contexts. Each individual can therefore be thought of as having a slightly different set of concepts, or at least associated symbols, available to them. As described by Krauss and Fussell (1991), then the individual encoding information must attempt to construct the annotation so that it has the best chance of being understood by the intended audience, given that they share at best only a partial set of concepts or associated symbols.

## **CLASSIFICATION, ORGANIZATION, UTTERANCE, AND IDENTITY**

Current research focuses on deconstructing tag sets via various models: search, relation to knowledge management, linguistic model, social network discovery, affect and emotion, philosophical and epistemological, and comparison to controlled vocabulary (Shiri, 2007). It is helpful to understand how social tagging is used in context, just as analysis of written and spoken utterance is important to related technologies, such as the semantic web, natural language processing, and search methods across bodies of spoken and written text in information retrieval. Social tagging is cheap to implement and popular to use. Many effects obviously extant in the informal classification domain – such as semantic shift, drift and change in scope – are visible, though less obvious, in other knowledge management systems, such as the semantic web. For this reason, results arising from the study of social tagging systems within a socio-cultural context

may potentially lead to a better understanding of inconsistencies in other datasets over time or between physical or social contexts.

Two principal approaches to the study of social tagging exist. The first is interpretive, focusing on analysis of specific annotation instances. The second examines tag application and could be described as structural; treating tags as symbolic markers across which a network, or graph, is defined. The former is not the primary focus of this article. However, findings from the interpretive approach are relevant to the latter, and therefore will be briefly summarized here. Several models have been developed describing tag networks according to the latter approach (see Figure 2). These concentrate on users tagging information, users connecting to other users by way of tags, and information being connected to other information by way of tags (Zhen, 2007). This in itself can be related, from a knowledge management perspective, to Richards (1923), who applied the structure of a triangle of meaning combining reference, referent and symbol, showing that there is a triadic relationship between the three entities. Peirce (1931-58) clarified this description, describing a triangle relating concept, object and sign.

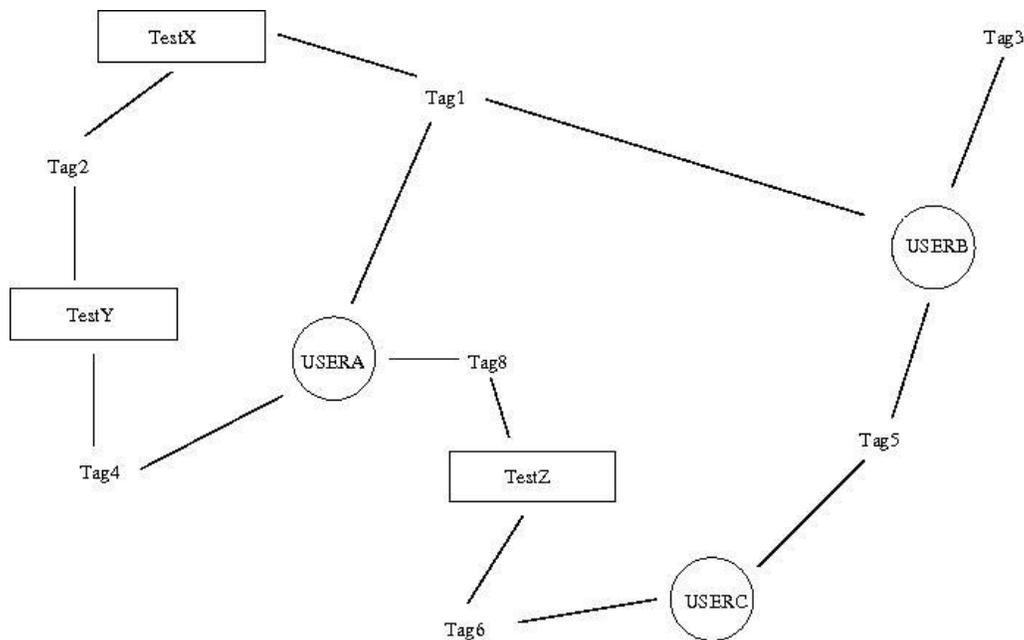


Figure 2: Is a combination of all three Zhen models - 1) User - Tag - Information; 2) User - Tag - User; and 3) Information - Tag - Information.

### Defining a cross-disciplinary meta-model

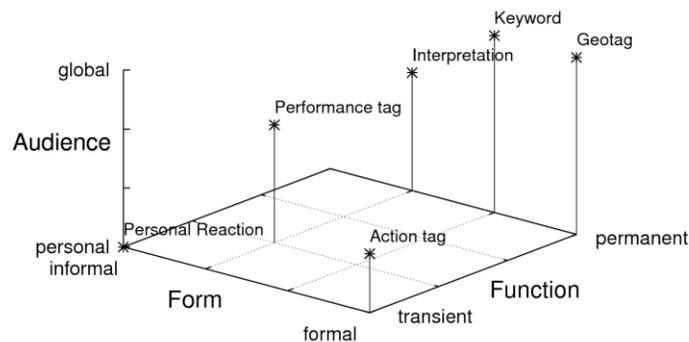
Within the management of knowledge, social systems are believed to become self-organizing (Fuchs, 2004). Knowledge is a manifestation of information in social systems that involve the interpretation, evaluation, and usage of data where individuals perform a re-organization of a knowledge system within a joint environment (Fuchs, 2003; Fuchs, 2004). Tags are often employed to convey information beyond their primary use as symbols representing the theme or content of an object (Tonkin et al., 2008). As such, they may contain keywords, interpretative

data, reactions, and functional/action tags (Golder & Huberman, 2006; Kipp, 2007). They may also perform social functions, such as persuasion, identity, and performance (Zollers, 2007).

The widespread move in classification research towards definition of functional models, frameworks or typologies of tags can be described by regarding these models superposed upon a meta-structure -- the typology of physical annotations developed by Marshall (1998), which may be seen as an interpretive study.

By examination of physical annotations, scribbles in the margin of a book made in biro or pencil, Marshall (1998) developed a set of dimensions describing variance in their use. Many annotations are well-formed, formal, completely specified and computationally tractable. Others exhibit some or all of the features of natural language (for example: incomplete, sparse, ambiguous and tacit, dependent on context). The full typology defines seven dimensions of variance, but for ease of visualization these are represented here according to the three major supersets that Marshall defines -- form, function and audience (see Figure 3). This model again implies that tags are not undirected -- that they are constructed with an intended audience -- Marshall identifies as examples of possible audiences the user, a community, or a global audience of speakers of that language.

Frameworks such as Marshall's (1998) or models such as Zhen's (2007) provide a means and a method for a rich, multi-dimensional model of social tagging, and explicitly model the social or pragmatic aspects as well as the semantic and syntactic. Accepting Marshall's model as a valid meta-model describing in coarse grain the characteristics of tag classification systems, we then ask ourselves whether a preexisting representation equivalent to this model exists in the domain of knowledge representation.



*Figure 3: A selection of tag types, represented according to placement on a simplified 3-D subset of Marshall's (1998) dimensions of annotations.*

From a knowledge representation perspective, this model is not unfamiliar. The tags are viewed as the 'glue' between the user and information or meta-data (Pfeiffer, Chavez, & Hartley, 2005). Of primary importance is the insight, familiar to the knowledge representation (KR) domain, that formulation of a message implies reference to an audience -- that is, the information is formulated in such a way as to maximize the listener's comprehension (Chavez & Hartley,

2005). The individual constructing a message works with reference to a representation of a listener. The speaker is not able to know the extent of knowledge of the listener, but must work from a theory constructed by reference to observable behavior (for example: a 'theory of mind' (Whiten, 1991)).

## **Self-organizing social systems**

Within the domain of knowledge management, social systems are often described as 'self-organizing' (Fuchs, 2004). Knowledge is a manifestation of information in social systems that involve the interpretation, evaluation, and usage of data where individuals perform a re-organization of a knowledge system within a joint environment (Fuchs, 2003, 2004). A social tagging system in widespread use by a large variety of contributors provides many examples that are describable as symptomatic of this re-organization behavior.

As a consequence of this characteristic, an ontology built for application within a dynamic social system is itself potentially subject to alteration, both planned and consequent to external forces. Thus, an old annotation may become irrelevant or inaccurate. Furthermore, annotations may be assigned in KR much as described by Barreau and Nardi, as instruments in a short-term task (Borri et al, 2006); such annotations may therefore be described as 'transient' in much the same way as described by Marshall (1998). Audience plays an important role in KR. Social tagging in a community setting might be described as being built within collaborative testbeds (Keeler & Pfeiffer, 2005) - shared services that enable interaction between users and user groups. These testbeds are using a game interface for the development of a formalized interface for building up rich context structures of tagging hierarchies for multiple contexts: such as, tools specification requirements for knowledge acquisition. The testbeds allow users to discuss and define the tags for the ontology in a collaborative manner.

Hovy (2006) within the critique found in this paper, argues that testbeds used by research communities often do not represent best practice in the domain, in that participants do not apply good methodologies in building ontologies and do not produce adequate ontological tags for the applications at hand. Instead, a game interface may be engineered that incorporates Peirce's Theory of Inquiry (Peirce, 1931-58), such that it requires that social tags cannot be added or modified in the ontology without stating a factual reason (Keeler & Pfeiffer, 2006). As a result, the process uses the scientific methodology of hypothesis generation, followed by experimentation, analysis of results and presentation of conclusions instead of purely representing social opinion, which may be ill-founded or transient and is difficult to deconstruct after the fact. In a closed process involving only a single individual, this scientific methodology, whilst formal and well-documented, may lead to an insular and perhaps brittle or inflexible approach to knowledge representation and the developed ontology. By using a collaborative testbed, however, widespread accessibility and openness increases the effectiveness of the approach, by ensuring that a wide variety of views and arguments are accessed during ontology development while still laying an emphasis on the central importance of well-founded argumentation.

## **Community as context**

The term *community* covers a wide spectrum of functional or rhetorical applications, of which a few characteristic definitions are represented here:

- language communities - sharing a common language and perhaps a shared knowledge base
- speech communities - the term arises from linguistics; a speech community uses language in a shared manner, generally unique to that community;
- discourse communities – sharing common public goals, mechanisms for intercommunication, participatory mechanisms, discourse expectations/genres, specialized terminology, and a critical mass of experts (Swales, 1990);
- national communities – nations of people of like culture and heritage;
- research communities – share a common ‘closed’ research area of interest when understanding methodologies and functionality of applications;
- practice communities - task groups, linked by a shared aim.

Many factors have an impact upon a given facet of measured 'community membership', including ideology, identity, shared interests and goals, and patterns of contact and communication. Community membership is complex to define and model: it may be partial, voluntary and circumstantial. Individual identity is sometimes referred to a self-image, bringing together certain interpersonal characteristics, roles, relationships and values (Huffaker & Calvert, 2005; Calvert, 2002), and may be developed through various means including experimentation, search and social interaction (Harter, 1998). Individual identity may reflect the individual's chosen community affiliations, but is not limited by them – that is, individual identity may contain unique characteristics that are not copied from other community members. Language use and identity have become viewed as closely ‘linked’ with participation in online settings being characterized by some as a form of identity exploration (Turkle, 1995). From both interpretive and structural perspectives, language use within a computer-mediated communication context is expected to show characteristics indicative of the underlying community network.

In practice, communities are seldom monolithic, stable and simple meta-structures. An assertion that an individual's language relates to membership in a given community or population may be accurate only to the extent that the community itself is clearly defined. Lassiter (2008) refers to this characterization of language, by analogy with political philosophy, as communitarianism. Other metrics that may be used to define a community, such as co-citation of thematically relevant resources (Moulaison, Tonkin, & Corrado, 2008) or other bibliometric approaches, are susceptible to similar objections. The grouping of individuals offers an opportunity to generalize across the activities of a large number of individuals, a process that is of course in many cases statistically defensible. Community structures have an objective, measurable existence and can be usefully studied (Wasserman & Faust, 1994).

Many sites applying social tagging show overt characteristics of language-in-use; terms are situated in context and often require pragmatic analysis -- examination of the context surrounding the use of terms -- to elicit meaning. Pragmatic analysis is linked to acceptance of the idea of the 'semantic triangle' idea that links reference (sometimes known as 'concept'), referent (or 'sign') and term (or 'symbol') in a tripartite graph (Odgen & Richards, 1923). The reference level is hidden, but there is an implication that examination of the wide variance in term use permits indirect examination of this landscape.

Sowa (2005) discussed that there are identifiable three basic fields involved in knowledge sharing: logic, ontology, and computation (). These fields are used by bringing together logic and ontologies to construct different contextual models for different applications. The problem of aligning tags in a single ontology with another ontology is very similar to aligning words from the vocabularies of different natural languages as discussed in Yeung's work (2007). Therefore,

creation and modification of ontologies are related to the community in which they are used. When tags in a current ontology cannot be aligned within a community, a new ontology needs to be created. However, if communities can merge to create a new compound domain or expand one of the existing ontologies, then both domains can be represented an ontology.

## **FUTURE TRENDS**

The recent resurgence of interest in social network analysis, identity, and community membership carries a risk of promoting an oversimplified view of a complex system – or, alternatively, of needlessly overcomplicating the problem. However, a critical approach to analysis acts to counterbalance the former complaint, promoting a more realistic and perhaps more sensitive perception of community membership and identity.

As one of many community systems are built upon network effects and interaction between individuals, the process of social tagging is intimately linked to the structures that underpin language: the growth and dissipation of community structures and resources, identity and culture, as well as manifestation of expressed ideas and ideologies. The structure is rich, complex, and dynamic. It is possible that this aspect of technology damages retrieval performance, although solutions, often dependent upon the existence of underlying community structures that govern or direct usage patterns, have been identified for ‘several specific shortcomings’ (such as disambiguation, hyponyms and synonyms). However, the richness of tagging networks as resources for identification of community structures - for example, via idiosyncratic use of terminology or choice of resources - has only recently become clear with widespread development and use of social tagging services.

In addition, the area of community informatics is increasingly important as the Web’s population grows and diversifies. Existing applications based around Web 2.0/user-contributed information show signs of the great potential of these techniques. Services such as Technorati presently combine social tagging of blogs with social network analysis techniques to help identify the primary subject area of a given site and to map how closely that author (or group of authors) is linked to others. This information is made available via a software interface, so that it can be used by third-party programmers and applications as well as through a Web interface. Other sites (such as Clouldalicious (<http://cloudalicio.us/tagcloud.php>) and Flickr’s timeline and ‘interestingness’) provide alternative views on display of tagging data that demonstrate features, such as shifting readership demographic or site focus and content. An increased focus on linking between social network and content network analysis constitutes an approach that the authors expect to be of some interest in the years to come.

## **CONCLUSION**

In this chapter we have highlighted various relevant areas of research and theory, which in combination paint a multidisciplinary view of the research area. These perspectives describe various different aspects of the processes underlying tagging, and approaches towards practical analysis and use of this information corpus, such as applications in the area of information retrieval, application of tags as units of semantic annotation, and further processing via techniques such as sentiment analysis. We have described relations between relevant theory and historical work in the area of classification research, taking into account usability issues surrounding document classification, the process and constructs applied during classification, users’ motivations and aims in classification, and the cognitive processes involved in generating

and interpreting an annotation. From the knowledge representation domain, we have examined the process of generating an ontology within a domain, highlighting the similarities of the triadic models described in Peirce and Richards' semiotic triangle and the constructs described by classification researchers, the shared need to take the user and surrounding social structure into account, and the potential that KR constructs such as the ontology may benefit from development via an open, collaborative testbed similar to social tagging services. The authors have shown that knowledge management theory is more compatible with the developed models of social classification than is sometimes suggested, although the problem is greatly simplified in some communities (networks) by formalizing and limiting the scale and use cases of the domain ontology.

Modeling different aspects of user behavior in tagging allow researchers in either the classification research or knowledge management domain to examine the role and influence of tagging behaviors in the development of a shared terminology or language. An emphasis on examination and description of social or cultural interconnections between users enables new views on the types of information that may be revealed via analysis of tag datasets, and inspires novel methods for extracting such data. On a more general level, the authors contend that user-contributed content and community informatics are closely linked, but that a holistic, interdisciplinary understanding of the research area is useful. Many topic areas and academic structures contribute to the research area of formal and informal semantic annotation, amongst them computer science, library and information science, linguistics and management studies. As a result of this heterogeneity, the field is uniquely challenging and rewarding.

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## KEY TERMS & DEFINITIONS

**Annotation** - Additions to a digital object, such as marginal notes containing reactions, commentary, analysis or links to related work.

**Community** - Commonly used to describe a notional grouping of individuals. However, the term also covers quantitative or functional definitions, such as shared language or dialect, aims, ideology, or resources.

**Community network** - Formally, community networks constitute systems supporting distinct geographical communities.

**Knowledge** - A manifestation of information in social systems that involve the interpretation, evaluation, and usage of data.

**Ontology** - Comes from the Greek words *onto* (being) and *logos* (study) meaning the study of being or the basic categories for existence

**Pragmatics** - The meaning of an utterance or written sentence often differs from that gleaned from a semantic analysis of the sentence. Pragmatics represents the study of language in use.

**Semiotic triangle** - Richards applied the structure of a triangle of meaning (namely: reference and referent and symbol) to show that the object which is referred to by a given symbol or word is not static, but relative to each language user. Peirce later used a similar notion based on a triangle, using *concept* instead of *reference*, *object* instead of *referent*, and *sign* instead of *symbol*.

**Social tagging services** - Services that permit one or more individuals to provide short plain-text descriptions or metadata that describe a unique identifier, usually a pointer to a digital object.