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THE ONTOLOGIZATION OF TAGS

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ABSTRACT

This dissertation explores the fundamental conceptual underpinnings of folksonomies and their potential contribution to semantic interoperability among our sociotechnical systems. Currently, formal ontologies attempt to provide semantic interoperability for our computational technologies, but they are problematic in that they simultaneously overspecify and decontextualize information, which to be meaningful must be adaptive in context. Folksonomies, on the other hand, are less well defined; they don't have any formal structure and are able to evolve as the lexicon of a community adapts to newly developed understandings among its members. Researchers have made various efforts, with limited success, at coupling ontologies and folksonomies to derive some sort of semantic interoperability. The difficulty with this coupling reveals a multifaceted tension between 1) structured ontologies and unstructured folksonomies, 2) lexicality, syntax and semantics, 3) social and cultural dimensions of tags, and 4) emergence and reification.

In this dissertation I propose an original model, the Emergent Culture Model (ECM), which allows for structuring the relationships between the social and cultural dimensions of tags as a means of discerning the emergent semantics of folksonomies. The ECM posits cognitive schemas as a mediating mechanism between the social and cultural dimensions of tags. Schemas, when shared as cultural schemas, illustrate the importance of identity and how we employ multiple identities in the creation of semantics within folksonomies. The mediating role of schemas leads to a reconceptualization of folksonomies as semantic networks that serve as *ready-to-hand* entry points into networks of cultural schemas. These schemas help us navigate the complex cultural landscapes that comprise our human conceptual ontologies and provide a flexible structure through which we share these landscapes in a social context. The ECM is used to illustrate that current folksonomy research focuses solely on the social dimensions of tags and

reifies the link between signifier and signified (i.e., between tag and resource) based on the traditional semiotic model. Current research fails to consider the cultural dimensions of tags, which are necessary for discerning their emergent semantics.

The structure of the ECM enables a discussion of tags using a Heideggerian phenomenological frame to explore tags-as-equipment, tags-as-patterns, and tagging-as-practice. When tags function as equipment, they exist as part of a semiotic relationship as a sign, which Heidegger says, "*functions both as this definite equipment and as something indicative of the ontological structure of readiness-to-hand, of referential totalities*." In exploring tags-as-patterns, I contend that a tag is ontic, not ontological, and only fulfill their ontic function as part of the phenomenological care-structure of Dasein, where the Heideggerian ideas of *thrownness, mood, solicitude* and *falling* hold sway. The interactions between equipment and care-structure reflects the social and cultural dimensions of tags and reveals the semantics of folksonomies to be an emergent phenomenon that can be modeled with the ECM.

The integration of our semantic networks and cultural landscapes is achieved through *ontologization*, a phenomenological characterization of the entwined processes of sense-making and meaning-making. Ontologization has significant implications for semantic interoperability, as it makes clear that the information is better conceived as a phenomenology rather than "data + meaning." Semantic interoperability involves not simply the transfer of information through a conduit, whether that conduit is human language or machine bits, but involves the connecting of semantic network data to cultural landscapes by way of schemas and ontologization. The ontologization of tags allows for the emergence of semantics within folksonomies and the delineation of the ontologization process is a first step towards the creation of schematic ontologies that will facilitate semantic interoperability among our sociotechnical systems.

In order to demonstrate the viability of the ECM and a phenomenology of ontologization to folksonomy research, I apply the model and framework to tags gathered among two sets of interdisciplinary scholars, whose endeavors are necessarily intercultural and involve the semantics of several domains. With these collected tags, I am able to illustrate how the ECM has an inherent scalability that allows for the incorporation of multiple cultural identities, and I apply this capability to explore the building of conceptual networks through tags-as-equipment, tags-as-patterns and tagging-as-practice. Tags are revealed to be a form of informational equipment and function as signs. I am able to illustrate how the configuration of tag-as-equipment into semantic networks reveals the underlying care-structure of the participants, which reflects the second element of the phenomenological framing: tags-as-patterns. Applying the notion of tagging-as-practice addresses three issues: 1) the multiplicity of cultural identities and their importance to discerning semantics; 2) the limitations of current research on folksonomies that mistakes the collective nature of folksonomies as lexicon for the collaborative nature of semantics as cultural practice; and 3) how tag sets, as useful equipment, withdraw from *present-at-hand* experience and fade into the background to become *ready-to-hand*. Through tagging-as-practice I am able to underscore the need for disaggregation of folksonomies into culturally meaningful tag sets based in cultural identities arising from the care-structure. It is only through linking cultural identity to the tags in folksonomies can semantics be appropriately discerned and semantic interoperability using folksonomic tags be realistically achieved among our sociotechnical systems.

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Chapter 1

The Problem Space: Ontologies, Folksonomies and Cultures

The expansion of the infosphere has lead to a proliferation of metadata and formal ontology artifacts for information systems. Information scientists are creating ontologies and metadata to facilitate semantic interoperability—the sharing of meaningful information rather than similarly structured information. Formal ontologies are a complex form of metadata that specify the underlying concepts and their relationships that comprise the information in an information system. The most common understanding of ontology in computer and information sciences is Gruber's "specification of a conceptualization" (Chandrasekaran, Josephson, & Benjamins, 1999; T.R. Gruber, 1993). This definition has held firm in the domains of information science and computer science. However, formal ontologies are problematic in that they simultaneously crystallize and decontextualize information, which in order to be meaningful must be adaptive in context. Smith (2003) describes accurately the motivation and practice of ontology creation:

> It becomes a theory of the ontological content of certain representations…. The elicited principles may or may not be true, but this, to the practitioner...is of no concern, since the significance of these principles lies elsewhere—for instance in yielding a correct account of the taxonomical system used by speakers of a given language or by scientists working in a given discipline.

In trying to construct a correct taxonomical system, formal ontologies are focused on syntactic precision rather than meaningful exchange of information. It is not fair to claim that syntax is irrelevant, but the meaning we make of information is dependent upon more than its syntactic structure. The semantic content of information is dependent upon the cultural context in which it exists. For true semantic interoperability to occur among diverse information systems, within or across domains, information must be culturally contextualized.

To cultural anthropologists, culture is an emergent phenomenon, one that emerges through the interplay of intrapersonal cognitive structures and extrapersonal structures in the world (D'Andrade, 1995; Strauss & Quinn, 1997). Its role in the creation of meaning makes culture integral to the study of semantics and, consequently, the study of ontologies and information technologies. The meaning we make of entities and phenomena in the world is always shaped by our cultural experience. Culture is a phenomenon integral to our experience and one that shapes our ontological commitments to the world around us. What we presume to exist and the meaning that we make of the world is dependent upon our cultural schemas and experiences. Our individual cognitive experience of the world is dependent in large part upon our cultural experience. Culture helps to focus our attention on and make meaning of relevant extrapersonal structures and their qualities and dimensions that comprise the context and background of the world. Our experience is always a cultural experience. And if we understand culture as the emergent interplay of intrapersonal cognitive structures and extrapersonal structures of the world, then the notion of cognitive and cultural schemas becomes essential to understanding ontology and the ways in which we might achieve authentic semantic interoperability among diverse information systems.

The notion of culture as described by cultural anthropologists is remarkably similar to the notion of Heidegger's *being-in-becoming*. In contrast to the Aristotelian ontology favored by information and computer scientists, Heidegger (1927) argues that rather than a series of hierarchically structured categories and classifications, ontology needs to focus on the nature of *being*. Indeed, Heidegger believes that the only way to achieve an understanding of ontology as the theory of *being* is through phenomenology. In *Being and Time* he offers a phenomenological examination of ontology, which includes the notion of *being-in-the-world*, in which each of us is immersed in and never separate from an experiential context. This context is the ever-present background that shapes our semantic and ontological commitments to the world around us—helps us make meaning of what we perceive to exist. Moreover, we are always *being-in-becoming*, experiencing the world as emergent—dynamic, contextualized and with a personal historical perspective. It is this notion of *being-in-becoming* that allows us to introduce the notion of culture to the study of ontology in information science.

With this dissertation, I introduce culture as an essential concept for information science, and I propose the development of an alternative type of ontology artifact—a *schematic ontology*—composed of folksonomic tags. Researchers have made various efforts, with limited success, at coupling ontologies and folksonomies to derive some sort of semantic interoperability (Bishr & Kuhn, 2007; T.R. Gruber, 2005; Hak Lae, Passant, Breslin, Scerri, & Decker, 2008). The difficulty with this coupling reveals a multifaceted tension between 1) structured ontologies and unstructured folksonomies, 2) lexicality, syntax and semantics, 3) social and cultural dimensions of tags, and 4) emergence and reification. As a first step towards creating a schematic ontology, I embarked on a research agenda that allowed me to explore the ontologization[1] of tags in terms of their semantics. Ontologization refers to the entwined processes of sense- and meaning-making in which data-information-knowledge is "made into being," to recognize it as

[1] Ontologize and ontologization have been used in a variety of ways in different domains. Semantic technologists use it to refer to the aggregation or linking of lexical units to taxonomies and computational ontologies (Kozareva & Hovy, 2010; Pantel & Pennacchiotti, 2008; Pennacchiotti & Pantel, 2006). Social and cognitive psychologists use it to refer to categorical exclusions of others and the making of outgroups (Roncarati, Perez, Ravenna, & Navarro-Pertusa, 2009; Schoeneman, Schoeneman-Morris, Obradovic, & Beecher-Flad, 2010). Ecologists use it to refer to the organizing conceptualization of ecosystems (Schizas & Stamou, 2010). My use of the term ontologization refers to the parallel processes of sense- and meaning-making in which data-information-knowledge is "made into being" through the transformation of patterns—recognized as being, as existing as part of one's conceptualizations that are grounded in a real-world experience. As part of our conceptual networks, whatever is ontologized is also stratified such that parts of the conceptual network can be segmented into ontological wholes and include/exclude/subsume various relationships with other ontological wholes that may also be expressed as categories, taxonomies or formal ontologies. Stratification is a multilayering and multifaceting of that which is being ontologized and which allows us to move in the conceptual space between sense-making and meaning-making. I use ontologize rather than reify to so as to not lose focus on the cognitive processes involved, to keep the discussion focused on the processes of sense- and meaning-making rather than just the object that has been reified. For example, we could argue about the reification of a particular entity or phenomenon as to whether it actually exists, but it is much less arguable as to whether or not it has been ontologized by a person or culture. I discuss ontologization extensively in Section 3.4.

being and existing as part of one's conceptualizations that are grounded in real-world experience. As part of our conceptual networks, whatever is ontologized is also stratified such that parts of the conceptual network can be segmented into ontological wholes and include, exclude, or subsume various relationships with other ontological wholes that may also be expressed as categories, taxonomies or formal ontologies. I see stratification as a multilayering and multifaceting of that which is being ontologized, and thinking of it in this way allows me to move in the conceptual space between sense-making and meaning-making.

The ontologization of tags casts information as a phenomenological process. In Heideggerian terms, tags are a type of *equipment*—actually a special type of equipment called a sign—and their aggregation into folksonomies reflects the notion of *referential totalities* that emerge through the *care-structure*, part of which is the hermeneutic discourse we engage in with others. Shared discourses and experiences establish a foundation for the emergence of cultural schemas and the semantics of tags in folksonomies.

In this first chapter, I introduce three concepts—ontology, folksonomies, and cultural schemas—that are necessary for understanding how semantic interoperability among our sociotechnical systems may be achieved. I explore the differences between philosophical and computational notions of ontology and identify specific problems with computational ontologies that this dissertation will address. I will discuss the recent developments of folksonomies and the practice of tagging that shifts the locus of classification systems from experts to individuals or, more accurately, to collections of individuals. The exploration of ontologies and folksonomies reveals the underlying problem as one of semantics, which I contend must be addressed at both individual and cultural levels. This contention leads me to introduce the concept of schemas as an essential element in discerning semantics and, therefore, as an essential element for incorporation into information systems ontologies. Through the integration of these three conceptual elements—ontologies, schemas and folksonomies—I contend that we can create schematic ontologies that enable a more effective semantic interoperability than computational ontologies currently devised.

In Chapter 2 I present an original model, the Emergent Culture Model (ECM), for discerning the emergent semantics of tags in folksonomies. I explain how the model integrates the notions of the intrapersonal cognitive functioning of individuals and the extrapersonal lexical structures of tags to allow for an emergent semantics at individual and cultural levels of analysis. I contend that use of the traditional semiotic model among researchers leads to a fundamental error—mistaking the social dimension of tags for their cultural dimension—and that we need both if we are to discern semantic information. I portray tag sets as semantic networks that manifest as present-at-hand equipment, and which serve as entry points into larger *ready-to-hand* conceptual landscapes that are based in cultural understanding.

The interplay of semantic networks and cultural landscapes prompts a detailed discussion of ontologization in Chapter 3, where semantic networks take on the characteristics of patterns of data and cultural landscapes take on the characteristics of patterns of knowledge. And it is through their interaction that the semantics of tags emerges as an informational phenomenon. The explication of the ontologization of tags informs information scientists how they might better utilize tags and folksonomies to construct information systems ontologies that retain the semantic flexibility and adaptability current ontology artifacts lack. Understanding information and how we ontologize it contributes to a better understanding of semantic interoperability across sociotechnical systems; and it opens pathways for creating schematic ontologies with folksonomic tag sets that facilitate semantic interoperability.

In Chapter 4 I apply this complex theoretical framework to the tags and tagging of two groups of interdisciplinary scholars: a group of management scientists, geographers, organizational behavior theorists, and information scientists who came together for two workshops on GeoCollaborative Crisis Management; and a group of first and second year IST graduate students. I devised surveys and activities that allowed me to elicit tags from these groups and analyze them according to various demographic measures that corresponded to their cultural identities. I use a Heideggerian framing of tags and tagging to discuss tags as *equipment* and their manifestation as signs, indicators, and clues; tags as *patterns* that are entwined with the *care-structure* where *thrownness* and the projection of understanding, *mood* and our disposition to context, and *falling* and temporality play integral parts to our discourse and interpretation of tags; and that tagging, as *practice*, is based in cultural identity, reflects both social dimensions of tags as a collective vocabularies and cultural dimensions of tags as schematic conceptualizations.

As mentioned above, the remaining subsections of this Introduction will outline the notion of ontology and ontologies, the idea of cultural schemas, and the characteristics of tags in folksonomies.

1.1 Ontology and Ontologies

In this subsection I discuss ontology, its philosophical underpinnings, and its contemporary manifestations. I explore the nature of ontology and how it has been transformed into multiple ontologies for domains. I illustrate how ontology and ontologies as classification and categorization systems are problematic, which will lead us to our discussion of Heidegger and a phenomenological conceptualization of ontology artifacts, which I call a *schematic ontologies*.

1.1.1 What is Ontology?

Ontology is a *philosophia prima* concerned with the theory of being, i.e., what exists. In his *Metaphysics*, Aristotle describes Ontology as regarding "all the species of being *qua* being and the attributes which belong to it *qua* being" (Aristotle, 1941 trans.). A "true" ontology would be one—and there would be only one—in which all things of existence and their relationships with one another were described in a single coherent and comprehensive treatise (B. Smith, 2003). Aristotle determined this to mean that everything could be described through a system of hierarchical categories. The historical path from philosophical ontology to computational ontologies is one that adheres primarily to the notion of ontology as a categorization and classification system. Sowa (2001) even refers to ontology as the "study of the *categories* of things that exist or may exist in some domain." The obvious implication for ontology as categorization is that there is a single objective world that exists and that it can be described as entirely separate from the person observing it.

Interestingly while logicians and researchers, especially from Western cultural traditions, have adopted a view such that there exists a single objective world and that we can separate ourselves as subjects observing it, they have also recognized that different domains often have a different understanding of the same concept. This idea of differing ontological conceptualizations was identified by Quine (1953), who described the task of the ontologist as discerning what types of entities scientists are committed to in their theories, which are discipline-specific. This specificity means that relations among objects belonging to different domains are not necessarily compatible, resulting in multiple ontologies among the domains (B. Smith, 2003). Ontology in the traditional philosophical sense is then replaced by domain-specific conceptualizations, which has been adopted widely in the computational and information sciences such that Gruber's (1993) definition of ontology as the "specification of a conceptualization" has become the de facto standard. This shift from ontology (singular, encompassing everything) to ontologies (plural, restricted to a particular domain), from an external to internal metaphysics, identified by Quine for the natural sciences, has found its way into the social science disciplines. Psychologists and anthropologists have attempted to elicit the ontological commitments of individuals and cultures in much the same way as philosophers of the natural sciences (Keil, 1979; B. Smith, 2003; Spelke, 1990). However, the idea that there is a single objective world separate from the persons observing it, and that humans can discern it through the study of categories, still permeates the ontological conceptualizations of natural and social science disciplines. The multiplicity of ontologies recognizes the fact that there are varied human understandings of this objective world, not that those varied understandings constitute a multiplicity of nonobjective worlds.

Aristotle (Aristotle, 1941 trans.) tried to describe a categorical hierarchy in which all things could be classified. Aristotle used formal logic (which he developed) in the form of syllogisms to guide his ontology. Four of the basic syllogisms that Aristotle developed are the foundation for a subset of first-order logic called *description logic*, two versions of which are the ontology languages, DAML and OIL (J. F. Sowa, 2001). Brentano (1862/1975) devised the structural relationships of Aristotle's Categories depicted on the left in Figure 1–1.

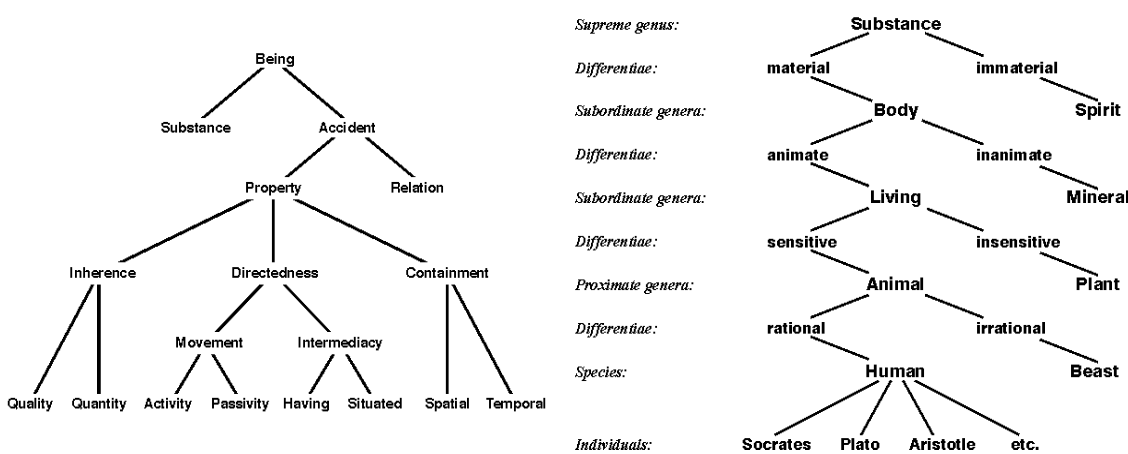

Figure 1–1. Aristotle's Categories (left) and the Tree of Porphory (right)

The Tree of Porphyry, created by Porphyry a few centuries after Aristotle, depicts Aristotle's category of Substance based on his distinctions between *genera* and *differentia*

(Wiley, 1988). At the levels of increasing granularity towards the bottom of the tree, we see the categories of *species* and *individuals*.

Sowa claims “Aristotle's method of defining new categories by genus and differentiae is fundamental to artificial intelligence, object-oriented systems, the semantic web, and every dictionary from the earliest days to the present” (J. F. Sowa, 2001). And he is correct insofar as computer scientists working on artificial intelligence (AI) have adopted this view of ontology as fundamental to their understanding of being and what is in the world. The view of ontology as a classification and categorization discipline is still the predominant view among not only AI researchers, but also among knowledge engineers, database designers, and information scientists (Chandrasekaran, et al., 1999; Guarino, 1998). Indeed, it is the dominant conceptualization of ontology used in most domains and the one advocated by researchers in those domains. In the realm of computational and informational sciences, ontologies have been developed for use in:

- AI (Chandrasekaran, et al., 1999);
- Knowledge engineering (Uschold & Grüninger, 1996);
- Knowledge representation (Artale, Franconi, Guarino, & Pazzi, 1996; J. Sowa, 1999);
- Database design (Burg, 1997; Van de Reit, Burg, & Dehne, 1998); information modeling (Ashenhurst, 1996; Weber, 1997);
- Information integration (Bergamaschi, Castano, De Capitani di Vimercati, Montanari, & Vincini, 1998; Mena, Kashyap, Sheth, & Illarramendi, 1996; Wiederhold, 1996);
- Object-oriented analysis (Pazzi, 1998; Wand, 1989);
- Information retrieval and extraction (Benjamins & Fensel, 1998; Guarino, 1998; McGuinness, 1998; Welty, 1998);
- Knowledge management and organization (Poli, 1996); and

- Geographic information systems (Casati, Smith, & Varzi, 1998) among others.

Though dominant, it is not the only conceptualization of ontology that exists among contemporary researchers. People interpret ontology to be philosophical, semantic, conceptual, formal, informal, representation, logical-theoretic, property-driven, purpose-driven, vocabulary, specification, and/or multi-leveled. Guarino (1995) identified seven distinct ways in which people interpret the term, “ontology:” (1) as a philosophical discipline; (2) an informal conceptual system; (3) a formal semantic account; (4) a specification of a “conceptualization;” (5) a representation of a conceptual system via a logical theory, (5.1) characterized by specific formal properties, (5.2) characterized only by its specific purpose; (6) the vocabulary used by a logical theory; and (7) a meta-level specification of a logical theory. Interpretations 4-7 are the dominant interpretations for information and computer sciences. These interpretations have an impact on the development, construction and use of ontologies in the wild (*pace* Hutchins).

The practice of creating a domain ontology as a classification system for that domain is an arduous, interdisciplinary task requiring not only domain experts, but also philosophers and linguists whose expertise includes languages, vocabularies, and formal, modal and predicate logics (B. Smith, 2003). Difficulties in practice highlight conceptual problems regarding ontologies such that for many ontology has come to mean one of two things: a representation vocabulary, or a body of knowledge describing some domain (Chandrasekaran, et al., 1999). Ontology is the conceptualizations underlying the representational vocabulary, not the vocabulary itself; it is the conceptualizations of relationships that constitute a body of knowledge, not the description itself. Translating from one language to another, according to this view, does not alter the ontology conceptually—a transistor is a transistor is a transistor no matter whether the vocabulary representing it is in English or Farsi or Cantonese. As a body of knowledge describing a domain, ontology attempts to specify the relationships of the concepts—a transistor is a *component of* operational amplifier, or that an operational amplifier is a *type of* electronic device.

And while it seems eminently reasonable to categorize a transistor in this way and to claim that its fundamental being is conceptualized the same way across cultural and linguistic boundaries, we might have difficulty in supporting this assumption when it comes to our conceptualizations of the spatial domain, as we shall discuss below.

Ontologies themselves fall into categories. Along with domain-specific ontologies, information scientists have also attempted to construct cross-domain ontologies, which have been referred to variously as upper-level, top-level, or foundational ontologies. Guarino (1998) distinguishes four types of ontologies across three levels. *Top-level* ontologies are the most general or the most inclusive in terms of their categorization. They categorize at a very high level and define the basic categories for space, time, matter, object, event, action, and so on. *Domain* and *task* ontologies exist subordinate to top-level ontologies. Domain or task ontologies specialize the terms introduced in a top-level ontology for a generic domain (e.g., medicine::diagnosing, law::prosecuting). *Application* ontologies are subordinate to and further specializations of the domain and task ontologies, often describing concepts that correspond to roles of domain entities performing a particular activity (e.g., replaceable unit, spare component).

There are many of these types of ontologies that have been and are being created. Swoogle[2], a semantic web search engine and metadata service provider, claims in its tagline: "Searching over 10,000 ontologies." There are formal top-level ontologies such as SUMO (Suggested Upper Merged Ontology) BFO (Basic Formal Ontology), and DOLCE (Descriptive Ontology for Linguistic and Cognitive Engineering), and less formal ones such as Cyc, which describes itself as a "general knowledge base and commonsense reasoning engine,"[3] and its related "lightweight subject concept reference structure," UMBEL (Upper Mapping and Binding

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[2] http://swoogle.umbc.edu/
[3] http://www.opencyc.org/

Exchange Layer).[4] Sowa (1999) developed a lattice structure as a tool to specify these types of relationships for top-level ontologies (Figure 2). There are formal domain-level ontologies such as PRO (Protein Ontology)[5], Gene Ontology[6] for genomics, and GOLD (General Ontology for Linguistic Descriptions)[7]. There are blends of ontologies such as COSMO (OpenCyc and SUMO)[8], the OBO Foundry for biomedicine[9], and Gellish English Dictionary[10] (upper and lower ontologies focused on industry and business). There are lexical reference systems such as WordNet[11] that have been used to augment ontologies (e.g., DOLCE).[12]

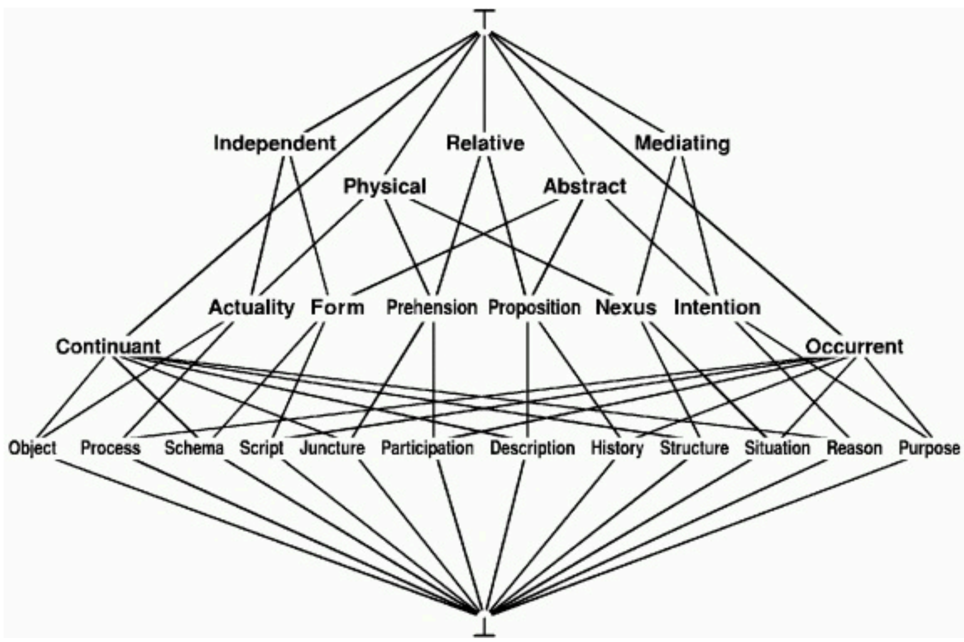

Figure 1–2. Hierarchy of top-level categories (J. Sowa, 1999)

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4 http://www.umbel.org/
5 http://pir.georgetown.edu/pro/
6 http://www.geneontology.org/GO.doc.shtml
7 http://linguistics-ontology.org/
8 http://colab.cim3.net/file/work/SICoP/ontac/COSMO/
9 http://www.obofoundry.org/
10 http://sourceforge.net/apps/trac/gellish/wiki
11 http://wordnet.princeton.edu/
12 http://www.loa-cnr.it/Papers/DOLCE-EKAW.pdf

Within ontologies, the idea of a class (from "classification") of objects has just as much, if not more variation as ontology or types of ontologies. Kuśnierczyk (2006) describes some of the conceptualizations of class:

> The most basic concepts in a domain should correspond to classes that are the roots of various taxonomic trees. (M. K. Smith, Welty, & McGuinness, 2004) Concepts are terminological descriptions of classes of individuals. (Welty, 1998) Concepts represent classes of objects. (Gómez-Pérez, Corcho, & Fernandez-Lopez, 2004) Just as in the object-oriented paradigm, there are two fundamental types of concepts in KM: instances (individuals) and classes (types of individuals). (Clark & Porter) … Classes represent concepts, which are taken in a broad sense. (Gómez-Pérez, et al., 2004) A class is a set of entities. Each of the entities in a class is said to be an instance of the class. An entity can be an instance of multiple classes, which are called its types. A class can be an instance of a class. (Chaudhri, Farquhar, Fikes, Karp, & Rice, 1998) The class rdfs:Class defines the class of all classes. (Gómez-Pérez, et al., 2004) A class has an intensional meaning (the underlying concept) which is related but not equal to its class extension. (Bechhofer, et al., 2004) … Instances are used to represent elements or individuals in an ontology. (…) Individuals represent instances of classes. (…) Individuals represent instances of concepts. (Gómez-Pérez, et al., 2004) Individuals are assertional, and are considered instances of concepts. (Welty, 1998)

Kuśnierczyk observes, "The issue is not merely one of incoherent nomenclature: it is not clear whether a class of all classes, and those classes themselves, are elements of the represented domain, elements of a formal representation of the domain, or, perhaps, elements of a representation of a mental imagination of the domain" (Kuśnierczyk, 2006). The way in which ontological engineers use *class* and *concept* interchangeably reveals the lack of clarity among those whose work is to produce precise descriptions and definitions for systems interoperability. It is not surprising that ontology modification and integration is a problematic endeavor.

We have a plethora of ontologies available to a variety of domains—this is not an exhaustive list. Each of them tries to specify concepts at various levels of granularity. Their creators' goal is to create engineering or cultural artifacts that facilitate the exchange of knowledge by casting that knowledge into a precise categorical structure. The tendency has been for ontologists to treat ontologies as rigid (or semi-rigid) taxonomies that serve to structure knowledge for a particular domain. In the simplest case, ontology describes a hierarchy of concepts related by subsumption relationships (e.g., x *is part of* y; y *contains* x). In more sophisticated cases, appropriate axioms are included to express other relationships between concepts and to constrain their intended interpretation (Guarino, 1998). They may take a hierarchical form or more complex forms as portrayed by the lattice, but they all impose structure and delineate structural and/or hierarchical relationships for the things being described.

All categorization schemes impose a rigid structure onto the entities or phenomena being described. In essence, they attempt to get back to the source of Aristotle's ontological pursuit and create categories that enable the classification and categorization of any *thing* that exists in the world. The underlying assumption to all of these hierarchies is that they describe an objective world. For many, the classical Aristotelian conceptualization of ontology as the study of categories persists. Different ontologists will categorize differently, use different descriptors to specify their conceptualizations of the things of the world (See Figure 1–3). The plethora of structures and vocabulary within and across domains indicates, however, that the ontologies are non-objective descriptions of the world.

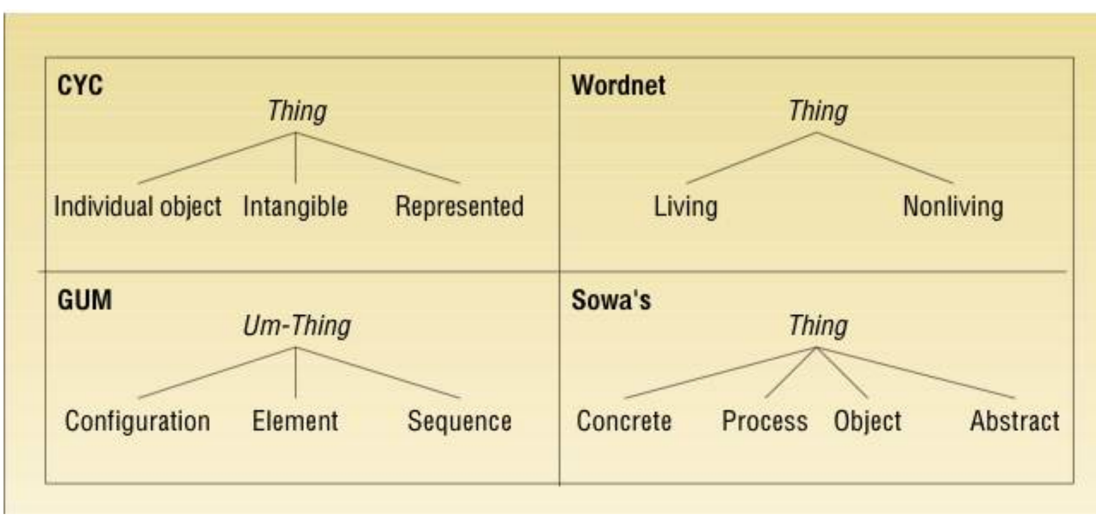

Figure 1–3. Illustration of how ontologies differ in their analysis of the most general concepts (Chandrasekaran, et al., 1999)

While information systems are generally good at connecting incompatible systems by using or translating protocols and formats, they often fail when it comes to interpreting the meaning of specific information (T. R. Gruber & Olsen, 1994). If the semantic content of some information does not comply with the formal ontological structure of the information system, it is not usable or interpretable by the system. The problem is one of meaning, and it is compounded by the fact that any or all of the meanings of a particular entity or phenomenon might be used by different users of the system at different times. It is the realization of Quine's observation that a multiplicity of ontologies exist across domains, but also within domains. Smith (2003) and Fonseca & Martin (2005) call this the "Tower of Babel Problem," illustrated quite simply in Figure 1–3. Different groups, including data- and knowledge-base system designers, have their own terms and concepts for understanding and building representative frameworks. Identical labels may have entirely different meanings; or the same meaning may have different labels. Information systems using different ontological classifications aren't able to communicate easily without additional layers of metadata that allow them to map one ontology to another.

1.1.2 The 'Problem' of Ontology

Even though the notion of ontology has continued to evolve in philosophy, information scientists still adhere to the notion of classification and categorization as the essence of ontology. The existentialist philosophers, notably Heidegger (1927), have developed the notion of ontology beyond mere classification and specification of relationships. Ontology from an existentialist and phenomenological perspective is not the study of categories of being but rather the study of experience of being:

> Basically, all ontology, no matter how rich and firmly compacted a system of categories it has at its disposal, remains blind and perverted from its ownmost

> aim, if it has not first adequately clarified the meaning of Being, and conceived this clarification as its fundamental task. (Heidegger, 1927, p. 31, H.11)

Integral to understanding ontology—to understanding *being*—is the notion of background and culture; what Heidegger refers to as *being-in-the-world*. What exists does not exist independently of the Being that is experiencing it, nor does it exist independently of the contextual background in which it is being experienced. We are forever immersed in the world and never separate from it. The clear line between subject and object, or between object and object, that exists in the Aristotelian notion of ontology becomes irreversibly blurred in the Heideggerian notion of ontology. If we are to understand being, and hence ontology, we must not separate ourselves from the world which is integral to our experience. If we are to understand information, which is presumably one of our goals as information scientists, we must not objectify it as an entity that exists independently of ourselves. We must strive to retain the context that provides the semantic content necessary for sharing information and knowledge.

The 'problem' of ontology arises from the tension between what Heidegger describes as the *ontological* and the *ontic*—between the conceptualizations we bring with us as *Dasein* (man's being) and the instances of those conceptualizations that comprise entities and phenomena in the world. What is the relationship between the rich ontological understanding we have based upon our experiential being and the seemingly objective ontic instantiations of what we encounter in our experience? The question lies at the heart of metaphysics and our philosophies of science. Heidegger sees science as a work of man-as-subject where through prescribed procedures man inquires of nature to learn more and more about it, though he is not open to it. Nature has become a human construction and the scientist (-as-subject) *represents* reality rather than let things *presence* as they are in themselves. From Lovitt's Introduction to *The Question Concerning Technology and Other Essays* (Heidegger, 1977):

> He arrests them, objectifies them, sets them over against himself, precisely by representing them to himself in a particular way. Modern theory, Heidegger says,

> is an “entrapping and securing refining of the real” (SR 167). Reality as “nature” is represented as a manifold of cause and effect coherences. So represented, nature becomes amenable to experiment. But this does not happen simply because nature intrinsically is of this character; rather it happens, Heidegger avers, specifically because man himself represents nature as of this character and then grasps and investigates it according to methods that, not surprisingly, fit perfectly the reality so conceived. …Technology treats everything with “objectivity.” The modern technologist is regularly expected, and expects himself, to be able to impose order on all data, to “process” every sort of entity, nonhuman and human alike, and to devise solutions for every kind of problem. He is forever getting things under control. (pp. xxvi-xxvii)

We need to see the world as objective and distinct from ourselves, to believe that we are not solipsistic ‘brains in vats’ merely imagining that a world exists rather than one existing actually. We reinforce this need by objectifying nature, by imposing order on all data, to make all types of entities subject to processing. We engage in this type of activity as scientists because our traditional ontological stance derives from the question, “What *is* it?” Heidegger asks a more difficult and vexing question: What does it mean *to be*? And at the center of this inquiry dwells man and his *being-in-the-world* as *Dasein*.

As *Dasein* we are thrown in the world with others. The essential nature of *Dasein* is to understand, to make meaning of our experiences, of our world. Indeed, we cannot help but make meaning of our experiences, whether we are able to articulate it or not. We make this meaning individually and collectively. We share our experiences of *being-in-the-world* with others, and as such, Heidegger says, we are always *being-in-the-world-with-others*. When we share with others we do so from a personal historical perspective, from the sum total of our experiences and the understanding we have created about them. Our experiences are always contextualized and the meaning we share with others is done from a contextualized perspective. We engage one another in hermeneutic discourse where our horizons of understanding are fused with others and thereby expanded. We don’t require extreme specifications of one another’s conceptualizations. In conveying meaning to others we make use of metaphor and imprecise language from which they can create their own, newly contextualized understanding. Our experiences are such that we are constantly negotiating the contexts in which we are immersed and sharing those experiences in imprecise ways—we are always contextualized and underspecified, as it were. Yet, we are able to understand each other and share meaningful information about those experiences. To address the problem of ontology, this dissertation proposes the development of *schematic ontologies* that retain semantic flexibility and adaptability. Schematic ontologies would use collections of folksonomic tags as the vehicle to retain such flexibility. In order to understand how folksonomies might help in this endeavor, we need to understand what tags are and how they function, which in turn requires a better understanding of our *being-in-the-world* and its manifestation as culture. I will introduce culture and tags in the next two subsections.

In order to understand how we might make our computational ontologies more "ontological," and not simply ontic, we need to first understand how our conceptual networks function. In the following subsections, I will explore the idea of cognitive and cultural meaning, and the notion of tags in folksonomies as representations of conceptual nodes, before returning to the 'problem' of ontology in terms of semantic interoperability.

1.2 Folksonomies/Tagging

Folksonomies is a term coined by Vander Wal (2006) to refer to the "result of personal free tagging of information and objects for one's own retrieval." The term, folksonomies, is a combination of folk and taxonomy, which is a bit of a misnomer since folksonomies lack the one critical characteristic of all taxonomies: hierarchy. Tagging happens in a social environment and is done by the individuals consuming the information. Folksonomies are the similar to taxonomies in that both use keywords to describe information or objects within a domain. They differ in that folksonomies are completely unstructured and are not arranged in hierarchies. Vander Wal considers folksonomies to be complements to taxonomies rather than replacements for them. Shirky (2005) makes the case for the use of folksonomies rather than rigidly structured ontological categorization schemes. He raises the issue of the "information explosion" as a primary force in the shift from standard classification schemes such as librarians use to tagging and folksonomies that are non-hierarchical, user-developed classification systems.

Tags are generated by individuals for their personal use, to be able to retrieve information and/or objects quickly and in a way that conforms to their understanding of the entity. Social bookmarking sites as Flickr[13], del.icio.us[14], and CiteULike[15] have incorporated the use of tags as way for users to retrieve photos, URLs, and citations in a way that is personally meaningful and which doesn't require learning a taxonomy constructed by a professional. Users don't need to learn a taxonomy because they are using their own vocabulary, which has meaning specific to them. It is these meaningful associations expressed as tags that enable faster and more direct recall of the object because they act as representations for the way we think (Halpin, Robu, & Shepherd, 2007).

1.2.1 Broad and Narrow Folksonomies

Vander Wal (2005) delineates two types of folksonomies—broad and narrow. Narrow folksonomies' tags are singular in nature. Frequency in a narrow folksonomy doesn't matter. Many people may tag the same entity with the same tag, but only one of each tag is applied to a resource. Even without the frequency and weighting of tags in a narrow folksonomy, they still allow for easy searching of non-textual entities by persons with similar "vocabulary mindsets." Approaching this phenomenon from the individual's rather than the object's perspective, Speroni

[13] http://www.flickr.com/
[14] http://del.icio.us/
[15] http://www.citeulike.org/

di Fenzio (2005) refers to this type of narrow folksonomy as a tag set—the tags that one user uses to tag a single entity. A tag either is part of the set or it is not.

We have already mentioned that some researchers have conceptualized tags as a shared vocabulary (Buffa & Gandon, 2006; Cudré-Mauroux, et al., 2006; Jäschke, Marinho, Hotho, Schmidt-Thieme, & Stumme, 2007; Quintarelli, 2005; Wang, Bai, & Liao, 2007). Broad folksonomies consist of many people tagging the same object with their own tags in their own vocabulary. In a broad folksonomy, the frequency of tags is important. Each instance of a particular tag associated with a resource is recorded. This type of folksonomy easily lends itself to application of power law curves and allows us to see trends in the tags people are using to tag an entity.

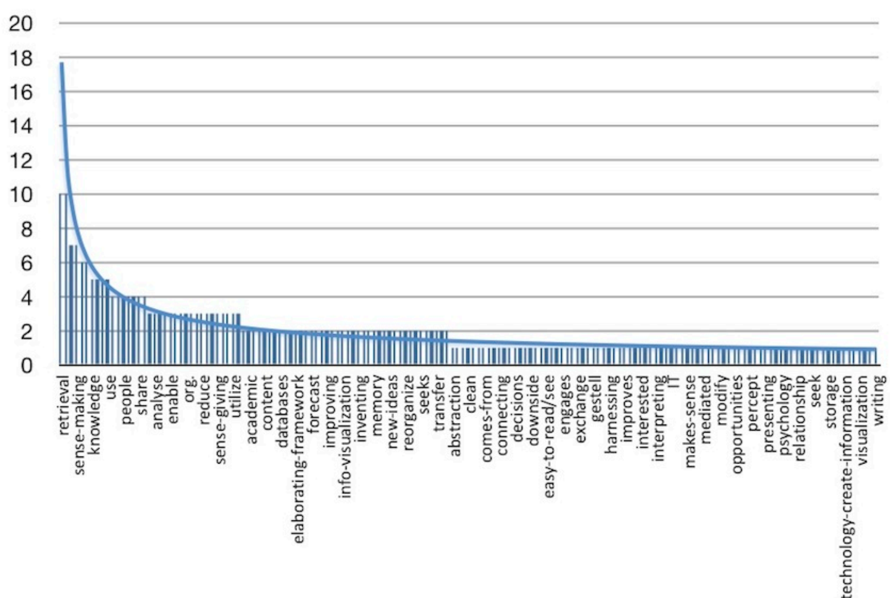

Figure 1–4. Frequencies of tags related to the concept, “information,” among IST graduate students and illustrative of how folksonomies conform to power law curves (X-axis depicts every third tag from a set of 157 unique tags; see Table 5-2. Frequencies of tags associated with the concept “information” among IST graduate students in Appendix D: Tags associated with the concept “information”)

The spikes of the power curve can be as meaningful as parts of the long tail, Vander Wal suggests, as they would reflect "vocabulary mindsets," which are akin to the cultural identity perspectives discussed later in this dissertation. A broad folksonomy, from the object's perspective, is often referred to as a tagcloud, which Speroni di Fenzio describes as a multiset of tags, where the frequency of each tag can be higher than one. Frequency and weight[16] are important characteristics of a tag in a broad folksonomy, and critical to our premise that tags reflect cultural schemas. Speroni di Fenzio points out:

> Not only we could study a culture by studying the differences in the power law approximated by the tagclouds used by people of that culture. But we could even measure cultural earthquake (sic) by measuring the difference between the tagcloud being generated before a certain event, or after a certain event.

There are some inherent problems with using tags in information search and retrieval, namely polysemy, synonymy, and basic level variation (Golder & Huberman, 2005). With respect to our goal of schematic ontology elicitation, polysemy and synonymy aren't necessarily problematic, simply because we are not searching for information. Basic level variation is, however, desired. Tags that are created at basic, superordinate, and subordinate levels are related to an individual's interactions with them (Tanaka & Taylor, 1991). There is systematic variation across individuals in what constitutes a basic level; and expertise plays a role in defining the specificity of the level an individual treats as basic.

The underlying factor behind this variation may be that basic levels vary in specificity to the degree that such specificity makes a difference in the lives of the individual.... Like variations in expertise, variations in other social or cultural categories likely yield variations in basic levels (Golder & Huberman, 2006).

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[16] Tag weights are generated by a simple formula: Weight of tag t = (number of people using t)/(total number of people).

Tagging entities is fundamentally about making sense of that entity. Our experience with those entities (or references to those entities) allows us to create meaningful associations for them. Tags may reflect descriptive associations or categorizations of those entities, through which meaning emerges. The collective tag contributions to any folksonomy will reflect both individual and cultural schemas.

1.2.2 Tagclouds

Tagclouds represent the patterned frequencies found in folksonomies. They are subsets of folksonomies and associated with resources (C. Hayes, Avesani, & Bojars, 2007). The resource may be of different levels of granularity—a blog, a blog entry, a dissertation posted on a blog or website. The repeated use of the same tags will engender greater weight to the tag in relation to the resource. Visually, this means that the tagcloud representation will indicate more frequent tags with larger and/or darker fonts (See Figure 1–5). Statistically, this means that the majority of tags in a tagcloud are used infrequently, with relatively few tags constituting the greatest number of tag instances. In other words, tags in a tagcloud tend to conform to a power law curve (See Figure 1–4).

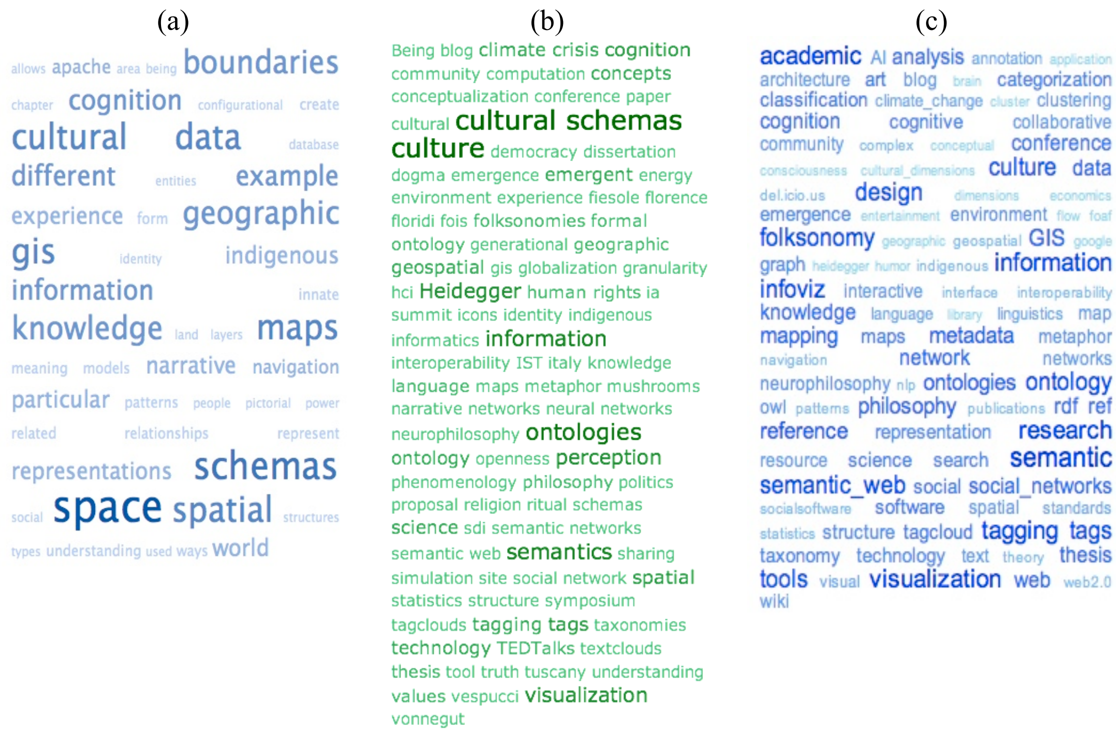

Figure 1–5. Examples of Tagclouds: (a) Single document; (b) Blog; (c) Delicious

Tagclouds can be represented without alphabetization or in non-linear/non-columnar representations. The two groups of participants in this research, for example, created tags for the concepts of *GeoCollaborative Crisis Management* and *Information* that were assembled into tagclouds in Figure 1–6 and Figure 1–7.

Figure 1–6. Tagcloud of the concept of GeoCollaborative Crisis Management (GCCM) from workshop participants at the Penn State GCCM workshop

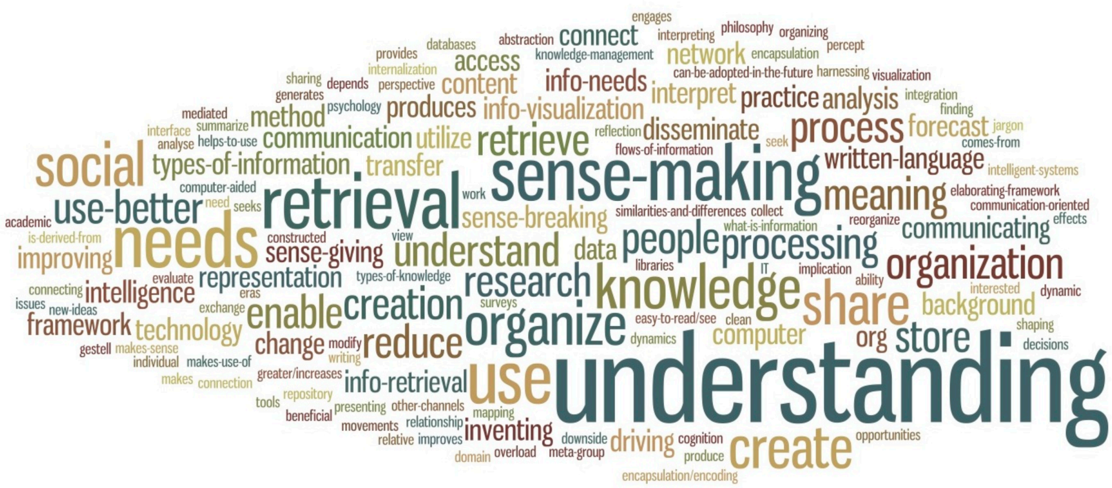

Figure 1–7. Tagcloud for the concept of “Information” from IST graduate students

1.2.3 Semiotic Analysis

Researchers of folksonomies tend to use a well-known and long-established model known as the semiotic triangle established as a formal model by Ogden and Richards (Ogden & Richards, 1923; see Figure 8), though arising from the philosophical analyses of Peirce (Peirce, 1868) and linguistic theories of Saussure (2006). Tagging entities is fundamentally about making sense of that entity. Our experience with those entities allows us to create meaningful conceptual associations for them. Tags may reflect categorical or descriptive associations for those entities, through which meaning emerges. Semantic web researchers have a strong interest in the semantic dimensions of folksonomies comprised of tags insofar as tags can help structure the information and knowledge available in the vast infosphere of the Web.

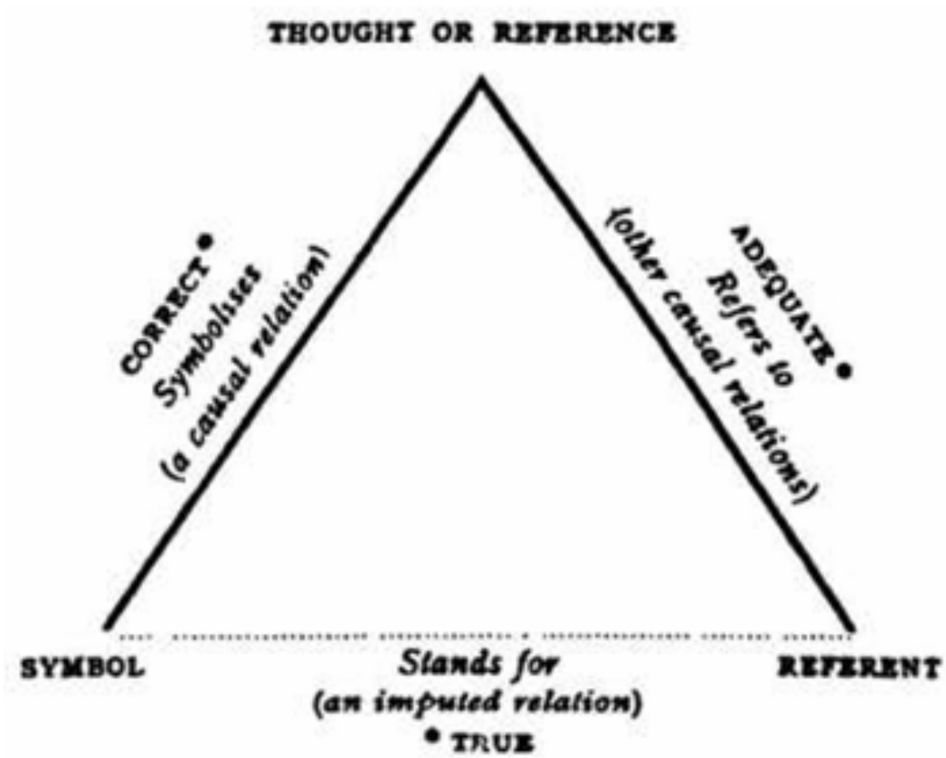

Figure 1–8. Semiotic Triangle (Ogden & Richards, 1923)

Researchers examining the dynamics of tagging systems (Choy & Lui, 2006; Furnas, et al., 2006; Golder & Huberman, 2006; Kipp & Campbell, 2006; Specia & Motta, 2007) have settled on a semiotic perspective where tagging is viewed as a tri-concept in which users, resources, and tags are linked, which is more akin to Peirce's exposition of semiotics (See Figure 2–4 in Section 2.3). Tags are associated with users who create them and resources to which they refer. A folksonomy is the entirety of a tri-concept tag set—all the tags created by all the users for all resources. Structuring the user-tag-resource relationship as a tri-concept facilitates the analysis of tags with respect to information systems (Gudwin & Queiroz, 2005) by enabling the application of data mining algorithms to folksonomies (Hotho, Jäschke, Schmitz, & Stumme, 2006). Some researchers focus on identifying the semantic dimensions of folksonomies (Buffa & Gandon, 2006; Cattuto, Loreto, & Pietronero, 2007; Staab, Santini, Nack, Steels, & Maedche, 2002), or understanding their emergent semantics based on this triadic relationship (C. Schmitz, Hotho, Jäschke, & Stumme, 2006) and creating ontologies from folksonomies (or "folksologies" as some researchers put it (Mazzocchi, 2005; Spyns, de Moor, Vandenbussche, & Meersman, 2006).

The difficulties with applying traditional semiotic models to folksonomies centers the confusing of the ontic for the ontological, the social for the cultural, which I will address in detail in Chapter 2. To address the problem, I need to discuss the third element of our problem space: culture.

1.3 Cognition and Cultural Meaning

In cognitive science, connectionist theory posits the human conceptual system as a network composed of a large number of units joined in a pattern of connections (Rumelhart & McClelland, 1986). Cognitive anthropologists and educational psychologists refer to these patterns of connections as schemas (Anderson, Spiro, & Montague, 1984; D'Andrade, 1995; Davis, 1991; Strauss & Quinn, 1997). Schemas are strongly connected networks of cognitive elements, having a bias in activation through repeated exposure to the same or similar stimulus, but they are not rigid and inflexible.[17] Strauss and Quinn (1997) describe schemas as “networks of strongly connected cognitive elements that represent the generic concepts stored in memory.” D’Andrade (1995, p. 140) expands on this concept and describes schemas as “flexible configurations, mirroring the regularities of experience, providing automatic completion of missing components, automatically generalizing from the past, but also continually in modification, continually adapting to reflect the current state of affairs.” Schemas facilitate our cognitive functioning, including use of our knowledge, in a world overflowing with all kinds of patterns.

Because of the strong connections of elements and their clustering, we are able to fill in information that may be missing from our experience. Schooling, for example, has a number of associated elements—teachers, peers, desks, books, reading, writing, lecturing, and so on (see Figure 1–9). When someone mentions ‘school’ or ‘schooling’, there are a variety of schemas evoked in cognition based upon our lived experience with the same. Simply mentioning the name of something is often enough to activate schemas associated with it. Schemas help to fill in the ambiguous or missing information because the associated neurons are more likely to be activated by the initial stimuli.

[17] They have also been referred to variously in the literature as frames, scenes, scenarios, scripts, models, and theories (D’Andrade, 1995).

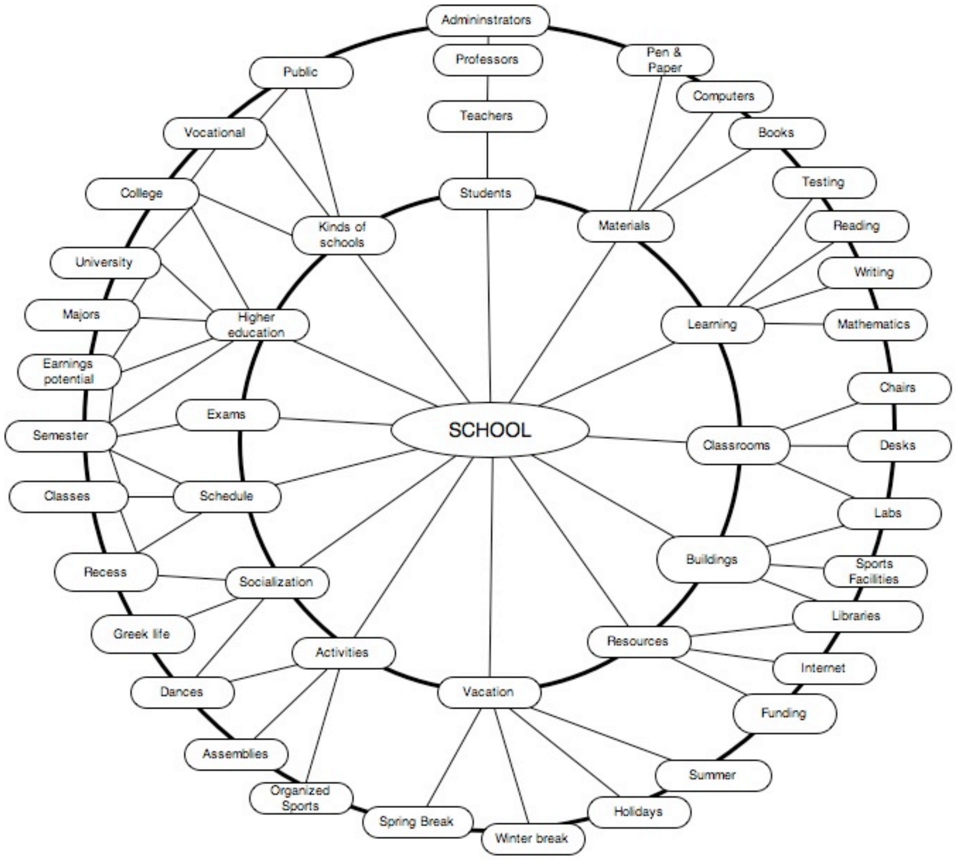

Figure 1–9. Example schema for "School"

Schemas—these strongly connected cognitive elements—are powerful processors of experience that help with pattern completion and promote cognitive efficiency. They serve to both inform and constrain our understanding of experience. People recall schematically embedded information more quickly and more accurately. In fact, schemas hold such sway in our cognition that people may falsely recall schematically embedded events that did not occur (DiMaggio, 1997). They are more likely to recognize information embedded in existing schemas because of repeated activation of the schemas. This repeated activation evokes expectations within cognition, and the easy recognition of contradictory or challenging information that do not conform to those expectations formed as part of the existing schemas. Information that is orthogonal to existing schematic structures, that doesn't acquire salience through the repeated activation of schemas and the creation of associated expectations, is much less likely to be noticed or recalled. Because of their functionality in pattern completion, schemas function, in some sense, as flexible filters of experience, enabling us to attend to its salient features while filtering out the non-salient.

1.3.1 Schemas' relationship to culture

Schemas are cognitive entities. They help us to process information. But they are also cognitive patterns that enable the recognition of patterns and entities in the external world. It would be inaccurate to say that schemas are separable from culture, for that would imply that culture consists solely of the external world structures outside the individual. The discussion of schemas marks a shift away from the focus on deliberative and explicit cognitive processes, which mirror the ways we deal with language in cognition, to thinking and cognition as automatic and implicit. It is the shift away from symbolic processing models of cognition to a connectionist model of cognition.

Schemas, as complex cognitive associations, are *intrapersonal* structures. The objects or events that are manifest outside individual cognition, the entities in the external world, are *extrapersonal* structures. Culture consists of the interplay between the intrapersonal cognitive structures and extrapersonal structures such as systems of signs, infrastructure, environment, social interaction, and so on. The intrapersonal and the extrapersonal are different and distinct, but closely interconnected. They are not isolated from one another, rather separated by a permeable boundary. Culture encompasses both intrapersonal schemas and extrapersonal structures, emerging from the interplay between them. It is through this interplay that we can see that some of the intrapersonal cognitive structures called schemas are shared.

1.3.2 Shared schemas as cultural schemas

The sharing of schemas does not require people to have the same experiences at the exact same time and place, rather that they experience the same general patterns. As beings in the world, we organize our experiences in ways that ensure ease of interaction, coordination of activities, and collaborative interaction. Because we organize our experiences in particular ways, people in the same social environment will indeed experience many of the same typical patterns. In experiencing the same general patterns, people will come to share the same common understandings and exhibit similar emotional and motivational responses and behaviors. However, because we are also individuals, there can be differences in the feelings and motivations evoked by the schemas we hold. "The learner's emotions and consequent motivations can affect how strongly the features of those events become associated in memory" (Strauss & Quinn, 1997, p. 6). Individuals will engage the external world structures and experience the same general patterns. Similar stimuli and experiences will activate similar schemas. It is in that sense we considered them shared schemas. It's their quality of sharedness that makes them a dimension of the cultural.

Schemas also have other qualities. Some schemas are durable. Repeated exposure to patterns of behavior strengthens the networks of connections among the cognitive elements. Some schemas show historical durability. They are passed along from one generation to the next. Some schemas show applicability across contexts. We draw upon them to help us make sense of new and unfamiliar experiences. Some schemas exhibit motivational force. Such motivation is imparted through learning, explicitly and implicitly, strengthening the emotional connections among the cognitive elements. Schemas are strongly connected networks of cognitive elements, having a bias in activation through repeated exposure to the same or similar stimulus, but they are not rigid and inflexible. They are adaptable, sometimes resulting in the strengthening of existing schemas, sometimes in their weakening in the face of new experience.

We share the intrapersonal dimensions of culture when we interact with others. In sharing these intrapersonal dimensions, schemas are activated. Activation evokes meanings, interpretations, thoughts, and feelings. We make meaning of our experience. The cultural meaning of a thing, which is distinct from the personal cognitive meaning, is the typical interpretation evoked through life experience, with the acknowledgement that a different interpretation could be evoked in people with different characteristic life experiences. In some cases our experience is intracultural, where we share a similar cultural frame. In other cases our experience is intercultural, where we are sharing different cultural frames. The meanings evoked by one person in relation to a particular extrapersonal structure may not be the same as those evoked in another. In fact, the meanings evoked may not be the same within the same person at different times, for they may experience schema-altering encounters in the interim. The ways in which we share these intrapersonal dimensions of culture makes each person a junction point for an infinite number of partially overlapping cultures.

In this chapter I have laid out the three elements that need to be understood as part of the problem space—ontologies, folksonomies, and cultural schemas. The common thread that weaves through and connects each of these elements is the issue of semantics. If the issue of semantic interoperability among sociotechnical systems is to be addressed through the creation of schematic ontologies with folksonomies (as complements to computational ontologies), we need to understand tags not only as lexical representations but also as entry points into complex conceptual schematic networks that are based in interpersonal and intercultural interaction.

Chapter 2

The Cultural Nature of Tags

This chapter starts by providing a short recap of the "ontology problem" as a springboard to introduce the Emergent Culture Model (ECM) for structuring the social and cultural dimensions of tags to discern emergent semantics in folksonomies. The model introduces several Heideggerian concepts: *ready-to-hand, present-at-hand, care-structure* (comprised of *thrownness, mood, solicitude, falling*), and *fore-structure*. Each will be explained in more detail in the subsections that follow. The ECM provides the basis for a phenomenological understanding of the ontology of tags by integrating several important elements: a) tag sets as representative of shared vocabularies and of shared conceptualizations; b) tags-as-equipment comprising semantic networks; c) tags-as-patterns indicative of cultural landscapes; and d) how culture mediates what is *ready-to-hand* and links semantic networks with cultural landscapes as part of a tagging-as-practice. This understanding will be examined in greater detail in the following chapter as a phenomenology of ontologization.

2.1 The Emergent Culture Model

Information scientists developed formal ontologies as a way of delineating the semantic content of information housed in an information system, (i.e., ontologies for information systems; Fonseca, 2007). The specifications, often constructed using predicate logic, facilitate system interoperability by providing machine-interpretable structures for semantic content. The reasons for creating ontologies in this way rest with the limitations of machine information systems. In order to communicate with one another—to achieve semantic interoperability—information systems need very specific rules and structures to share data.

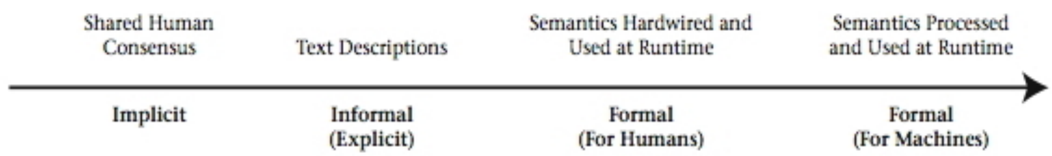

Figure 2–1. Uschold’s Semantic Continuum (Uschold, 2003)

As we move from shared human consensus towards formal machine semantics, we lose meaning (see Figure 2-1; Uschold, 2003). The contextualized understanding of people becomes progressively lost through greater and greater abstraction. Or, there are simply too many contextual frames to codify and inference rules to follow so as to enable practical contextualization of the information being processed (Dreyfus, 2007). The difficulty with formal ontologies for our sociotechnical systems is that they decontextualize the information content and crystallize it into rigid, overspecified and inflexible structures.

In trying to construct a correct taxonomical system, formal ontologies are focused on syntactic precision of the representations rather than meaningful exchange of information and semantic interoperability. Paradoxically, adding more information to ontologies, making them richer, does not reduce the ambiguity but rather increases it by providing for finer ontological distinctions (P. Hayes, 2006), which then have to be represented with greater complexity and convolution. For every distinction that is specified, a series of contexts and associations that could alter the specification arise. Different ontologies have different ways of categorizing very general concepts, as illustrated in Figure 1–3 in the first chapter. What Figure 1–3 illustrates is the fundamental problem faced by ontology engineers, information scientists and philosophers today: the difficulty of eliciting and representing a shared conceptualization of a domain by its members.

Everyone has a slightly different conceptualization; everyone has a slightly different vocabulary and way of describing the things that exist as part of their domain.

The Emergent Culture Model (ECM; Figure 2–2) provides a structure to help integrate a phenomenological understanding of tags as equipment and tags as patterns. The ECM captures the interaction between equipment and care-structure, broadly conceived. In the model, equipment in the form of tags comprises an extrapersonal structure. The care-structure is a particular configuration of intrapersonal schemas based on a variety of contextual factors manifesting at a variety of levels—national culture level, organizational culture level, and personality level. The difficulty in recognizing intrapersonal schemas is the same difficulty we have in recognizing cognition: we can't observe them directly. We have to interpret and infer what people are thinking via their actions and speech. And this is always done in context, with thrownness, mood, solicitude and falling all contributing to the intrapersonal side of the contextual equation; and tags as signs and indicators in relation to other entities, signs and other manifestations of the referential totalities contributing to the extrapersonal side of the equation.

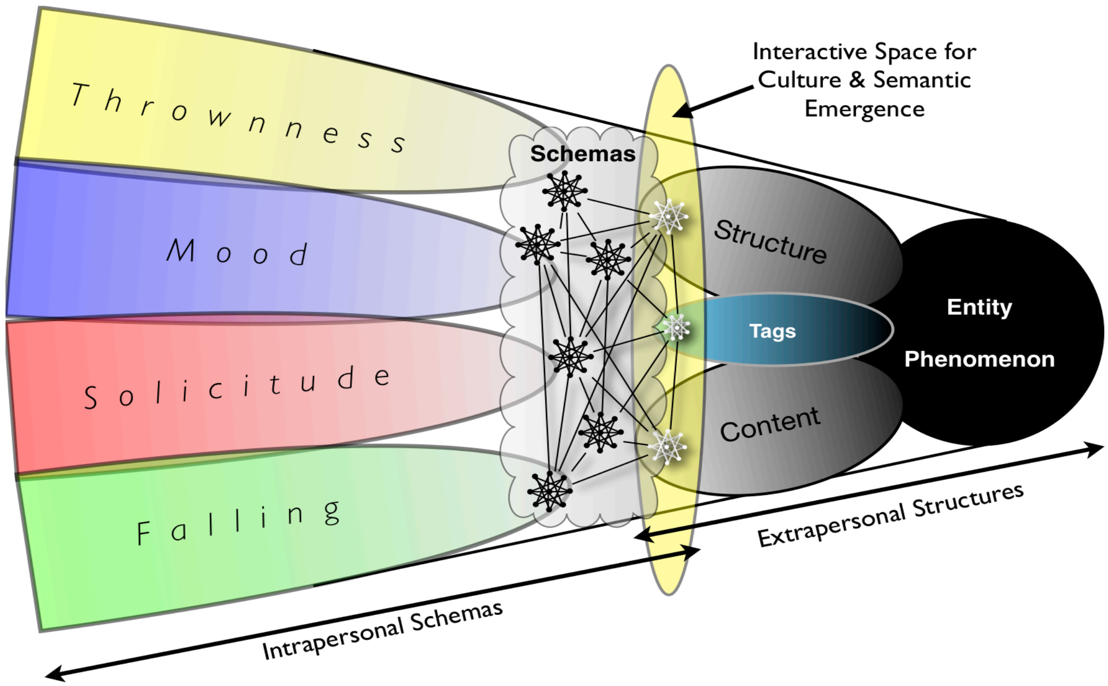

Figure 2–2. Emergent Culture Model

Though people's intrapersonal schemas can never be transferred or exchanged directly, we are able to share them to some extent through language. It is through this sharing that we develop a cultural understanding of the patterns and connections of entities and phenomena we encounter in experience. It is these larger cultural patterns of intrapersonal schemas—cultural schemas—that we might posit as representative of identity. Identity in this context is simply a means of aggregating a set of cultural schemas into an ontological whole—male, son, brother, husband, father, uncle, student, employee, manager, citizen, voter, writer, photographer, footballer, scientist, activist, atheist, Taoist, vegetarian, and so on.

The mere mention of a word is often sufficient to evoke any number of schemas. As extrapersonal structures, words and language (i.e., tags) serve as social representations that help us identify relationships between images, ideas, objects, and phenomena we encounter in the world (Fisher, 1997; Moscovici, 1984). They form the entry points into our complex intrapersonal schemas and rich ontological understanding of experience. What intrapersonal schemas a tag will evoke are dependent upon the comportment of the care-structure in the cultural context in which it is being experienced. While each of the care-structure elements work together to form a phenomenological whole, it is important to understand that each helps to shape and influence the way our schemas are engaged in the interactive space for culture and semantic emergence. The care-structure influences expectations and our schemas' auto-completion process as part of its *thrownness* and *falling* elements. *Mood* and *solicitude* influence the how and what we come to share as cultural schemas. Tags are simple lexical representations, but when aggregated into tag sets as folksonomies they reveal referential totalities of the people creating or consuming tags. The care-structure of the user shapes their individual understanding of those referential totalities, but the solicitude dimension of the care-structure enables them to reshape their individual schemas into a set of shared cultural schemas.

How cultural schemas develop will be discussed more extensively in the section about tagging-as-practice and the building of conceptual networks. What is important to understand at this point is that as beings-in-the-world we are able to employ multiple cultural perspectives and use multiple cultural identities in any given context. The ECM can be modified to represent multiple cultural identities and perspectives. Figure 2–3 illustrates the integration of the culture model using a mandala to represent eight perspectives on a phenomenon. In reality, the perspectives may overlap a great deal more or a great deal less depending on the extent of overlap of shared cultural schemas, but they are depicted as a mandala for ease of discussion, not to suggest that our cultural identities are completely independent of one another.

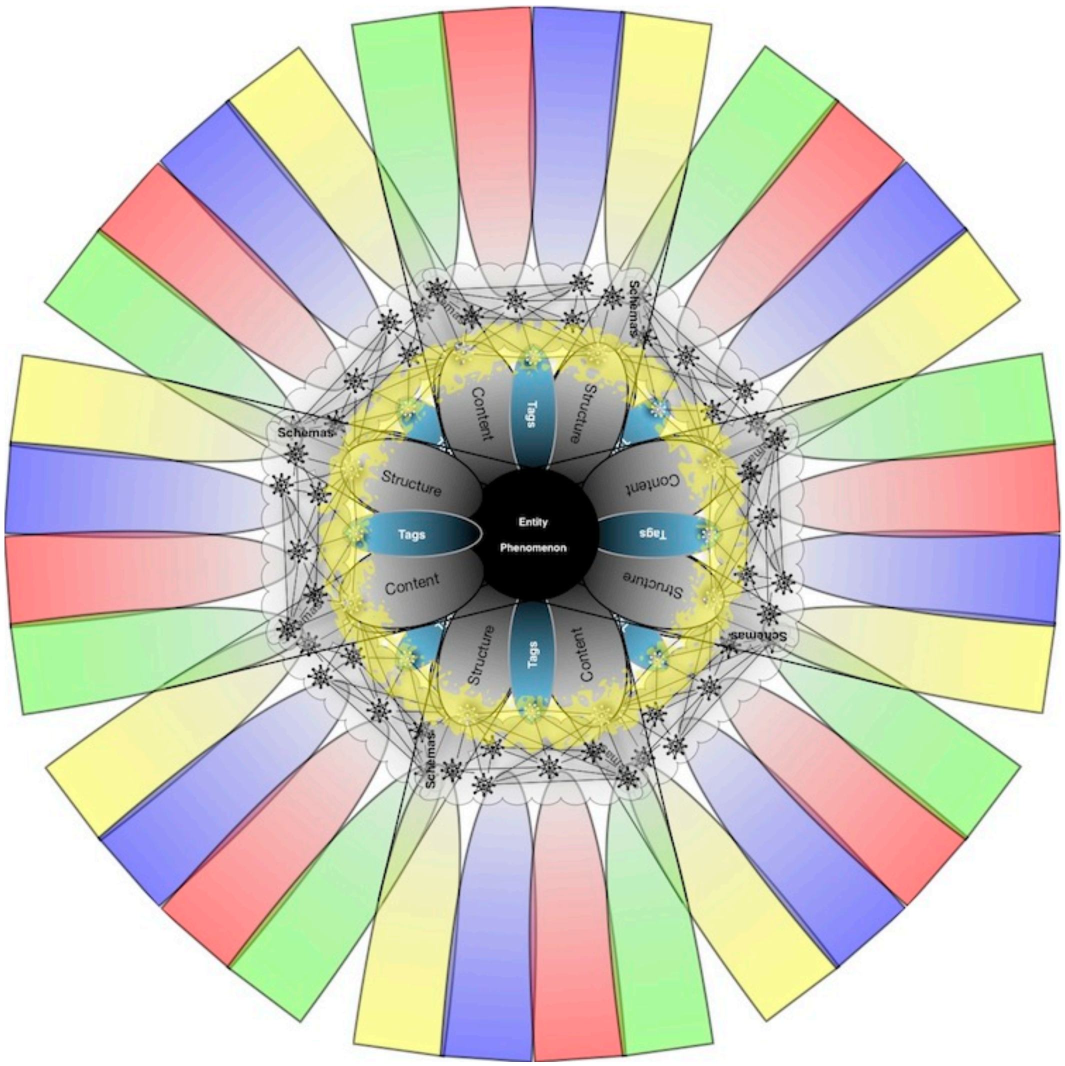

Figure 2–3. ECM Mandala illustrating eight perspectives on a single phenomenon

We can contextualize the interactions between perspectives in different ways and illustrate the flexibility of the model to portray culture at individual, group, organizational and societal levels of analysis. In the context of a single culture, where the entire mandala is understood to represent a common cultural identity, each perspective would correspond to a single person. Each person would have a set of tags they created for the entity or phenomenon. Those sets of tags would be reflective of the intrapersonal schemas of a single individual and would consist of the individual's cognitive and cultural schemas. Because the tag sets are reflective of the cultural schemas of a single culture, we would predict that the individuals would use many of the same tags to describe the phenomenon. The aggregated tag sets would exhibit a power law curve, with a few particular tags with high frequency and a relatively larger number of tags with low frequency.

We could also contextualize the interactions between different perspectives such that they are intercultural, arising from different cultural schemas. We could consider each of the eight perspectives unique to a particular cultural perspective (of individuals, of knowledge domains, of organizations, of nations, of societies, etc.). Each set of tags would be created from those different cultural perspectives and reflect a much greater diversity of conceptualizations with respect to the entity or phenomenon under examination. We might see several power law curves and see distinct clustering of sets of tags based on the different perspectives. Comparisons of the tags sets in this type of configuration might yield places where different cultures can begin a discourse that would allow for the negotiation of meaning across cultures. This clustering of cultural identities will be illustrated and their implications for semantics of folksonomies in the tagging as practice and analysis sections below.

The simplicity of the model belies its strength in terms of scalability. The eight perspectives illustrated in Figure 2–3 could be applied to the cultural identities of a single individual (e.g., male, student, New Englander, photographer, technologist, socialist, gay, atheist). The ECM could represent several individuals from any one of these cultural identities. Or, it could be used to represent multiple individuals from each of these identities. Like with Actor-Network Theory (Latour, 1987, 2005), there is an inherent flexibility to the model in terms of scaling. A node can be representative of a single individual or a sub-network, just as the ECM mandala can represent a single individual (with multiple cultural identities) or several individuals (with the same or different cultural identities). The entity or resource that is being tagged remains a constant in any application of the model, but the perceived structure or content of the resource, as well as the tag associated with it, is dependent as much upon the cultural identity being mapped as it is to the entity to which these qualities belong. The ECM and its mandala variation allows us to properly articulate the level at which the tag analysis is being done and prevents confusion of the social and cultural dimensions of tags by ensuring that both are considered appropriately.

So, what are the social and cultural dimensions of tags? Fundamentally, the distinction rests on the difference between vocabularies and conceptualizations, between the ontic and the ontological. The following subsection examines the tension between the social-cultural, ontic-ontological that gives rise to some of the confusion surrounding the semantics of tags and consequently to the idea of semantic interoperability.

2.2 The Cultural Nature of Tags

While folksonomies do not explicitly state the relationships that exist in a conceptualization, the use of tags by users with similar interests tends to converge to a shared vocabulary (Buffa & Gandon, 2006; Cudré-Mauroux, et al., 2006; Jäschke, et al., 2007; Quintarelli, 2005; Wang, et al., 2007). Vocabulary convergence is treated as a collaborative activity by researchers, but there is some confusion as to whether sets of tags constitute a collaborative activity or a collective one (Vander Wal, 2006). This confusion has implications for how researchers understand folksonomies and their approach to analyzing them. They describe folksonomies as products of "collaborative" tagging, which is a common characterization in semantic web research (Capocci & Caldarelli, 2007; Cattuto, Loreto, et al., 2007; Choy & Lui, 2006; Jäschke, et al., 2007; Kipp & Campbell, 2006; Lambiotte & Ausloos, 2005; Santos-Neto, Ripeanu, & Iamnitchi, 2007; P. Schmitz, 2006). However, collaborative implies working together towards some goal—that there is active, focused, and agreed upon intent among a group of persons to achieve a specific goal or set of goals (Hveinden, 1994; Mattesich, Murray-Close, & Monsey, 2001; Saab & Fonseca, 2008; Wood & Gray, 1991). A group agreeing to tag a particular set of resources using an agreed upon vocabulary would be an example of collaborative tagging. Folksonomies are not collaborative in the sense that there are articulated goals towards which the persons creating tags are driving, sans any prior agreement. They are created through a collective tagging process, not a collaborative one (Vander Wal, 2006). Assuming collaboration situates a folksonomy within the confines of a single culture. However, most folksonomies are not so confined. They are open to individuals who have many cultural affiliations and identities, many nationalities and ethnicities, many research domains and spheres of interest (Talmy, 2001). In other words, many cultures, and we can never be certain that the collective set of tags reflect the cultural conceptualization of a particular group.

The collective nature of folksonomies is indicative of culture only in a very broad sense (e.g., Western culture, English-speaking culture). We should not mistake the tag representation for the underlying ontological conceptualization. A tag is ontic, not ontological, and as such it *"functions both as this definite equipment and as something indicative of the ontological structure of readiness-to-hand, of referential totalities, and of worldhood"* (Heidegger, 1927, p. 114, H. 83). As an instance of the ontic, it represents an extrapersonal structure. In order for a tag to be considered as part of a cultural phenomenon, it must interact with an intrapersonal schema. Tags will evoke schemas as the individual interacts with them, and it is through this interaction that meaning (i.e., semantics) emerges. A single, isolated tag is meaningless and indicative of no particular culture or cultural perspective, per se. When researchers treat tags as if they are ontological, or representative of a single culture's ontological conceptualization with only minimally recognizable variation, they mistake the collective for the cultural, the latter being where semantics emerge. The assumption is that the conceptualizations brought forth in creating the tag are the same (or only minimally different) for all users who create them. It is an ecological inference fallacy.

It is easy to make such an assumption when looking at folksonomies, because they adhere so closely to power law distributions and seem to be remarkably stable. In social bookmarking sites, as entities and phenomena receive more tags, the set of tags as well as the frequency of each tag's use within that set, represents the combined description of that entity by many users (Cattuto, Baldassarri, Servedio, & Loreto, 2007; Golder & Huberman, 2005). Rather than foster chaotic patterns, the aggregated tags give rise to stable patterns in which the proportions of each tag are nearly fixed. In studying this phenomenon, Golder & Huberman (2005) found that after the first 100 or so bookmarks, each tag's frequency is in nearly fixed proportion to the total frequency of all tags used. They speculate that this stabilization might occur because of imitation and shared knowledge (i.e., a cultural process).

Cultural understanding is expressed through language, and a shared vocabulary is one means by which members of a culture share their understanding of an entity or phenomenon. The shared vocabulary is negotiated over time and evokes shared cultural schemas within an individual’s cognition. A shared vocabulary has meaning to the cultural group because the semantics emerge through the evocation of the ontological (i.e., schemas) via the ontic (i.e., tags). The stabilization of tag patterns over time is analogous to the stabilization of cognitive schemas as cultural schemas.

The collective tags of a folksonomy will certainly reflect the dominant cultural schemas of a broad population, but the assumption that collective tags represent a shared conceptualization, interferes with discerning minority cultures, whose schemas may overlap with but are not necessarily entirely consistent with those of the dominant cultural group. In the absence of perspective and cultural identity information about users, folksonomies can be considered as reflections of cultural schemas only for dominant cultural groups and only in the broadest possible sense of “cultural group.”

Tagging entities is fundamentally about making sense of that entity. Our experience with those entities allows us to create meaningful conceptual associations for them. When dealing with the semantic dimensions of tags, issues of polysemy and synonymy reveal themselves (Golder & Huberman, 2005). How does one disambiguate among polysemous or synonymous tags? One solution for disambiguating tags is to add a specification to OWL (Web Ontology Language) such that "`<tag> owl: DifferentFrom <tag>`", where the tag is the same lexical unit (e.g., apple) but has different meaning (e.g., fruit vs. computer company) (Mazzocchi, 2005). A complementary suggestion includes the use of “`owl: SameAs`” to merge tags with the same meaning (e.g., *semweb* and *semantic web*). This approach, such as it is, looks promising, but it doesn’t easily account for the evolution of the collective lexicon. Also, it would put a burden upon the tagger to specify the “`owl: Relationship`” in a tagging system or it would shift the burden to the ontology revision process, which has its own set of associated problems.

Tags are created at basic, superordinate, and subordinate levels and are related to an individual's interactions with them (Tanaka & Taylor, 1991). There is systematic variation across individuals in what constitutes a basic level, and expertise plays a role in defining the specificity of the level an individual treats as basic:

> The underlying factor behind this variation may be that basic levels vary in specificity to the degree that such specificity makes a difference in the lives of the individual.... Like variations in expertise, variations in other social or cultural categories likely yield variations in basic levels. (Golder & Huberman, 2005)

Tags do need to include the perspective of the tagger in order for semantics to emerge, but recreating the category problem and making it more complex by specifying `DifferentFrom` and `SameAs` relationships only addresses the ontic side of the equation. In order to address the ontological, our understanding of the user as part of the semiotic relationship must not neglect his cultural perspectives and identities when trying to discern the semantics of particular tag sets. We must consider meaning-making, which is a cultural activity, as a multifaceted process, where semantics emerge through a process of interaction, construction and communication (Staab, et al., 2002). Interaction involves tasks and activities that generate the need for new meanings based on our being-in-the-world. Construction involves the imposition of “new categories” that are not so-called natural categories in the Aristotelian sense but rather, categories that are based on features that guide retrieval. Communication is negotiated through an alignment of “external tokens” (ontic tags) associated with categories (ontological conceptualizations). There are no “pregiven conventions” or constraints to the communication of categories. “Communication is crucial, because it is the motor for testing the concepts' adequacy and for pushing the development of new concepts when there are misunderstandings of task failures” (Staab, et al., 2002). In other words, solicitude in the form of discourse is important in shaping interpretation and generating understanding individually and culturally.

Interpretation results from the mutual adjustment of the explicit and implicit content of an utterance. An exhaustive, one-to-one mapping between concepts and words is quite implausible. An interpretation that does not match exactly the intent is not a failure of communication, rather "an illusion of the code theory that communication aims at the duplication of meanings" (Sperber & Wilson, 1998). Communication succeeds despite semantic discrepancies because the words used in a given situation points the hearer in the direction intended by the speaker. It does not matter whether a word linguistically encodes a full-fledged concept, and, if so, whether it encodes the same concept for both speaker and hearer. Words are used as pointers to contextually intended senses; utterances are merely pieces of evidence of the speaker's intention. We need to know who the speaker is, their identity, to interpret the perspective from which the tag originates. The fact that the interpretation of tags is not exact reflects the real-world experience of communication and knowledge sharing and the need for an interactive, hermeneutic discourse to achieve understanding.

Meaning making is a hermeneutic process. If research on the emergent semantics of folksonomies is to be successful, it must incorporate the hermeneutic process of meaning making as part of the semiotic relationship. The hermeneutic process with respect to the creation and analysis of tags is a process of understanding whereby tags are generated as ontic signs that point to ontological conceptualizations. This ontic-ontological distinction offered here derives from Heidegger (1927). For Heidegger, meaning cannot be uncovered in the structure of a thing, however complex. The semantic content does not exist in the thing. Meaning-structure is, rather, latent in experience. In other words, meaning emerges from one's interaction with it, emerges alongside our experiences with it: "…meaningful objects…among which we live are not a model of the world stored in our mind or brain; they are the world itself" (Dreyfus, 2007). For Heidegger (1977), language was a primal dimension of his ontological pursuit of Being, for words as translucent bearers of meaning point to something beyond themselves. Tags, being ontic entities, can only serve as entry points into the complex networks of conceptual associations within our cognition, that is, our ontologies. Tags, when represented in a folksonomy, become semantic networks (of lexical units) that evoke parts of our culturally schematic conceptual ontologies, i.e., our cultural landscapes. Before discussing semantic networks and cultural landscapes in more detail, it would be beneficial to elaborate on the semiotic model adopted by folksonomy researchers and how the approach advocated in this dissertation requires its modification.

2.3 Implications for the Semiotics of Tags

Tagging is a simple concept and a simple process: allow users to categorize entities using words that reflect the conceptual connections they make to the entity, and by doing so create a set of keywords that facilitates recall. Allowing users to create tags that are meaningful to them avoids the need for users to learn complex taxonomies created by experts, assuming experts could categorize the increasing amount of information being made available online.

The tagging concept is based primarily on semiotic theory. Creating tags is essentially the creation of signs. Signs, as discussed above, are a special type of equipment that serve as indicators of other things. The semiotic analysis in which researchers engage to determine the semantics of tag sets is based on an analytic model that has been around for at least a century. Ogden (Ogden & Richards, 1923) codified the Saussurian model (see Figure 1–8), but there is a slight difference between it and the original model described by Peirce (Peirce, 1868). Both include a referent/resource as the extrapersonal structure to which a symbol/tag refers. However, the Saussurian model places “thought or reference” at the third point of the semiotic triangle, where Peirce’s original model places an “interpretant” to complete the triadic relationship. In folksonomy research, (Buffa & Gandon, 2006; Cattuto, Loreto, & Pietronero, 2006; Cattuto, Loreto, et al., 2007; Staab, et al., 2002) tags are associated with users who create them and resources to which they refer, which more closely aligns with Peirce’s original construction.

A folksonomy is the entirety of a semiotic tag set—all the tags created by all the users for all resources. However, applying the semiotic model to a folksonomy mistakes the ontic for the ontological by assuming the collective is collaborative. Users associate signs (signifiers) with things signified (see Figure 2–4).

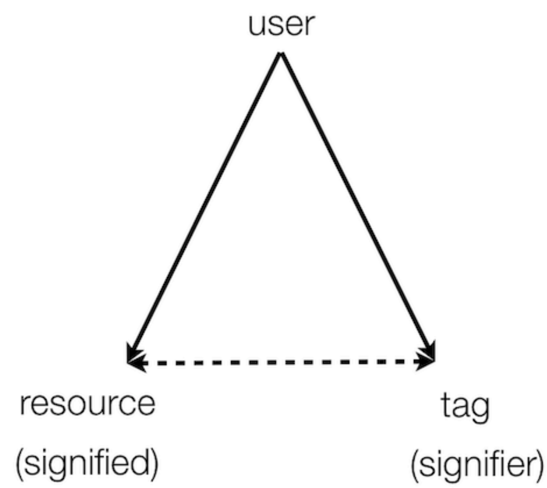

Figure 2–4. Simplified Semiotic Diagram

Semiotic approaches assume a direct connection between the sign and that which is signified—in our case the tag and the entity. Their focus is on the extrapersonal structures, and they tend to blackbox the intrapersonal schemas. However, as pointed out above, this assumption fundamentally confuses the social and cultural dimensions of tags (Saab, 2010). The ECM conceptualizes the semiotic relationships differently. There is no direct or assumed connection between the tag and the entity. Rather, the interaction between the user and the entity is the emergent space in where semantics are created. When a user interacts with his own tag as a consumer, the interaction between the user and the lexical unit generates a memory of the emergent experience with the entity. We can't say the same is true when a user interacts with a tag created by someone else. The chances that a similar semantic experience will occur is greater if the users share a cultural identity, but not if they don't. Assuming a relationship between the signifier and signified across users is tenuous and is avoided in the ECM. The semiotic relationship in the ECM can be illustrated as follows:

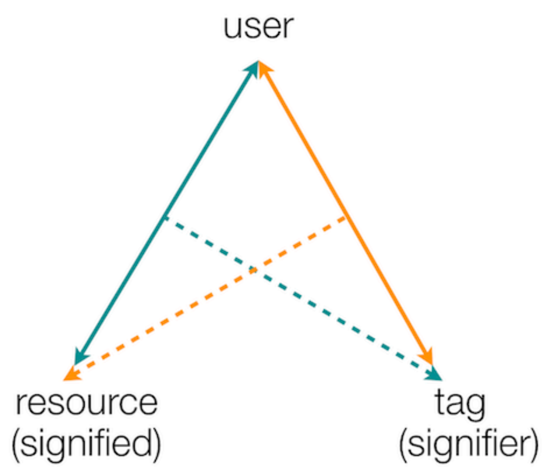

Figure 2–5. ECM Approach to Semiotic Relationships

Figure 2–5 depicts the interactions of the user as solid lines between the user and resource and the user and tag. In the user-resource interaction, a tag is generated through the experience, illustrated as a dashed line. The tag doesn't directly interact with the resource and isn't necessarily a direct referent for the resource, but rather links to a salient entry point of the schematic associations that emerge as part of the cultural interaction between user and resource. In the user-tag interaction, the memory of the experience with the resource is generated (again, indicated with a dashed line). The interactions with extrapersonal structures are depicted as solid lines, while the activation of intrapersonal schemas are depicted with dashed lines. The semantics of the experience cannot be separated from the user and the cultural schemas that he uses during his interaction, as they would be in Figure 2–4 where the dashed line is indicated. The assumed relationship between tag and resource, as depicted in Figure 2–4, mistakes the automatic processing nature of schemas for a direct relationship. Modeling the semiotic relationships with the ECM approach maintains the basic understanding of semantics as emerging through the interplay of extrapersonal structures (entities, tags) and intrapersonal schemas (user).

This variation on the semiotic model requires us to consider the cultural dimensions of tags, not just the social ones. In order to be used effectively to discern the semantics of tag sets, it requires us to identify intrapersonal schemas and focus on the interactive qualities of the tagging process. The biggest challenge in using this model to structuring folksonomies, in assessing their emergent semantics, is: how do we gather social metadata tags that reflect the various cultural schemas and identities of the users that the model suggests are required to properly discern the emergent semantics of folksonomies? How can we know what cultural identity a person is using at the particular time he is creating a tag? There is no simple answer to these questions, and the ECM does not specify a means by which to gather such information. It may be possible to have users create tags for their own cultural identities (e.g., male, student, New Englander, photographer, technologist, socialist, gay, atheist). But this, in some ways, reproduces the category problem discussed above (i.e., `DifferentFrom` and `SameAs`). It may be possible to mine the data from existing sources and create the cultural identity tags based on a variety of demographic information, as was done with the IST graduate students above. Such information must be created, collected, and utilized if we are to properly disambiguate folksonomies to discern their emergent semantics.

The relative simplicity of the tagging concept is transformed into a problem of greater complexity when we begin aggregating tags into tagclouds and broad folksonomies associated with particular perspectives—cultural identities and schemas. Compounding this complexity is the fact that many perspectives exist as part of an individual's cognition, and that the same perspective can be used as an identity for many individuals. To illustrate this complexity, I have extended the graph model for an e-commerce recommender system (Huang, Chung, & Chen, 2004) from a 2-layer to a 4-layer graph. The detailed graph in Figure 2–6(a) depicts a relationship between a phenomenon (or entity), the tags created for it by an individual, and the individual's cultural identities. The graph in Figure 2–6(b) illustrates a small increase in this complexity by incorporating three individuals tagging one phenomenon. Once the cultural identities have been derived, "activating" one reveals the tags associated with that identity in relation to a phenomenon.

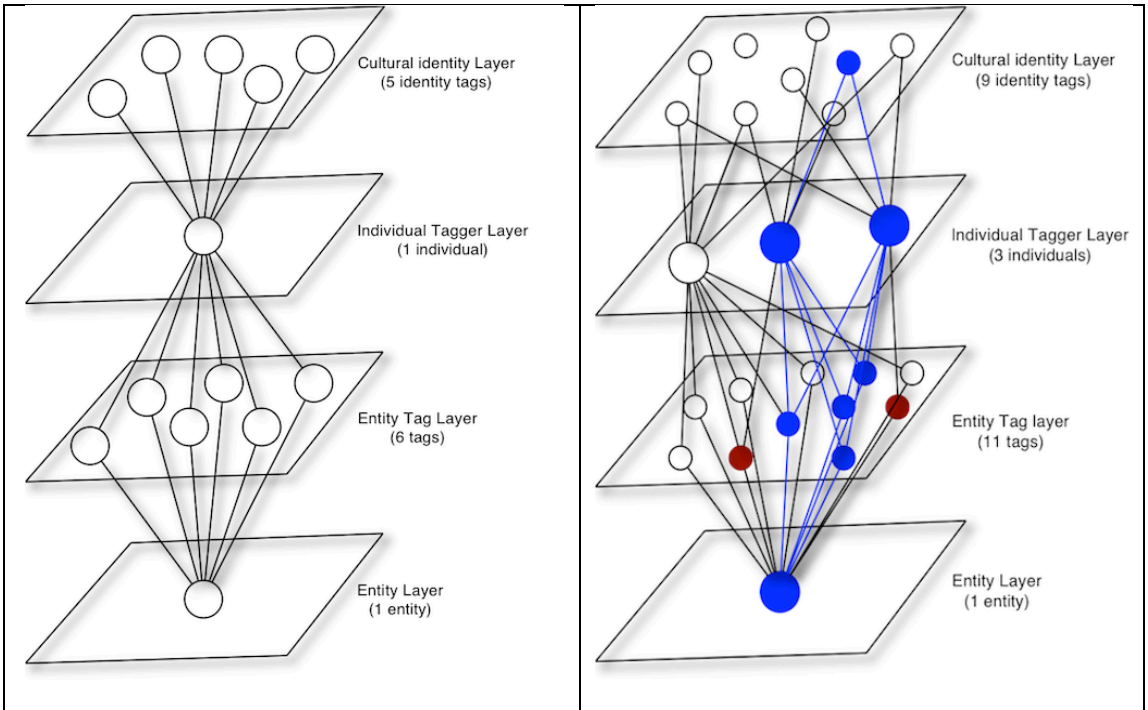

Figure 2–6 (a) Four-layer graph model linking cultural identity of a single individual with a single phenomenon; (b) Activating a cultural identity shared by two individuals reveals the overlap of four of six tags created for the phenomenon

These figures illustrate the complexity of our task of associating semantic tags with phenomena and entities, generated by individuals using a variety of cultural identities with which can then be used to appropriately interpret the semantic tags. In essence the triadic relationships of the semiotic model of folksonomies has been transformed into a quadratic relationship model that accounts for cultural identity perspectives that allow for semantic interpretation of tags. How the 4-layer graph and the ECM line up is illustrated in Figure 2–7:

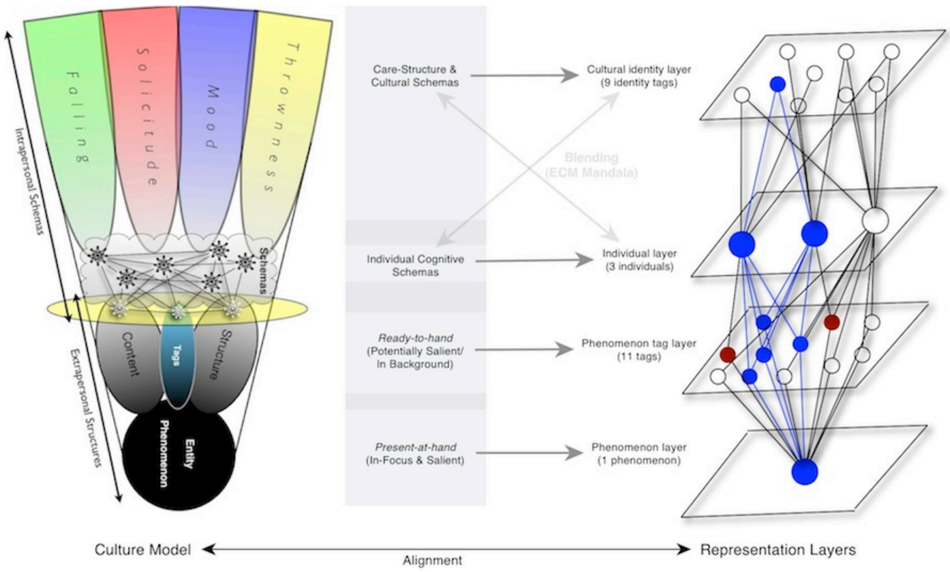

Figure 2–7. Emergent Culture Model Alignment with Layered Representation of Phenomenon, Tags, and Individuals

2.4 Semantic Networks

Semantic network representations have been described in a variety of ways: as a method of encoding a hierarchy of knowledge (Collins & Quillian, 1969), as a directed graph structure of nodes and edges (Konstable, 2007), as representations of concept and concept relationships (Collins & Loftus, 1975), as visual representations of properties, attributes and predicates, etc. Sowa (1992) identifies six types of semantic networks based on their intended purpose: definitional, assertional, implicational, executable, learning, and hybrid. He claims "what is common to all semantic networks is a declarative graphic representation that can be used either to represent knowledge or to support automated systems for reasoning about knowledge."

Concept maps are examples of semantic network graphs. There are lexical units (words) that form the nodes of the graph, and there are edges that (sometimes) have labels describing the mereological relationships between the lexical nodes. They are similar in construct to formal ontologies, albeit more simplified. Novak developed the idea of concept mapping in the 1960's as a way of representing the structure of information (Novak, 1991). “Concept maps are two-dimensional representations of cognitive structures showing the hierarchies and the interconnections of concepts involved in a discipline or a subdiscipline” (Martin, 1994, p. 11). Concept maps typically consist of networks of nodes and links, where each node represents a concept, while each link represents a relationship between concepts (Lanzing, 1997), but concept maps take on many forms to elicit representations of knowledge as functions, concepts and sketches (McNeese & Ayoub, 2011). These links could be one-way, two-way or non-directional; and in this case there were instances where there were no links at all, only clusters of nodes. Concept maps are related to but distinct from idea maps, mind maps, causal mapping or cognitive mapping, where the latter are focused on the ideas or concepts of an individual, but concept maps are specifically designed to elicit a structured conceptualization of a group (Trochim & Kane, 2005). Concept maps also differ slightly from fuzzy cognitive maps in that they are not focused on creating a structured representation of a complex decision-making process for purposeful action (Perusich & McNeese, 1997; Perusich & McNeese, 2005), meaning that the node relationships are not always clearly defined, delineated or weighted in a concept map like they are with fuzzy cognitive maps.

Semantic network graphs might be described as naïve or folk ontologies. Both semantic network graphs and formal ontologies attempt to impose a structure or structural relationships upon a lexicon, usually for a particular domain. The lexical elements of a semantic network refer to entities or phenomena in the world in a semiotic type of relationship—there is an entity in the world that has an associated referent that derives from and is a lexical expression of our conceptualization of that entity or phenomenon. A representational entity such as a semantic network graph focuses our cognition upon a particular facet or element of the entity or phenomenon in the world. However, “there are also many aspects of semantic structure not captured in our simplified semantic network models: the context sensitivity of meanings, the existence of different kinds of semantic relations, or the precise nature of the relations between word meanings and concepts" (Steyvers & Tenenbaum, 2005).

It is important to recognize that semantic network graphs exclude some of the conceptual connections that may exist as part of our complex conceptualizations of the entity. We may see this as obvious, as all models exclude something whether by convenience or design, but when we model semantic networks, do we make a fundamental mistake of excluding what makes the lexical and syntactic representations actually semantic? I want to focus of the issue of exclusion with respect to semantic networks.

When we impose a structure upon our lexicon to create a semantic network graph, we are also excluding many of the other conceptual connections that may exist as part of our contextualized, experiential conceptualizations of the entity or phenomenon—we focus on one semiotic relationship and exclude others. We select particular elements for representation, and through doing so crystallize a segment of our semantic landscape as a semantic network. While our representations of semantic networks are limited and bounded, our semantic landscape is vast and continually changing and adapting as part of our lived experience. If the purpose of identifying a semantic network is to achieve semantic interoperability for our information systems, as claimed by Sowa and implied by Uschold, issues of inclusion and exclusion with respect to the semantic landscapes becomes important as part of the hermeneutic process of meaning-making and understanding.

If we examine our interpersonal discourse, we realize that conveying meaning doesn't require our discursive lexicon to be overly structured. Moreover, the more experiences we share, the less necessary it is to be extraordinarily detailed in our communications in order for us to understand one another. In our close personal relationships, for example, we easily make meaning of another's body language and voice tone—no syntax or lexicon necessary. Syntax is no doubt helpful to meaning-making, as in English when we transpose the verb and object to signify a question: “Is this ball blue?” But syntax and lexicon are insufficient in the creation of meaning. Context and situational awareness are necessary to appropriate semantic interpretation and understanding.

However, we tend to reify the network graph as representative of things in the world. This satisfies our realist tendencies and assumptions, and our scientific epistemologies, which are reinforced by intersubjective agreement.[18] This intersubjective agreement, however, is a hermeneutic cultural phenomenon. It is based on our shared cultural schemas and assumptions about the world in which we are immersed. Ironically, we recognize that our understanding, our sense making of entities and phenomena in the world, adapts and changes throughout our lives and throughout history. Semantic technologists came to realize that sense-making was a more complex hermeneutic phenomenon than they originally thought:

> “...we found that we as representatives for different semantic technologies were talking different languages. We were explaining our technologies with different terms to mean the same thing and the same term to mean different things, and our models for addressing the issue of semantic interoperability were so different it was hard to get our message across to people who already identified deeply with their own way of thinking. We were supposed to be experts on semantic technologies, but we experienced a complete breakdown of semantic interoperability among ourselves.” (Aassve, et al., 2007)

Is the solution, as they believe, more structure, more standardization, more explicit rules, more syntactic structure? By imposing more structure and adding greater degrees of specificity, are we heading directly into another type of Zeno’s paradox by adding finer and finer gradations and distinctions to bridge the distance to our semantic goal? Are we confusing syntax for semantics, structure for meaning, language for thought, lexical for ontological?

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[18] Here, “intersubjective agreement” signifies not only the social agreement as to what we become committed to ontologically but also the epistemological means by which we achieve it, i.e., the “valid” ways of measuring and assessing the entities and phenomena we experience.

We recognize that semantic networks are typically domain-specific, or even sub-domain-specific. We assume that there is at least general agreement within a domain with respect to their semantic networks. If we were to portray a semantic network graph to persons from a particular domain, we expect that they would be able to readily match the representation to their shared conceptualization. Persons from other domains likely wouldn't produce the same semantic network graph.

Persons from different cultures, with different languages and experiences of their environment, will almost certainly have different conceptualizations of the same entities or phenomena in a particular environment. For example, let's suppose there is a crisis in the ancestral lands of the aboriginal Krantji clan in Australia that requires a GeoCollaborative response. What meaning does an academically trained GIS practitioner and an aboriginal Australian of the Krantji clan make of the geographic entity known as Krantjirinja? The geographer sees a rock formation composed of slate, which can be mapped to a Cartesian grid, located atop a natural spring that serves as the source of the area's hydrological cycles. The member of the Krantji clan sees a sacred space in which Krantjirinja, his Kangaroo Ancestor who has existed since the Dreamtime and continues to exist and exert his influence today as part of *tjukurppa*, dwells (Cane, 2002; Kane, 1998; Saab, 2003, 2009; Stanner, 1987). Krantjirinja must be given deference as a revered ancestor, for his power protects the red kangaroos that graze in the surrounding landscape. How might the semantic network graphs drawn by the geographer and the Krantji clan member differ? In fact, there may be no overlap at all in terms of the lexical units and relationships between these two graphs of the exact same geographic entity they "see." How might these graphs influence their strategy for the management of crisis relief? What outcomes might we expect as part of an automated reasoning support technology given these different graphs? How would a machine know which one to employ as part of its reasoning process at any given time or in any given context?

Meaning requires a contextualized perspective. We need to understand both the context and what elements of it our discourse partner finds salient. We need a shared understanding of the context and its salient elements in order to communicate meaningfully. The semantic technologists quoted above discovered that while they had similar vocabularies, the salient contextual elements related to their lexicon were imprecisely aligned. Each was using a slightly different ontology related to their lexical expressions. They assumed that since they were all semantic technologists that they shared a common understanding of the salient elements, entities and phenomena related to semantic technologies. However, through their extended discourse, they discovered that they derived different meaning from the same lexical units and that their different ontological conceptualizations made progress towards their collective goal slower than originally expected.

We recognize that different domains (i.e., different cultures) can have different perspectives about a particular extrapersonal structure, and we are willing to accommodate such diversity generally. We simply prefer to think of our own cultural schemas that relate to it as realist, privileged above others because of the assumed superiority of our epistemological methods. Whatever justification we use for establishing that privilege does not negate the fact that we are one culture among many, nor that each culture has its own ways of legitimizing meaning and handling the semantics of their discourse. Recognizing that there exist different ontologies and different epistemologies among different cultures is not an anti-realist position; rather it is a transcendence of the realist/anti-realist dichotomy. It is relativist to the extent that legitimizes the existence of diverse cultural perspectives but it is not a chaotic relativism. The cultural schemas we develop and employ have a stabilizing influence upon members of a culture and enable them to co-create shared understanding of the world.

2.5 Cultural Landscapes

Can semantic network graphs facilitate semantic interoperability among our machine information systems? My analysis suggests that they can't, at least as currently contrived, because semantic network graphs are not semantic, per se, but rather extrapersonal structures of lexical units syntactically (and/or spatially) arranged. While providing some structural constraints that facilitate the sharing of meaning we engage in as *Dasein*, such graphs are insufficient because they exclude too much of the vast cultural landscapes of our experience. More specifically, they exclude cultural schemas that are essential for meaning making and that would provide the connections to the larger conceptual landscapes.

I have argued that we must embed within our machines the ability to negotiate meaning through hermeneutic discourse based on the creation and incorporation of cultural schemas—to adapt their "intrapersonal" schemas to those of others, both human and machine. Our machines' semantic networks and cultural landscapes would not need to be perfectly aligned, as they need now be with respect to formal ontologies, but having "intrapersonal" schemas that are flexible and adaptable would facilitate the formation of shared cultural schemas and conceptualizations through hermeneutic discourse. Embedding this capability within our machines become more critical as the diversity of devices, forms of information, and cross-national and intercultural communications increase. We have an increasing number of cultural landscapes that are becoming part of the global discourse through blogs, tagging, social networks, wiki spaces, mashups and more. We must look to handling their emergence through a hermeneutic process rather than try to impose a privileged and particular set of cultural schemas or expert categories that just happen to align with our own.

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Appendix E: GCCM Concept Maps Integrated illustrates a color-coded semantic network graph of the combined concept maps from the GCCM mini-workshop. We might consider it to be the beginning outlines of a much larger cultural landscape but, again, we should not mistake the ontic for the ontological, the signifier for the signified. Semantic networks are not the representations found on a directed graph. Nor are they syntactic patterns of lexical elements. Semantic networks are partial representations of our conceptual networks that comprise larger cultural landscapes, i.e., our ontologies—our understanding of what exists and what is real. Semantic networks form the bridges, not simply between our lexicon and what we recognize as existing outside of our body-mind, but more importantly between our complex network of ontological conceptualizations and our culturally-shared contextualized experiences of the world and the structures that we recognize as embedded in it. Semantic networks allow us entry into a more vast cultural landscape that is continually explored as part of *Dasein's care-structure*.

Why reconceptualize semantic networks as entry points to cultural landscapes? The simple answer is that by trying to formalize meaning through the computation of lexical units and how they are structured in relation to one another, we exclude the essential element of a contextualized perspective—the very thing that allows us to create meaning of our experience in the world. Woven together, our semantic networks comprise larger semantic landscapes, and because they require a contextualized perspective to be understood by the agents involved in the discourse, they can also be described as cultural landscapes.

What is meaningful is culturally based. People from different cultures can look at the same extrapersonal structure and derive completely different meanings from it. The high-contrast example above concerning Krantjirinja illustrates this point simply and effectively. In this sense, semantic networks also reflect the veracity of my characterization of semantic landscapes as cultural landscapes. Being cultural, they must therefore include both the intrapersonal schemas as well as the extrapersonal structures of the world. It is the interplay of the intrapersonal and extrapersonal that provides the contextual frame for proper interpretation of semantics. We engage in such interplay effortlessly in human-to-human interactions, as all experience is culturally contextualized—we are always situated within a context, and our cultural schemas shape our understanding of it. When we decontextualize the semantic network by representing it as lexical units and mereological relationships within a directed graph, we transform the intrapersonal schema into an extrapersonal structure. Our representations metaphorically crystallize it, making it rigid and inflexible. Representation externalizes the schema and thereby eliminates its dynamic and emergent nature. Extracting a small part of the larger cultural landscape to represent as a network graph excludes the essential intrapersonal cultural elements that allow for the emergence of meaning. If we want to achieve semantic interoperability among our informational and computational systems, my analysis suggests that we can't exclude the cultural schemas that are essential to the emergence of meaning and provide for us the complex connections to what Heidegger refers to as the *ready-to-hand*.

2.6 Cultural mediation of what is *ready-to-hand*

Reconceptualizing semantic networks as representation segments of cultural landscapes is better explained using a Heideggerian ontological perspective rather than an Aristotelian one. For Heidegger, the basic state of *Dasein*—man's being—is understanding, making sense, making meaning of the world in which he is embedded. Immersion in the world is an inescapable fact of human existence. The world and the meaning we make of the world are inextricably linked through our experience within the world. Our experience of the world is also always cultural—what we recognize as salient is dependent upon the conceptual *fore-structures* (i.e., intrapersonal schemas) we employ in making sense of our contextualized experience (i.e., the extrapersonal structures we encounter).

Another inescapable fact of our existence is temporality. We are always *falling* into the next moment with an accompanying directionality of our conceptual *fore-structures*. In other words, we have expectations as we move temporally through the world. The expectations generated by our *fore-structures* have a duality about them. They are able to accommodate the holism of our experience to some degree by what Heidegger describes as *ready-to-hand*, as well as the more narrow focus of our attention and the entities and phenomena that become present-at-hand. Our *fore-structures* shape our falling such that the world we experience can be described as a cultural landscape. Our cultural landscapes have coherence because they have structure that derives from our cultural schemas, which encompass what is *ready-to-hand* and what is *present-at-hand*, as part of our concernful circumspection of *referential totalities*.

I have already described semantic networks as segments of larger semantic landscapes and argued that the latter are more appropriately considered cultural landscapes. From a Heideggerian perspective, we can also describe semantic networks as what becomes present-at-hand within the wider landscape of the *ready-to-hand*. What is *present-at-hand* is the extrapersonal structure that is momentarily salient and becomes the focus of our attention. That momentary focus constrains our experience in terms of its directionality because we are attending to the salient elements of the entity or phenomenon we experience. It limits the possibilities of what is *ready-to-hand*. But we continue *falling*, and we attend to what is *ready-to-hand*, and transform those elements into salient focus, making them *present-to-hand*. In other words, each constraining focus opens up a limited set of possibilities, which in turn constrains then opens another set of possibilities in an unending process of emergent experience—a hermeneutic circle.

The relationship between wave and particle in quantum physics might provide us with some analogical insight. Let us think of our cultural landscape as a wave, as a phenomenon that can only be grasped as temporal and in continual flux. When we try to focus upon the wave, it collapses into a particle. The quanta exhibit the qualities of both waves and particles. Our cultural landscapes are similar. They exist within a continually emerging experience, as if they were a pattern of waves. The segmentation of a cultural landscape into a semantic network graph is similar to a series of particles that results from the focus of our attention and the limited possibilities of what is *ready-to-hand*. Every interaction we have with the wave alters it, just like every contextualized experience we have alters our intrapersonal schemas. The difficulty we have is that our semantic network graphs are lexically expressed—a syntactically sequenced series of particles. If we want to achieve semantic interoperability among our computational and informational systems, we must devise ways of including an understanding of the waves of the cultural landscape—what is *ready-to-hand*.

In this chapter I have offered an Emergent Culture Model that more appropriately structures the relationships between intrapersonal schemas and extrapersonal structures. The mediating role of schemas reveals the importance of cultural identity to discerning tag semantics. I was also able to illustrate the scalability of the ECM and its ability to accommodate multiple cultural identities. The use of the ECM prompts a modification of the traditional semiotic model favored by folksonomy researchers to reflect the phenomenological relationships between users, tags and resources. I offered an analysis of tags and tagging that argued for a reconceptualization of tag sets as semantic networks that serve as entry points into cultural landscapes. The analysis addresses the issues of lexicon, syntax and semantics; the social and cultural dimensions of tags; and, emergence and reification. In the next chapter I will put forth a phenomenological framework of ontologization that has significant implications for the understanding of information as it relates to tags and upon which semantic interoperability seemingly rests.

Chapter 3

The Ontologization of Tags

Although a phenomenological approach is by definition anti-reductionist, preferring instead to examine the holism of subjective experience, it does not mean that we cannot identify important and salient elements, categories or themes as part of our examination of the phenomena. In a Heideggerian phenomenological frame, there are at least three basic elements to consider: the equipment, *Dasein's care-structure*, and the practices involving both. These are reflected in the ECM with tags-as-equipment comprising part of the extrapersonal structures of the world, with the *care-structure* evoked and patterned as part of the intrapersonal schemas we hold as individuals, and practice emerging from the interactive space where the intrapersonal and extrapersonal elements are structured and regulated schematically. This chapter will describe tags in terms of each of these—tags-as-equipment, tags-as-patterns, and tagging-as-practice, respectively. Having delineated tags in this way, I can then tackles ontologization—essentially a phenomenological characterization of the informational qualities of tags, where the entwined processes of sense- and meaning-making connect the patterns of the semantic networks and the cultural landscapes, in terms of data and knowledge respectively—which is essential to understanding the possibilities of semantic interoperability among our sociotechnical systems using tags, tag sets and folksonomies.

3.1 Tags-as-equipment

Information is not new; we have always used information in the form of language, but we rarely think of it as "equipment," per se. When we think of equipment, we typically think of types of tools or gear that enables us to accomplish certain goals. They are useful things. A carpenter's equipment—hammers, saws, rulers, squares, etc.—help him to build things from wood. A machinist's equipment—drills, grinders, vises, etc.—enable him to build things from metals. A mountain climber's equipment—ropes, carabiners, harnesses, axes, etc.—enable him to climb mountains. A firefighter's equipment—hoses, trucks, oxygen tanks, axes, etc.—enable them to save lives and minimize damage to property. Of course, those of us who are not carpenters, machinists, mountain climbers or firefighters can also encounter and recognize the same equipment, but we will likely see their usefulness, and hence what they signify or indicate or provide clues for, differently:

> If we consider again even our sketch of how the workshop is manifest, were not the variations in the way it was manifest keyed to the individuals who encountered it? The workshop shows up as an array of tools ready for use to the carpenter whose shop it is, whereas it shows up differently to the termite inspector, and differently again to someone wholly devoid of the skills had by the carpenter. While this kind of variety or relativity must be acknowledged, nonetheless we should not take it as indicative of the subjective character of manifestation. A number of considerations tell against taking this relativity as point in this direction. To begin with, the ways in which the workshop is manifest to our various individuals are not entirely disparate or unrelated. There is instead considerable overlap among them, and so the differences are more one of emphasis. The carpenter's readiness is geared to the tools, whereas the termite inspector is geared to the beams and boards making up the structure of the workshop, but this does not mean that each readiness thoroughly effaces what is manifest from the perspective of the other. Indeed, if we consider again our remarks on the accessibility of one world from another, here is a pretty easy case of it: the carpenter, the termite inspector, and the carpentry novice can all coordinate and convey their respective understandings. More importantly, that coordination and conveyance will be facilitated by the workshop itself. When the carpenter tells the inspector that he will move his workbench away from the wall, the workbench and its contents will be equally manifest to both of them; similarly, the inspector can call the carpenter's attention to a particular post or beam, indicating to him some worrisome patterns of wear in the wood. Finally, the carpenter can instruct the novice, showing him which tools are which, what they are for and how they are used, thereby enriching the novice's apprehension of the workshop by equipping him with a readiness to engage skillfully with it. In considering the interactions among these three individuals, we do not find ourselves needing to multiply entities, as though the hammer as it shows itself to each of them were something different in each case, nor do we need to add 'appearances' to the workshop understood as a totality of interrelated equipment. (Cerbone, 2008, pp. 48-49)

Tags serve as a primary example of how information has taken on the characteristics of equipment in the form of data. From a Heideggerian perspective tags would be signs, which are a special kind of useful thing (i.e., equipment). “Being-a-sign-for can be formalized as a universal kind of relation, so that the sign-structure itself provides an ontological clue for ‘characterizing’ any entity whatsoever” (Heidegger, 1927, pp. 107-108, H. 177). Tags, as signs, are items of equipment whose specific character consists in showing or indicating. Indicating is a referring, but not all referring is indicating. Tags are not references, per se, but rather indicators for the cognitive schemas that are activated upon encountering the tag. Tags, as extrapersonal structures within the ECM, are indicators to the particular entity or phenomenon for which it was created.

Tags are lexical units that enable users to categorize and classify other entities and phenomena for later retrieval. Tags, in the sense described here, are ontic. The lexical quality of a tag makes it available as equipment, as an object from which we glean referential totalities. The lexicality of the tag makes it present-at-hand, that which is the focus of our attention—what we are thinking about without all of the background also coming into focus. Tags, as signs, are indicators of what Heidegger calls *ready-to-hand*, that which is ready to be used without theorizing about it—the emergent evocation of our ontological conceptualizations and commitments. When we encounter a tag, as when we encounter a sign, our activated schemas make salient parts of the environment in which it is embedded, and the encounter orients us in a particular way, making us ready to engage ‘what is coming.’ It is the *readiness-to-hand* quality of tags that evoke the cognitive and cultural schemas that connect us with the tag and to that which it indicates and provides the space where the semantics of a set of tags can be discerned.

3.2 Tags-as-patterns

A single tag is a sign, an indicator in the Heideggerian sense. But tags are rarely considered in isolation; they are almost always patterned into tag sets and folksonomies. It is these patterns which concern us and which become meaningful to us because we are sensitized to certain patterns through our experience of being-in-the-world and develop schemas to accommodate them. This ability for pattern recognition stems from the *care-structure* described by Heidegger. The *care-structure* provides "a kind of structural unity for all these aspect of *Dasein's* existence" (Cerbone, 2008); they provide an ontological wholeness to the being of Dasein. The *care-structure* that allows us to recognize the patterns consisting of the equipment we encounter—tag sets in folksonomies—is what we as beings-in-the-world bring to the experiential encounter.

Although the care-structure provides wholeness, there are several facets to it that are difficult to describe in linear temporal terms. Heidegger tries to describe it thus:

> The formally existential totality of Dasein's ontological structural whole must therefore be grasped in the following structure: the Being of Dasein means ahead-of-itself-Being-already-in-(the-world) as Being-alongside (entities encountered within-the-world)…Because Being-in-the-world is essentially care, Being-alongside the ready-to-hand could be taken in our previous analyses as concern, and Being with the Dasein-with of Others as we encounter it within-the-world could be taken as solicitude. (Heidegger, 1927, p. 237, H. 192-193)

Our *being-in-the-world* is thrust upon us inasmuch as we are thrown into the world, always finding ourselves already there. Moreover, even as we encounter our own thrownness, we are projecting our understanding of our circumstances "ahead of ourselves." Our projection of understanding is colored by our moods, which has an effect on how things show up to us. The care and concern of the *care-structure* is attenuated by *thrownness* and *mood*. These also affect our solicitude, in which our *being-in-the-world-with-others* requires discourse and interpretation. The *care-structure* allows us to become absorbed in our activities and tasks as we create and refine the *referential totalities*—the *ready-to-handedness*—of the things we encounter. Heidegger refers to this absorption as *falling*, as a sort of horizonal stumbling into the next temporal moment, but which moment is "informed and sustained by its relations to my past and future" (Cerbone, 2008, p. 65).

3.3 Tagging-as-practice

The *care-structure* is manifest in terms of cultural identity and the implications that has for tagging as practice. Tagging as practice refers to the creation of tags. Rarely, however, do tags present themselves as singular; they are almost always parts of tag sets called folksonomies. Creating tags is essentially the creation of signs. Signs, as we discussed above, are a special type of equipment that serve as indicators of other things. What are these other things? In this case, they are the conceptual networks (i.e., cultural landscapes), which emerge through the experiential *care-structure*. When we engage in tag creation, we are engaged in the practice of building conceptual networks. In other words, we are creating ontic representations of the ontological experience.

The building of conceptual networks—tagging as practice—is not independent of tags as equipment or tags as patterns. Tagging as practice illustrates how tag sets, as useful equipment, withdraw from present-at-hand experience and fade into the background to become *ready-to-hand*. This withdrawal is part of our experience of *falling*, as we are absorbed into the processes of recall and interpretation of the referential totalities to which the tag set was originally created to indicate.

3.4 The Ontologization of Tags

From a Heideggerian perspective tags would be signs. What is the *being* of signs? "Being-a-sign-for can be formalized as a universal kind of relation, so that the sign-structure itself provides an ontological clue for 'characterizing' any entity whatsoever" (Heidegger, 1927, p. 107-108; H. 77). Tags, as signs, are items of equipment whose specific character consists in showing or indicating. Indicating is a referring, but not all referring is indicating. Tags are not references, per se, but rather indicators for the cognitive schemas that are activated upon encountering the tag. When we encounter a tag, as when we encounter a sign, our activated schemas make salient parts of the environment in which it is embedded, and the encounter orients us in a particular way, making us ready to engage 'what is coming.' Tags indicate where one's concern dwells, what sort of involvement one has with something. Tags form entry points into our complex of cognitive and cultural schemas that shape our ontological commitments to the world in which we are immersed.

In terms of creating tags, when we use them for personal recall, we are identifying the salient qualities and dimensions of our experience with the phenomenon or entity being tagged. From the ontological, we create the ontic sign—the tag. They are meaningful to us because they are created based on how we understand the phenomenon, which is in turn based on our personal historical context. Tags become an indicator of that salient experience. They allow us to reactivate our ontological understanding (i.e., activate our schemas) in later encounters with the tags that we create. This is reflected in the modified semiotic model in the previous chapter.

We are not only creators of tags, but also consumers of them. The lexical quality of a tag makes it *present-at-hand*, that which is the focus of our attention—what we are thinking about without all of the background also coming into focus. Tags are indicators of what Heidegger calls *ready-to-hand*, that which is ready to be used without theorizing about it—the ever-ready emergent evocation of our ontological conceptualizations and commitments. It is the *readiness-to-hand* quality of tags that evoke the cognitive and cultural schemas that connect us with the tag and to that which it indicates and provides the space where the semantics of a set of tags can be discerned.

If folksonomies are to serve as supplements or complements to formal ontologies, we must be able to disaggregate the sets of tags into cultural identity perspectives, each of which entails the ontological commitments of the culture. But in doing so, we must not mistake the ontic tag representation for the ontological cognitive conceptualization, the extrapersonal lexical structural unit for the intrapersonal schemas it may evoke. Eventually, we want to be able to utilize tag sets in information systems in order to facilitate intercultural understanding, so we must remain aware of the need for interaction, construction and communication mentioned earlier.

Tags, which ultimately are simply words, are “translucent bearers of meaning that point to something beyond themselves” (Heidegger, 1977). I have argued in the previous chapter that what they point to—or more precisely, form entry points into—are cultural landscapes. Tags taken in isolation may still be bearers of meaning, as they will evoke intrapersonal schemas. However, tags are rarely found in isolation. They are nearly always grouped into folksonomies. In groups tags form larger patterns of semantic networks, whether or not the relationships between the tags is explicitly specified. Recall the concept of clustering as it relates to both the cognitive elements of intrapersonal schemas and the experiential context comprised of extrapersonal structures. These clusters are patterns. I have also discussed how persons with different cultural backgrounds, schemas and care-structures, can perceive the same “objective” pattern (e.g., Krantjirinja; and as will be demonstrated in Chapter 4: the concept of *information*, the concept of *GCCM*, the set of seven key nodes of the concept mapping exercise) entirely differently—as different patterns with different meanings. This capacity of pattern recognition has significant implications for the possibilities of semantic interoperability among our sociotechnical systems. Before addressing these implications, however, I want to explore an essential part of semantic interoperability: meaning-making. How do we come to make sense of a pattern? How do we attribute meaning to it? How do we make the connections between our semantic networks and cultural landscapes? What is that process, if it is indeed a process, and how does it emerge? I will discuss the notions of tags and folksonomies, semantic emergence and cultural schemas in a broader context of data, information and knowledge—concepts important to Information Science—but draw parallels and include specific examples related to tags as appropriate.

The starting point for this analysis is the insight that information cannot be described as data that possess an objective meaning. Rather, information results from a primarily schematic interpretation of data, in which the subject makes sense of a given pattern by employing intrapersonal schemas. Which sense is made of such pattern depends on background knowledge (Searle, 1997), or as Dretske (1981) describes it: "the information one receives is a function of what one already knows," echoing the Heideggerian notion of *thrownness* and finding ourselves "already there." This means that the term data already presumes the informational character of the respective pattern. This informational character, which I call *sense*, describes the scope of possibilities—the particular set of *referential totalities*—afforded to the subject by the data. That data provides the clues for the subject's orientation (Stegmaier, 2008) that enable the subject to cope with the situation and identify action opportunities—it allows us to orient ourselves as we are falling. The character of these clues definitely depends on the person's individual capabilities. Information is closely related to identifiable action opportunities as derived from the sense-making process. Information, therefore, is a product of a subject's capability rather than an aggregation of data objects imbued with objective meaning.

In most cases sense-making is not a single interpretative process but a multifaceted one, in which data and information appear at different interpretational levels. For example, a letter provides a pattern that becomes data in the context of a word. The recognition of letters then allows for the identification of aggregations of letters, that is, words for which we give a sense that goes beyond that of individual letters. For example, a letter provides a pattern that becomes data in the context of a word while the word appears as a pattern that becomes data in the context of a folksonomy. Embedded in this idea we can see Heidegger's notions of *present-at-hand* and *ready-to-hand* as well as Polanyi's (1962) idea of *stratification*. Polanyi's view helps better articulate the mutual dependence of data and information. While the term data describes the physical manifestation of interpretable patterns (e.g., tags as equipment), information refers to the subjective process and the resulting clues (e.g., tags as patterns). The idea of data cannot be thought without the idea of information so that the concept of data already presumes its informational character.

This might seem curious since we sometimes call some patterns data, even if we are not able to make appropriate sense of them. For example, we refer to a hieroglyphic text as data even if we cannot read it. In such case, however, we assume that there has been at least one competent interpreter of this text, e.g., the author. An automatically produced random text can only count as data inasmuch as it consists of interpretable patterns. In such case it might happen that such a text consists of meaningful words but meaningless sentences for a reader so that the sense-making process and, therefore, the information remains rather limited.

On the other hand, the reference to data is the main differentiator between information and knowledge. The latter describes a persistent capability (Riss, 2005) as an internal point of reference while information is—at least partially—the transient result of a data based sense-making process based on an external point of reference. Here I prescind from the fact that knowledge might have a physical manifestation in the brain since this is not accessible to the subject in the way that data are accessible. One can clearly recognize the distinction of information and knowledge from our use of the two words. If I say that Alice possesses the information that *p*, it suggests that there is some data from which this information originates; if I say that Alice knows that *p*, this suggests that Alice might have learned this by herself. Knowledge does not primarily rely on (physical) data whereas information depends on it. In any case we realize that both information and knowledge are bound to persons.

The ability to employ knowledge relies on active cognitive patterns called schemas (D'Andrade, 1995). Schemas help to structure information in terms of (1) facilitating my knowledge capacities with respect to information as part of my individual experience and (2) enabling me to share information with others in ways that allow us to narrow the possible senses of data into a more specific and culturally shared meaning. To express the latter, I say that we are involved in meaning-making, where I distinguish subjective sense from intersubjective meaning (Vygotsky, 1986). If we develop different cultural schemas, our knowledge becomes structured differently and the sense-making and meaning-making in which we engage will yield different information and data. Since none of us are ever without our schemas, we are continually bringing our knowledge to bear on the patterns we encounter (i.e., engaging our *care-structure*), making sense and meaning of them such that they yield information and let us see the underlying patterns as data. The introduction of schemas into this discussion enables me to situate the concept of information within a phenomenological perspective as a way of better understanding the interpretive process related to it.

The relationship between data and information, typically understood discrete categories within a data-information-knowledge hierarchy (Rowley, 2007; Tuomi, 1999) must be revised in favor of a phenomenological perspective. In particular, I posit that a “process” of ontologization[19]

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[19] Ontologize and ontologization have been used in a variety of ways in different domains. Semantic technologists use it to refer to the aggregation or linking of lexical units to taxonomies and computational ontologies (Kozareva & Hovy, 2010; Pantel & Pennacchiotti, 2008; Pennacchiotti & Pantel, 2006). Social and cognitive psychologists use it to refer to categorical exclusions of others and the making of outgroups

accompanies information. The core of this ontologization process consists in a dual process of sense-making and meaning-making through which I am able to understand the underlying data as well as the resulting clues as part of information. All these aspects are merged into one *being* (i.e., information as an ontological whole), which is the basis for my use of the term *onto*logization.

In the next sections I will continue my examination of the process of sense-making in more detail and describe how I discern data from patterns by their informational nature. I continue with a detailed discussion of ontologization that reveals information's process character before proceeding to an examination of schemas and the meaning-making process that allows us to discern knowledge, which is also informational in nature. Then I reflect on how our orientation (i.e., our *care-structure*) helps to bias our ontologization of data-information-knowledge and to shape the stratification of information inherent to our communication of data-information.

3.4.1 From Data to Information

In the following I will explain why I think that we can only understand data in relation to a process of sense-making. To this end I start with the concept of pattern, by which I mean any recognizable and physically manifest structure. This can be a reoccurring event, a thing or any

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(Roncarati, et al., 2009; Schoeneman, et al., 2010). Ecologists use it to refer to the organizing conceptualization of ecosystems (Schizas & Stamou, 2010). My use of the term ontologization refers to the parallel processes of sense- and meaning-making in which data-information-knowledge is "made into being" through the transformation of patterns—recognized as being, as existing as part of one's conceptualizations that are grounded in a real-world experience. As part of our conceptual networks, whatever is ontologized is also stratified such that parts of the conceptual network can be segmented into ontological wholes and include/exclude/subsume various relationships with other ontological wholes that may also be expressed as categories, taxonomies or formal ontologies. Stratification is a multilayering and multifaceting of that which is being ontologized and which allows us to move in the conceptual space between sense-making and meaning-making. I use ontologize rather than reify to so as to not lose focus on the cognitive processes involved, to keep the discussion focused on the processes of sense- and meaning-making rather than just the object that has been reified. For example, we could argue about the reification of a particular entity or phenomenon as to whether it actually exists, but it is much less arguable as to whether or not it has been ontologized by a person or culture.

other perceivable entity. A pattern may vary from simple geometrical patterns such as a Penrose tiling or the regular ticks of a metronome to sequences of letters, words, or entire sentences—tag sets and tagclouds are patterns, for example. The recognition of such patterns is to be seen as an act of abstraction (Saab & Riss, 2010) that prescinds from individual particularities of an object and subsumes it under a common identity. As we know from physical measurements even the ticks of a metronome are different to each other if we examine them in sufficient detail. Pattern recognition is essential to all kinds of living beings and provides a central means of orientation in the environment (Bich, 2010; Hutchins, 2000/1; Maturana & Varela, 1998; Riedl, 1987)—or, in Heideggerian terms, how we manage our *thrownness* and *falling* and how these are attenuated by *mood* and *solicitude*. Such capability can be innate or learned. For instance, the recognition of patterns such as faces is a mainly innate capability, arising out of evolutionary processes, though there are cultural differences to which degree certain features of the face are taken into account. Generally the recognition of other patterns is based on acquired capabilities that are more complex and depend on our individual experience as well as our sociocultural background. For instance, I was able to understand the clustering of tag nodes in terms of their spatial relationships because I understood the importance of spatiality and spatial analysis to geographers who were members of the groups who created the clusters within the concept maps.

An important point is the impact of a pattern on us, which can be significantly different between individuals or at different times. Some patterns (e.g., ornamental patterns) have only minor influence on our behavior even if they may be aesthetically pleasing. Other patterns such as traffic signs have a more immediate and significant influence on our behavior. Does this mean that it has more meaning for us? What is the difference between these two cases if we compare the ornamental pattern to a traffic sign? Although we clearly recognize both, there are different affordances in play in our encounter with each. For instance, we stop our vehicles at a stop sign. Nevertheless we must not confuse impact on our behavior with meaning. For example, we would not say that a traffic sign is more meaningful to us than Shakespeare's *King Lear*, although its *salience* is likely to be greater and its immediate influence more significant in terms of our actions.

This makes clear that I need to clarify of the role of meaning. In the following I will use a distinction that has been introduced by other authors, namely that of *sense* and *meaning*. While sense is personal and situational, meaning is more stable and determined by the sociocultural context. Vygotsky (1986) describes the meaning and sense, respectively, as follows: "A word in context means both more and less than the same word in isolation: more, because it acquires new context; less, because its meaning is limited and narrowed by the context." Engeström and Sannino (2010) interpret the difference in the context of activity: meaning refers to general activity (as part of sociocultural context) while sense has the focus of individual action. For instance, they see a medical treatment under the aspect of maintaining health (meaning) or under the aspect of treating the problem of a particular patient (sense). Stegmaier's philosophy of orientation relates sense with our personal need for orientation in order to clarify our action opportunities (Stegmaier, 2008). Such orientation requires making sense of a situation. In the process of sense-making the person realizes what he or she can do with the data when they seen it as a possible starting point for action. Hereby the data becomes a clue, a reference point for action. In Heideggerian parlance we might say that data becomes that which is *present-at-hand* in relation to the *ready-to-hand* referential totalities that reflect potential opportunities for engagement of our care-structure. Let us go back to our traffic sign example. The fact that it is a pattern only means that we have seen a similar plate before; the fact that it is data means that the observer can connect it to some prior knowledge of hers; the fact that it is a clue describes that it influences her behavior how to cross the street in a specific way. Sense(-making) is fundamentally temporal. The longer we reflect on a pattern the more senses we might discover—the sets of referential totalities multiply. Imagine, for example, you are one of the IST graduate students (discussed in greater detail in section 4.4) whose research focus resides on the Information-Technology side of the triangle and are given the tag set (i.e., a pattern) most closely related to information generated by the Information-People researchers—*framework, analysis, forecast, access* and *understanding*. These tags are markedly different from the ones you would create—*types of information, representation, technology, people*. When confronted with the others' tag set, you might reflect for some time to discern possible reasons for their different associations, e.g., that they are based on the activities they engage in based on their research priorities. The more you reflect on the tag set, the more possibilities may come to mind, as if each possibility evokes a different set and configuration of referential totalities, and each possibility highlights different starting points for action, i.e., more clues. Sense-making, therefore, is an open and ongoing process that can lead to multiple possible meanings and multiple clues, i.e., various starting points for action.

How we distinguish random patterns from meaningful ones? An example that is often discussed in this respect are texts that we take for meaningful information although we do not understand them, such as the Egyptian hieroglyphs before the discovery of the Rosetta stone (Floridi, 2005). The hieroglyphs seem to support the view that meaning is inherent in the object and independent of the observer, who cannot read them. This view is based on an assumption, namely that someone has purposefully written these texts to communicate some message. However, such expectation is always based on a number of scientific assumptions and we could also imagine an Egyptian artisan who simply mixed informative data with senseless but decorative textual patterns. Even if such an assumption is unlikely we cannot exclude it as long as we cannot make sense of the texts.

3.4.2 Ontologization and Stratification

As the tags and hieroglyph examples show, information is generally ascribed to objects. This ascription is also exhibited among folksonomy researchers that assume the social dimensions of the tag are synonymous with or encompass its cultural dimension. It is embedded in the description of information as meaningful data. In the following I will advance the view that this is only one aspect of information and that it also includes aspects of a process. This view is reflected in Buckland's distinction of *information-as-thing*, *information-as-process*, and *information-as-knowledge* (Buckland, 1991), which is similar but not entirely identical to my framing of tags-as-equipment, tags-as-patterns, and tagging-as-practice. However, we cannot consider these in isolation, which would only serve to amplify the ambiguity of the concept of information; we must consider them as distinct but interdependent aspects of information.

I discussed above how information is closely interwoven with sense-making starting from a recognized pattern that informs the observer and ending with the determination of clues. The fact that we nevertheless regard information as a unity is the result of an ontologization of this process. Generally, to ontologize is to "make into being" and being is always what we understand, however implicitly, in our encounter with entities (Cerbone, 2008). To better understand ontologization let us start with an example that illustrates what we mean: If we consider the arithmetic expression "2 + 3" we can understand it in two different ways. On the one hand, we can understand it as an expression that is equal to "5". On the other hand, if we consider this object in more detail, we can realize that it actually stands for a process (Sfard, 1991), namely the process of counting to "2" that is followed by the process of counting to "3". In this interpretation the expression "2 + 3 = 5" just describes that this process yields the same result as the process of directly counting to 5. We use the term information in the same way as we use the expression “2 + 3”, that is, as an expression for the result of the process of making sense of the respective data that consists in the clues that we derive from it.

In the same way as we use the description “2 + 3” to refer to the object “5” while keeping the process of addition in mind, we also phenomenologically use the ontologization of information to refer to the derived clues while keeping the original sense-making of information in mind. We can also realize this from another phenomenon. If we say that two documents contain the same information, we do not necessarily mean that the two documents are identical but rather express that we derive the same clues or action possibilities from it in the same way as we say that “2 + 3” and “1 + 4” are identical.

It is interesting to note that we can also consider ontologization from a Polanyian perspective (Polanyi, 1962). For example, when someone reads a word she sees the individual letters but her focus is on the word as a whole; the reader is subsidiarily aware of the letters but her focal awareness is placed on the word as a whole. The same holds for words and sentences. In the same way as “2” becomes a summand under the process of addition, patterns become data under the process of sense-making. When we focus our attention on the pattern the process is still subsidiarily aware to us, which we express by denoting the pattern as data. When we focus on the results, the clues, we are also still subsidiarily aware of the process and its origin and label it “information.” As Polanyi has described it we can shift the focus of our attention from the process to the underlying objects and back but doing so there is still a subsidiary awareness of the other constituents. The idea of subsidiary and focal awareness illustrates what I mean when I say that data presumes information; if I talk about information as data I mean the pattern but I am still subsidiarily aware of the sense-making and the resulting clues. In the same way, if we focus on information as the process of sense-making we are still subsidiarily aware of the pattern and the resulting clues. A similar Heideggerian parallel can be made for sense-making of what is *present-*

at-hand, while the pattern that supports my sense-making is the referential totalities of what is *ready-to-hand*.

Applying the notions of focal and subsidiary awareness to a folksonomy, the folksonomy constitutes a pattern that becomes data (i.e., individual tag nodes) through the process of sense-making. When I focus my attention on the folksonomy, the process by which I identify the individual tag nodes is still subsidiarily aware to me. The tag data become starting points for generating clues that link some of the tags into a semantic network. When I focus on the resulting clues (i.e., the semantic networks) I am also still subsidiarily aware of the sense-making process and its origin (i.e., the folksonomy), and refer to these resulting clues as information. When I focus on information as the process of sense-making, I am still subsidiarily aware of the folksonomy as pattern and the resulting semantic networks as clues.

Another Polanyian idea that is related to subsidiary and focal awareness is that of stratification. Stratification refers to the segmenting of patterns at different levels of abstraction (Floridi, 2008) such that they form meaningful ontological wholes. Polanyi describes this integration process (of ontological wholes) by a comparison to gestalt theory. Recall Sfard's example above regarding the mathematical expression "2 + 3" and the process it exemplifies. This expression ontologizes the process of adding at a particular level of stratification: this includes the sum "5" as the upper and determining level of stratification and the summands "2" and "3" as the lower level that are connected by the process of adding. A slightly more complex example would be the ontologization of Φ as the Golden Ratio derived originally the process of segmenting a square and extending it to a rectangle. Repeating this simple sequence of measures and extensions, creates a proportional shape that produces structurally-sound architectural forms, has been recognized in the shape of the nautilus' shell arising out evolutionary processes over eons, and reveals an underlying mathematical formula for gauging aesthetic beauty in both natural and artificial forms. Φ symbolizes and encapsulates the ontologization of a fairly complex process enacted in various contexts, but which is belied by its simple form.

The information and data discerned from patterns can only be determined from the perspective of the receiver and depends on how they ontologize it. An architect might ontologize Φ differently than a mathematician, for example, recalling the Parthenon as opposed to the Fibonacci sequence. We can only recognize the informational content after the interpretation, after we have ontologized the pattern of data and information at a particular level of stratification. At each of the levels of stratification that occur during the sense-making process we find subordinate sense-making processes which are mostly automatically integrated as part of the enactment of schemas. In this way, the interpretation of the subordinate level helps identify larger patterns that are then integrated again. This stratified sense-making process becomes largely schematic based on shared cultural experience.

3.4.3 From Information to Schemas

How does knowledge manifest, i.e., emerge as part of our experience? It is to be shown that it manifests through ontologization by way of schemas. Alternatively I can say that the external manifestation of information is transformed into internal schemas. I have described schemas at several points throughout this dissertation, and here I repeat much of that description, but only to tie it more explicitly to the concept of ontologization. Strauss and Quinn (1997) describe schemas as "networks of strongly connected cognitive elements that represent the generic concepts stored in memory." D'Andrade (1995, p. 140) expands on this concept and describes schemas as "flexible configurations, mirroring the regularities of experience, providing automatic completion of missing components, automatically generalizing from the past, but also continually in modification, continually adapting to reflect the current state of affairs." Schemas facilitate our cognitive functioning, including use of our knowledge, in a world overflowing with all kinds of patterns.

Schemas—these strongly connected cognitive elements, are powerful processors of experience—help with pattern completion, and promote cognitive efficiency. They serve to both inform and constrain our understanding of experience. People recall schematically embedded information more quickly and more accurately. In fact, schemas hold such sway in our cognition that people may falsely recall schematically embedded events that did not occur (DiMaggio, 1997). They are more likely to recognize information embedded in existing schemas because of repeated activation of the schemas. This repeated activation evokes expectations within cognition, and the easy recognition of contradictory or challenging information that do not conform to those expectations formed as part of the existing schemas. Information that is orthogonal to existing schematic structures, that doesn't acquire salience through the repeated activation of schemas and the creation of associated expectations, is much less likely to be noticed or recalled.

Since schemas also function as pattern-completion processors, they allow us to generate expectations that we use in conjunction with clues to orient ourselves to the environment. Continued exposure to the same or similar patterns will eventually become meaningful in the sense that it will be associated with other ontologizing or ontologized schemas. We rarely encounter isolated patterns in the world; our experience is more complex than that, and our schemas reflect that. As new patterns appear, new clues are generated, which activate other schemas and generate new expectations that enable our active orientation within the world. Experience of varying contexts facilitates the strengthening of schematic conceptual connections and their extension to other concepts.

3.4.4 Sense-making and Meaning-making

Thus far I have argued for a distinction between patterns and data where the latter lead to clues. I find that the sense-making process associated with data is both objective as well as subjective—besides its binding to the pattern, as part of its objective facet, it depends on the interpreter's knowledge and the situational context in which it is interpreted. To express this difference I distinguish sense-making, as a plainly subjective process, from meaning-making as the social dimension of information. In doing so, I want to explain how it is possible that information appears to us as objective although it is based on an individual interpretative process.

The sense-making of patterns allows for the discernment of data, which provide clues for possible action as an orientation bias for the subject. I cannot say how much sense I must have to discern data within a pattern since this is a continuous process and depends on the amount of time I invest in it. The longer I reflect on a datum, the more sense I can associate with it, the more clues it provides to me. The generation of clues is based on my schemas, which are necessarily tied to previous experience. While clues become aware to me, as they are indicators of action opportunities, schemas remain opaque.

Though the sense-making process occurs at the level of an individual, it also takes place in a shared environment that produces similar experiences in cognitive agents embedded in similar sociocultural contexts. These two factors—sharedness and embeddedness—lead to a streamlining of the individual sense-making process with different actors as part of a cultural meaning-making process. It is the manifestation of Gadamerian play where the player is acting within the context of the game, but is simultaneously aware of the rules of the game that are shared among the players and acts accordingly. This streamlining consists in a continuous, mutual adaptation of individual sense and social meaning via communication and collaboration (i.e., a fusion of horizons as part of a hermeneutic circle; Gadamer, 1975). This requires that the individual subject is usually aware of the fact to which degree the sense that he or she gives some data deviates from the average sense that others might give, and which are reflected in his and others' schemas. For instance, even if I don't perceive information like social science researchers in terms of *framework*, *analysis* and *forecasting*, (see the example of IST students in section 4.4) the fact that I have taken classes with, engaged in discussion with, and studied the philosophies of science employed by information scientists, enables me to understand the meaningful connections made by those who do perceive information that way. In this circumstance meaning-making overlies sense-making.

Thus far, I have discussed patterns, information, data, clues, orientation, stratification, sense-making and meaning-making as integral parts of the ontologization process. I have made mention of underlying schemas, but haven't fully explicated their roles in ontologization. Figure 3–1 below depicts how I see the process and character of ontologization. With this representation in mind, I will delve further into the role of knowledge, schemas, salience and the sociocultural dimension of meaning-making as part of this process in the next section.

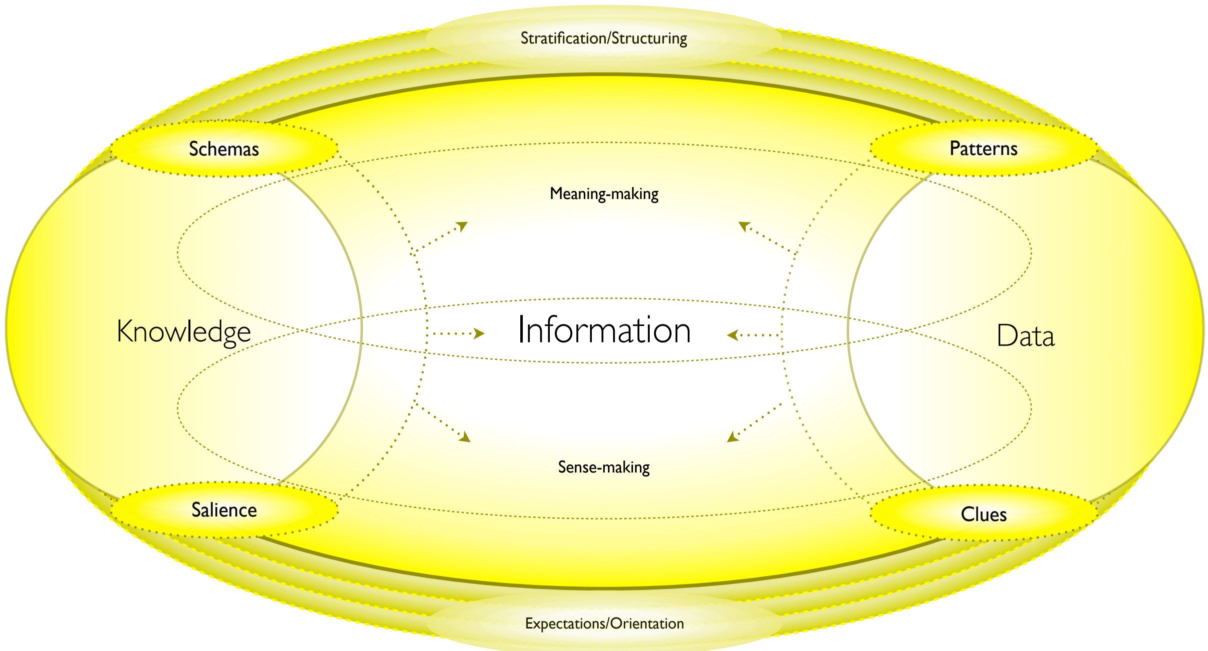

Figure 3–1. Ontologization: The Phenomenological Character of Information.

Because of their functionality in pattern completion, schemas function, in some sense, as flexible filters of experience that enable me to attend to its salient features while they filter out the non-salient at the same time. Schemas' role in regulating what is salient and non-salient is essential to my understanding of sense-making and meaning-making. What is salient in a particular context depends on how I focus my sense-making and meaning-making as part of my ontologization. This does not mean that that which is not salient at any given moment is not being ontologized, simply that it is subsidiary to the salient. In other words, what is "meaningful" to me in a given context and a particular point in time is that which is most salient, which is what I have argued in the case of semantic networks in relation to cultural landscapes. And it can only be meaningful if I have the appropriate schemas for recognizing its salience. My assertion here contrasts with Dretske's assertion that information does not have to be meaningful to a subject to be information; it can simply reflect a stable pattern, such as relevant contextual or background information available to a subject. Being relevant means being salient to some degree, which does not imply that what is less salient is not meaningful, only that it is subsidiary to that which has greater salience at that moment. Ontologization and stratification, through the enactment of schemas, reveals that the patterns I perceive are always meaningful in that I am able to identify that which is more salient and comes to occupy my focal awareness, by becoming *present-at-hand*, and that which is less salient and comes to occupy my subsidiary awareness, by becoming *ready-to-hand*. Dretske was correct in that we should not confuse information with meaning, but I also assert that we should not confuse meaning with salience, nor should we mistake schematic for "not meaningful."

So, how do we acquire an understanding of what is salient, which become integral to our schemas? Certainly, we develop schemas individually, as they are part of our cognitive networks. But we also develop cultural schemas, which are those schemas we co-develop with others. The notion of what becomes salient often depends on our sociocultural interactions with others, though it may also arise out of purely personal experience as when encounter something that is about to cause us injury. The co-development of schemas does not require people to have the same experiences at the exact same time and place, rather that they experience the same general patterns. As agents in the world, our experiences are organized in ways that ensure ease of interaction, coordination of activities, and collaborative interaction. Due to this fact people in the same social environment will indeed experience many of the same typical patterns. In experiencing the same general patterns, people will come to share the same common understandings and exhibit similar emotional and motivational responses and behaviors. However, because we are also individuals, there can be differences in the feelings and motivations evoked by the schemas we hold. "The learner's emotions and consequent motivations can affect how strongly the features of those events become associated in memory" (Strauss & Quinn, 1997, p. 133). Individuals will engage the external world structures and experience the same general patterns. Similar stimuli and experiences will activate similar schemas. It is in that sense we considered them shared schemas. It‘s their quality of sharedness that makes them a dimension of the cultural.

It is this process of creating a mutual cultural understanding of patterns within our experience that I call meaning-making. It is sense-making on a sociocultural level, where the awareness of others' knowledge capacity allows us to refine the sense of a thing into meaning (Vygotsky, 1986). Both sense-making and meaning-making are aspects of the interpretative process that appears to us as an ontologization—one allowing us to ground perceived patterns in data tied to the physical world and the other allowing us to reconfigure the associations of these patterns in ways that can be communicated meaningfully in context.

3.4.5 From Information to Knowledge

Our capacity for meaning-making is important to understanding of information and knowledge. In accord with the hierarchical notion of data-information-knowledge, knowledge is often characterized as information plus context (Nonaka, 1994). We normally think of information as the foundational bricks for building knowledge; however, as we have seen, we need knowledge in the same way to discern information. We need to bring to bear our cultural landscapes to properly discern the information that we might be able to derive from semantic networks.

First, we need to distinguish different types and sources of knowledge. Then we have to ask which kind of knowledge we get from information. To this end let us consider the following propositions to get an initial idea of the fundamental difference between information and knowledge:

(1) Alice knows how to recognize trees.

This proposition is clearly an example of Alice's knowledge, but not information. More precisely (1) is a case of knowledge-how where (1) describes a specific capability of Alice, namely that Alice can recognize tree in various situations; we can also say that Alice can actualize her respective capability in an appropriate action. An example of such actualization is the case where Alice stands in front of a tree and we realize that:

(2) Alice knows that this is a tree.

Proposition (2) obviously describes Alice's knowledge-that the respective object is a tree. We infer that Alice knows this because she sees or is experiencing the tree in some way. She disposes of visual data that she interprets in a way that the object is a tree. We may now ask what is the difference between these two propositions and the following one?

(3) Alice has the information that this is a tree.

In (3), Alice has information that is not especially characterized as knowledge. However, reading (3) we would not assume that Alice is standing in front of the tree but interpret the situation in such a way that, for example, she reads a piece of paper on which this is written. While in (2) we assume that Alice relies on her capability to (directly) recognize trees, in three we assume that Alice relies on her capability to interpret (mediating) data.

This might pose the question what is the difference between visual data of the tree and textual data on a piece of paper. First, Alice has the information because she is engaged in an experience whereby the information that is emerging is doing so as part of Alice's sensory capacities of sight, touch, smell, etc., which are connected to the patterns she is experiencing, that through her sense-making ability she is able to discern information and the corresponding data grounded in a physical world. Repeatedly experiencing this or similar patterns enables the formation of schemas that enable the transformation of information into knowledge. Second, Alice has the information because someone else has provided it as communicated knowledge, perhaps as a photograph or drawing as part of a science or reading lesson. In (3) we would not assume that she has seen the tree herself. In this second scenario, Alice is relying on schemas that she has developed (or if Alice is a very young child, perhaps still in the process of developing), that through her meaning-making ability allow her to incorporate this information into her already existing knowledge structure. Either scenario is possible, and both illustrate that the transformation of information to knowledge is enabled through schemas. How do we know that Alice has transformed this information into knowledge? It is simply the case that Alice can leave the place and still claim to know that the object she had seen was a tree, without any visual information still available—knowledge is persistent, information less so due to its dependence on data.

Both information and knowledge refer to experience and only differ with respect to their point of reference. A person who claims to have information about something refers to some data and must be able to provide the respective data; a person who claims to know something might be required to justify this claim but this justification can be different from data, for instance, it might consist in the accomplishment of a specific action. In that moment where the data have vanished, the subject has to rely on knowledge instead. I can also express this in the following way: information relies on external reference, while knowledge relies on internal reference. Another aspect is that information rather complies with knowledge-that than knowledge-how. However, this assignation is not completely exclusive. For instance, a picture might give us some understanding even if we are not able to verbally express this. However, in most cases data consists in texts and spoken language, in particular if they intend to reach certain specificity.

3.4.6 Towards Schematic Ontologies

The solution to problem of semantic interoperability among our sociotechnical systems rests upon an understanding of ontologization that facilitates the pattern recognition of semantic networks within a cultural landscape and the ability to connect them in ways that validate our individual sense-making and sociocultural meaning-making. This dissertation establishes the relevance and importance of including cultural identity (as aggregated sets of cultural schemas) as an essential component for discerning the semantics of folksonomies as a first step towards creating schematic ontologies. The motivation for designing schematic ontologies using tags arises from the failure of traditional domain ontologies to fulfill their promise of knowledge sharing among information systems. To date, nearly all attempts at ontology creation have succeeded only in creating a customized solution for a single information system that cannot be applied generally. Modifying an information system ontology often results in significant internal conflicts among classes, subclasses and instances of entities defined in the ontology. The result is that the ontology is broken and unusable. Integrating different ontologies carries with it similar problems such that the structured hierarchies of classes, subclasses and instances often result in conflicting conceptualizations, with no clear way to resolve the conflicts. The highly structured nature of information systems ontologies makes them fragile in the face of change and inflexible in the face of integration. A schematic ontology, on the other hand, based on an understanding of information as ontologization and used as a complement to information system ontologies, would be inherently flexible and adaptable and could facilitate the interactions between systems that have or use formal ontology artifacts.

3.5 Ontologization and the Problem of Semantic Interoperability

While traditional conceptions assume a static nature of information, expressed by the equation information = data + meaning, I have argued that this understanding is based on an ontologization of an entwined process of sense-making and meaning-making. This process starts from the recognition of a pattern that is interpreted in a way that influences our behavior. More precisely the pattern provides us with clues that help us to find orientation for our actions. For example, as will be discussed in Section 4.4, IST graduate students created tag patterns that provided clues for their orientation within Information Science and the research activity they would undertake. In this sense information within semantic networks is to primarily be understood as a process that differs from person to person and from situation to situation. It is only these entwined processes of sense- and meaning-making that makes patterns data. It also tells us that it is only a fine line that separates meaningless patterns from meaningful data.

Such interpretative processes are not arbitrary, however. We are bound to objective conditions that become manifest in our experience and a specific cultural background that we share with others. These factors limit the differences in understanding specific data. These converging factors are also responsible for the fact that different data can result in the same information, that is, the same clues for our actions. On the other hand we also have to realize that the same data can lead to different clues. These similarities and differences are what the mandala form of the Emergent Culture Model (Figure 2–3) was designed to portray.

I have argued that the traditional static understanding of information is based on an ontologization of the interpretive process. This ontologization allows me to refer to data, process, and clues by means of one entity where the respective meaning, that is, the particular aspect I refer to, becomes apparent from the context. Another reason for this understanding is that the data-based interpretative process is closely related to my schemas, which are internal and not transparent for the subject. Therefore I might also use the term information to refer to the schemas that are related to specific interpretation of data.

Despite the persistence of a static view of information (i.e., as a thing to be transferred), I think that it is necessary to expose the phenomenological character of information if semantic interoperability is to be achieved. The traditional conception assumes an objective, fixed, and data-dependent meaning (i.e., tags-as-equipment, information-as-thing). Nevertheless we have to understand that due to the phenomenological character of information this meaning is primarily subjective and only becomes objective through a shared sociocultural background and experience—shared cultural landscapes and the semantic networks that facilitate their uncovering within a hermeneutic circle. I can also say that it is an ongoing task to establish objective meaning of data, which is achieved through the solicitude of discourse and interpretation in communicating with others. It also explains why this meaning can change over longer time horizons.

Ontologization also supports the stratification of data, as it especially appears in language with its hierarchies of letters, words, sentences, and texts—or in schematic ontologies with its tags, tag sets, semantic network graphs and cultural landscapes. This stratification brings some order to data and, by extension, tags in folksonomies. At the same time, the process character of meaning-making makes us aware of the fact that this ontologized hierarchy is in fact an interwoven process. The meaning of a word is influenced by the sentence in which it appears—a word can be replaced by a metaphor or be misprinted, and still we can make meaning of it; a tag set can include polysemous words and synonyms, and we can still make meaning of it. All this is due to the phenomenological character of information.

Regarding technological solutions in information science, one consequence of information as ontologization is that we should never mistake data for information, or the collective for the collaborative, but also we must always realize that sense-making requires specific conditions to be successful, including the schematic cultural identity perspectives from which tags are created. It also tells us that the mere provision of data, such as a collection of tags in a folksonomy, does not give us information if we have neither the time nor the schemas to make sense of it. Nowadays semantic technologies are able to articulate the required links between data that can help users to engage in sense-making. Developers of information-based applications must be aware of their respective applications' requirements, and a more complete understanding of the concept of information (i.e., as a phenomenology and not simply as “thing”), provided here, is a necessary precondition for this.

Recognizing the mutual dependency of data and information is important with respect to our definitions of information, as is the mutual dependency between semantic networks and cultural landscapes. Information does not only depend on data as part of its definition—the concept of data already presumes the concept of information, just as a semantic network presumes the concept of a cultural landscape. I have shown that data become mere patterns when we abstain from any sense-making: there is a mutual dependence in data and information such that we cannot separate one from the other, even though we generally consider them to be self-contained and independently meaningful entities. In my analysis, data is a moment and not a constituent (*pace* Vygotsky). The definition of data-information is a simplification that abstracts it from its process character. I hope that I have shown that the phenomenological nature of ontologization makes into being data, information, and knowledge in such a way that none of the three can exist independently. Similarly, the phenomenological nature of the ECM makes into being extrapersonal structures, culture, and intrapersonal schemas such that none of the three can exist independently if semantic interoperability is to be achieved.

Chapter 4

Concept Demonstration: Applying the Heideggerian Frame and the ECM

The re-characterization of information as a phenomenology of ontologization rests on the less complex ECM that structures the social and cultural—the ontic and ontological—dimensions of tags so that semantics of folksonomies may be identified through the emergent interplay of extrapersonal structures and intrapersonal schemas. The efficacy of this approach depends upon our ability to disaggregate folksonomies into culturally bounded perspectives that roughly correlate to cultural identity. In this chapter, I will use the Heideggerian ontological frame to delineate examples of tags collected from two different groups of academics in terms of tags-as-equipment, tags-as-patterns (reflecting the *care-structure*), and tagging-as-practice. The section on tagging-as-practice illustrates quite clearly the utility of the ECM for structuring the social and cultural dimensions of tags, especially the latter, in order to discern the emergent semantics of tag sets within folksonomies.

At the risk of being repetitive, tags are ontic lexical units that function as a special kind of equipment called signs. Their nature as signs makes them useful by bringing "explicitly…a totality of useful things to circumspection so that the worldly character of what is at hand makes itself known at the same time" (Heidegger, 1927, pp. 110-111; H. 180). A tag is ontic, not ontological, and as such it "functions both as this definite equipment and as something indicative of the ontological structure of readiness-to-hand, of referential totalities, and of worldhood…. In anything ready-to-hand the world is always 'there'. Whenever we encounter anything, the world has already been previously discovered, though not thematically" (Heidegger, 1927, p. 114; H. 183). The totality of useful things is directly related to the care-structure described by Heidegger, which develops from our *being-in-the-world-with-others*, i.e. cultural experience. Through our being-in-the-world, i.e., our embodiment and embeddedness, we apprehend the complex ontologies of objects and phenomena. Our *being-in-the-world-with-others* necessitates a way of communicating our apprehension such that others can understand us. *Being-in-the-world* is essentially connected to the building of conceptual networks and the creation of cultural meaning as part of tagging as practice.

The following section of this chapter outlines how the datasets for application of this research were gathered through surveys, a concept mapping exercise and a concept deconstruction exercise. Each dataset is framed in Heideggerian ontological terms—tags-as-equipment, tags-as-patterns and tagging-as-practice—in the subsequent sections. The equipment and patterns elements of the framing refer back to the extrapersonal and intrapersonal dimensions of the ECM respectively. Tagging-as-practice, where the interaction between the intrapersonal schemas and extrapersonal structures are demonstrated, illustrates the importance of including cultural identity in determining the emergent semantics of folksonomies.

4.1 Tag Sets of Two Groups of Interdisciplinary Academics

I collected tags from two groups of academics to use as concept demonstrations of the main ideas of this dissertation—semantic networks, cultural landscapes, ECM, ontologization. The first group was a group of US and China based researchers interested in GeoCollaborative Crisis Management (GCCM). The second group was IST graduate students participating in the IST 590 Colloquium who were exploring ways of understanding their research community in terms of information, technology and people.

I collected tags in several ways, each illustrating the three parts of the Heideggerian frame. I explain them in more detail below, but briefly, I devised a two survey instruments and a workshop. The first survey was a standard survey that asked the participants to generate tags and provide basic demographic and attitudinal data. The second was a conceptual connections survey where the participants were asked to deconstruct a particular concept using tags and provide a description for the semantic network created through that deconstruction. I also conducted a mini-workshop with the graduate students attending the US GCCM workshop. Any conceptual prompts used to generate the tags in the surveys and the mini-workshop were derived from existing materials used by the groups and did not originate with me as the researcher.

4.1.1 US-China Workshop on Geo-collaborative Crisis Management

The First US-China Workshop on Geo-Collaborative Crisis Management (GCCM) explored the issue of information technologies regarding crisis management as conceptualized by the American and Chinese cultures with an eye towards facilitating cross-cultural and geographic collaboration, and by extension intercultural understanding. More formally, the call for participation states:

> The goals are: (a) to develop a vision of the core GCCM information technology research challenges; and (b) to foster long-term, US-China research collaboration and intellectual synergy towards understanding and supporting the roles of the government in geocollaborative crisis management in government.[20]

GCCM was funded by the National Science Foundation (of the United States) and the National Science Foundation of China. It was designed to be an initial set of two workshops held in the US and China. There were two workshops held—the first in China and the second in the US. While the workshops were originally designed to be collaborative, with the expectation that participants from both countries would participate in both workshops, in practice only a minority of participants attended both—the key organizers and a few graduate students.

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[20] http://spatial.ist.psu.edu/GCCM-01/

In China, the GCCM workshop was hosted by the School of Management at Lanzhou University in September 2008. For this workshop I constructed a survey (See Appendix A: GCCM China Survey) that asked several questions regarding how the participants in the workshop conceptualized GCCM. The survey also asked them to provide a small concept map consisting of keywords (i.e., tags) that reflected how they envisioned GCCM. Other questions on the survey included several demographic items about university degrees, research focus, cultural self-identification, technologies used for GCCM, and rankings of approaches or perspectives important for optimizing technological support for GCCM. The workshop participant list included 40 people, however, only 9 completed and returned the survey.

In the US, the GCCM workshop was hosted jointly by IST and the Geography Department at Pennsylvania State University in December 2008. For this workshop, I used the same survey as delivered in Lanzhou, but the response was negligible, with only three respondents returning surveys out of a possible 45. However, as one of the organizers, I was tasked with conducting a separate mini-workshop with 12 graduate students participating in GCCM workshop during the second day. I devised a concept mapping activity that used group-generated tags about all the presentations given during the first day. We generated the tags as a group and selected the most frequently occurring tags from which three groups created concept maps that represented their understanding of GCCM from a self-selected analytic perspective—analytic/decision-making, social media, and technological/application. These results were then presented to the workshop as a whole, where a conversation about the scope of GCCM from a variety of specialized perspectives was conducted in order to establish common ground and common understanding.

The mini-workshop was designed as a tag generation and concept mapping exercise. Concept maps were used as "data collection tools to obtain information about mental representations" (Hui, Huang, & George, 2008) about the concept of GeoCollaborative Crisis

Management as derived from the presentations given by participants of the main workshop. Concept mapping was selected as the mini-workshop exercise because of its ability to facilitate an understanding of how participants organize their relevant conceptual networks (McNeese & Ayoub, 2011) in relation to the primary concept of GCCM. Moreover, concept maps are not simply externalized representations of pre-existing internal knowledge, but are also facilitators of knowledge construction (Leake, Maguitman, & Cañas, 2002), which supports the claim in this dissertation that cultural schemas are developed in part through hermeneutic discourse about the patterns we encounter in experience.

The concept maps from the GCCM mini-workshop represent not only the intrapersonal schemas developed by individuals as part of their understanding, but also the blending of that understanding with others' in a constructive way that reflected a particularly situated and culturally schematic understanding of GCCM as a concept. During the exercise, the concept maps were constructed using Post-It notes, and then later transformed into the maps in Figure 4–7, Figure 4–8, Figure 4–9 and **Error! Reference source not found.** using Cmaps[21].

4.1.2 IST Graduate Students

The second case for this study was The College of Information Sciences and Technology (IST) at The Pennsylvania State University, specifically graduate students enrolled in the colloquium course. The graduate students enrolled in the colloquium were in their first or second year of graduate education and were still developing their understanding of information science and the topics with which it deals. The idea of research in IST is framed by a metaphorical triangle, the points of which are Information, Technology, and People (ITP). Students situated on

[21] http://cmap.ihmc.us/

the Technology-People side of the triangle tend to focus on human-computer interaction issues and research, including interface design. Students situated on the Information-People side of the triangle focus on human information behavior—information seeking, how information flows in organizations, etc. Students on the Information-Technology side of the triangle are interested in the various technological constraints surrounding information, including the structuring and storing of data and how technology is constructed to retrieve it. The participating graduate student population were a mix of ethnicities from a variety of countries, with a diverse array of skills and perspectives molded by their educations, and research interests that were situated on every side of the ITP triangle and in some cases encompassing the entirety of it.

Because the students were in the early period of their graduate education, their ideas about information, technology, human behavior and interaction, research, and a variety of other topics were still forming as they interacted with each other, learned about different perspectives and applications in courses, and interacted with their advisors. This formative period in their education will become an important factor in the building of conceptual networks as part of a culture of academic researchers.

To elicit concepts about IST and information science, I used two short essays written by the students. The first essay focused on the students' own conceptualizations of IST, its research, and how they would situate themselves within the field. The second essay was focused on their advisors' conceptualizations and situatedness. The essays were analyzed using Leximancer[22] to extract key concepts from each set of essays as well as key concepts from the combined set of essays. The top three extracted concepts from each set of essays were utilized to construct an array of connections with the five most closely related concepts based on the Leximancer analysis. Not surprisingly the concept of *information* was most prominent within the collective set

[22] http://www.leximancer.com/

of essays. The pertinent question was how is the concept of *information*, situated with the cultural landscapes of the students expressed within their semantic networks? Figure 4–1 illustrates how one instance of the concept, information, was portrayed in the survey. The participants then ranked the associated concepts in terms of strength of association, based on their own understanding of the concept parings. For the strongest pairing, they were then tasked with creating three "connecting" concepts and providing a brief description of the concept pairing and connections as an ontological whole.

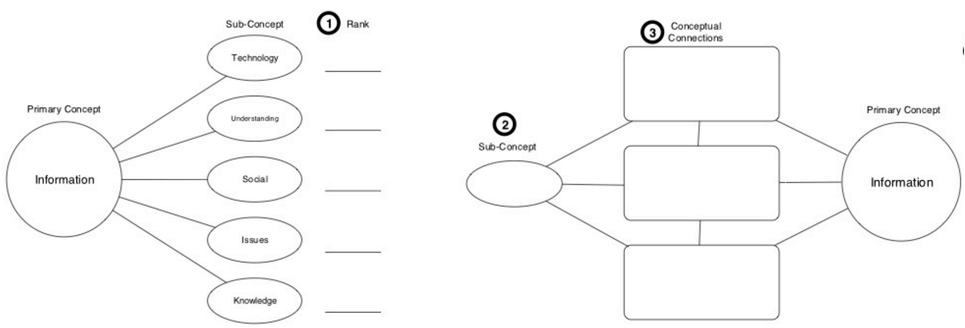

Figure 4–1. Example of semantic network connections survey for the concept of "information"

The concept deconstruction exercise (See Appendix B: Conceptual Connections Survey) served as a complement to the concept mapping exercise. The idea of concept deconstruction through tagging is a modified version of concept mapping. Rather than create an expansive concept map as a group exercise, concept deconstruction works in the opposite direction. It took the group's collective essays and extracted key concept pairings, and then asked individuals to supply "connecting concept" tags to understand the relationship between the extracted concept pairs, but only for the pair they considered most strongly associated. As the concept mapping exercise tried to elicit a cultural group understanding of a concept, the concept deconstruction exercise tried to elicit an individual's understanding derived from the collective. It allowed for an unpacking of the *ready-to-hand* associations of individuals in relation to a particular *present-at-*

hand concept—*information* in this case. Concept deconstruction helped to uncover the salient elements of each individual's semantic network that formed the entry points into their larger cultural landscapes.

4.2 Tags as Equipment: Signs, Indicators and Clues

One of the difficulties with explicating the results and findings of this research is that they must somehow be represented. I elected to represent tag sets as concept maps and as tagclouds, although my concern in this research has less to do with the form of representation of the tag sets than it has to do with how cultural schemas influence the underlying ontological conceptualizations represented by them. However…

> Every computer scientists knows that we can only process information when the information is somehow represented—there's no computation without representation. Traditionally, human programmers have designed the representations. They select what aspects of the domain are relevant and thus must be made explicit, and they design appropriate data structures that efficiently support the processing required for a task…. Computation requires representation, but how can this computation generate its own representation? A representation casts a frame on the world, but this frame is a strength as well as a limitation. Stepping out of the frame is like jumping out of a hoolahoop while holding it…. We can schematically classify efforts to understand the origins of representations into two approaches: induction and selection. I propose a third alternative, which relies on interaction, construction, and communication (Staab, et al., 2002).

In the context of this dissertation, which strives towards understanding conceptual and ontological complexity, representation becomes a significant limitation. I do not want the reader to substitute the ontic for the ontological, which is where representation of tag sets, tagclouds, semantic networks, and their related numerical and statistical associations will lead if we are not careful and cognizant of this dilemma.

In the case of the GCCM workshops, the respondents to the surveys and participants in the mini-workshop were asked to provide tags that describe their conceptualization of GCCM.

Figure 4–2 below captures the tags generated by the Lanzhou respondents. Figure 4–4 below illustrates how the tag sets of a couple respondents could be configured into a semantic network graph. The tags, whether in a tagcloud or semantic network graph, are signs—words that characterize the concept of GCCM. They comprise the ready-to-hand set of referential totalities that the participants selected as a way of explaining the concept of GCCM to others. The tags *collaboration, crisis management, inter-organizational cooperation, communication, GIS, information integration,* and *decision support* serve as the primary equipment among a cloud of other equipment for explaining the concept to others.

In the case of the IST graduate students, the tags generated as part of their conceptual connections survey in Figure 4–12 below served the same purpose—to illustrate the ready-to-hand concepts related to the concept of information and set of referential totalities associated with it by IST students. The tags understanding, retrieval, sense-making, needs and use serve as the primary equipment among a cloud of other equipment for explaining the concept of information to others.

The survey for GCCM (see Appendix A: GCCM China Survey) asked the participants to create a simple concept map with five key nodes and up to three additional nodes for each key one. Rather than portray it as a graphical network, the respondents portrayed them as lists, e.g.:

> **Collaboration** (mechanism, process, effectiveness); **Information Processing** (extraction, mining, analysis); **Human-Computer Interface** (interface, interaction, visualization); **Infrastructure** (equipment, facility, communication); **GIS** (database, presentation, real-time)

I was able to take the responses and do two things: 1) create tagclouds[23] from the tags provided by each participant group (Figure 4–2 and Figure 4–3), and 2) create semantic network graphs of each participant's responses (Figure 4–4 and Figure 4–5).

Figure 4–2. Tag set for the concept of "GCCM" for workshop participants in Lanzhou, China

Figure 4–3. Tag set generated for the concept of "GCCM" arising from workshop presentations in State College, PA, USA

Persons from different cultures, with different languages and experiences of their environment, will almost certainly have different conceptualizations of the same entities or

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[23] The tagclouds in Figure 4–2 and Figure 4–3, as well as all tag sets created for the second case study involving IST graduate students were created using *Wordle*, an online tag cloud generator available at http://www.wordle.net/.

phenomena in a particular environment. Compare the two examples of semantic network graphs in Figure 4–4, which were created by the GCCM workshop participants in Lanzhou, China with those created by the GCCM workshop participants at Penn State in Figure 4–5. Two examples of semantic graphs created by GCCM participants at Penn State, USA. The former were constructed by graduate students in a Management program, while the latter by Geographers and IST students.

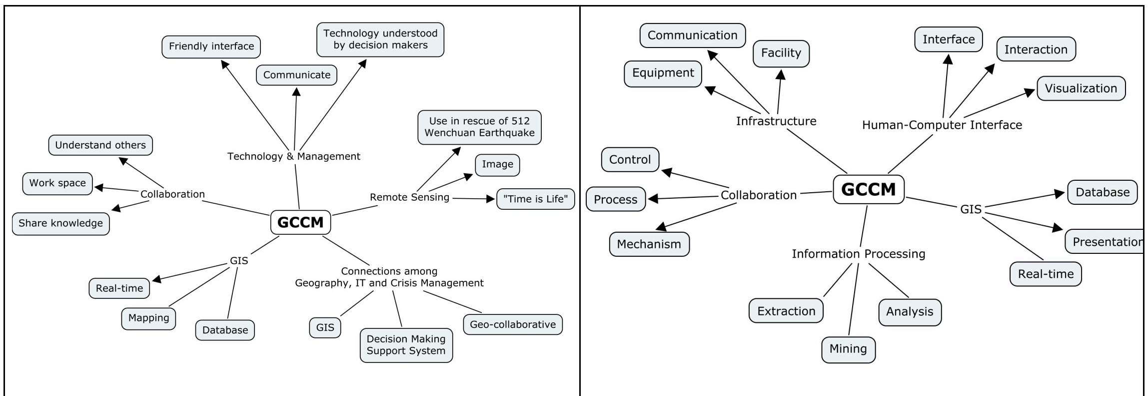


Figure 4–4. Two examples of semantic graphs created by GCCM participants in Lanzhou, China

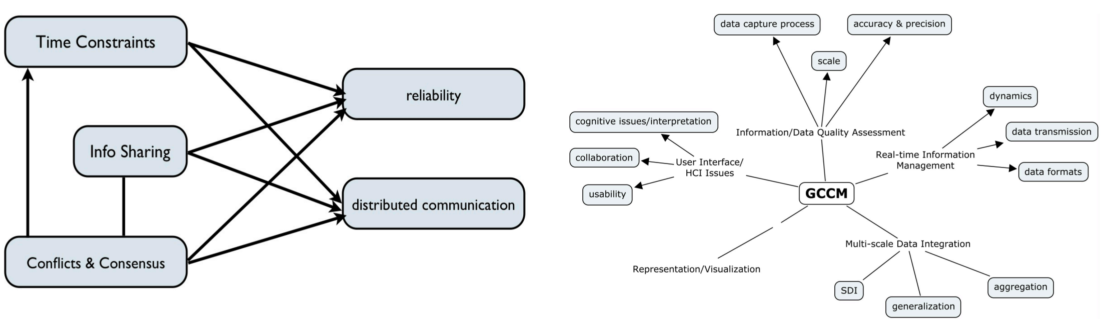


Figure 4–5. Two examples of semantic graphs created by GCCM participants at Penn State, USA

While there was much less data from the surveys from the US GCCM workshop, there were a couple instances of concept maps offered by the three respondents (Figure 4–5). Most of the data from this workshop was obtained through the mini-workshop held among the graduate student participants in the US GCCM workshop. The key concepts derived from the tagging exercise are represented in Figure 4–6 below with a turquoise blue node. The participants connected the key tags with lines, sometimes labeled, and with other tags generated as part of the tagging exercise (See Figure 4–7, Figure 4–8 and Figure 4–9).

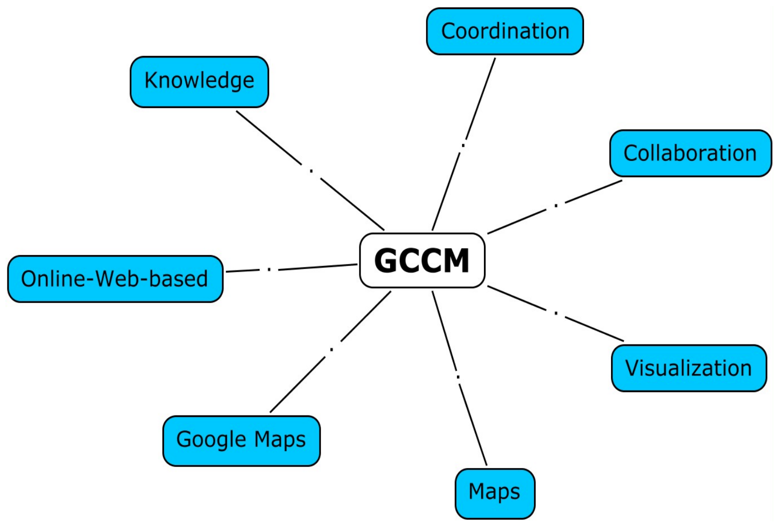


Figure 4–6. Seven most frequent tags from the GCCM mini-workshop

Sometimes the participants created clusters of tags with no specific linkages or relationships defined, but which were nonetheless representative of a conceptual grouping and indicated the relationship with spatial distance (See Figure 4–10 and Figure 4–11 in the next subsection). Considering the importance of spatiality among the many geographers at the workshop, this clustering as a way of indicating conceptual relationships is unsurprising.

4.3 Tags as Patterns: Care-Structure

The concept maps developed by the graduate students attending the GCCM mini-workshop in Figure 4–7, Figure 4–8 and Figure 4–9 are illustrative of the care-structure. Once the tags had been generated and the most frequent identified, the students broke into three groups to construct a concept map that integrated (into a coherent pattern) the seven most popular tags (Figure 4–6). The groups produced very different conceptual maps based on the particular perspective they adopted, much like the carpenter, novice and termite inspector described in the quote in section 3.1. The circumstances of their thrownness, mood, solicitude and falling gave rise to unique referential totalities represented in the concept maps. These referential totalities reflect the conceptual patterns of understanding engendered by the care-structure. To shorthand it, tag sets become patterns.

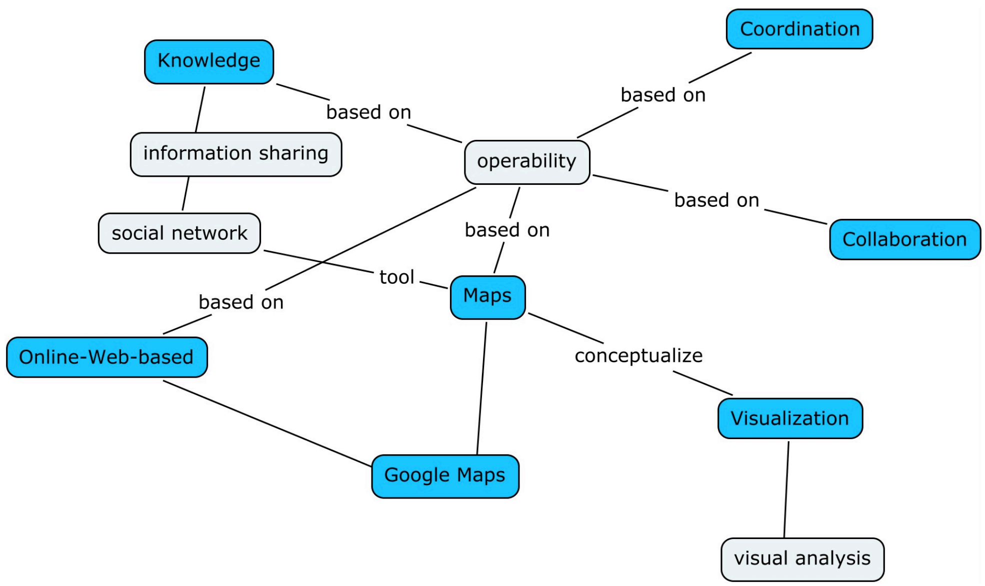


Figure 4–7. The Concept of GCCM from a Social Networking Perspective

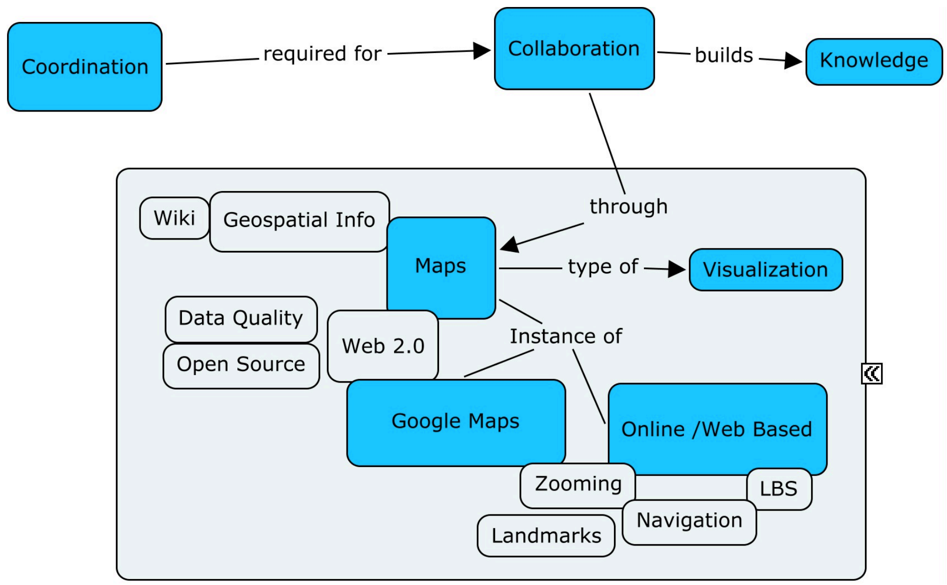


Figure 4–8. The Concept of GCCM from an Applications Perspective

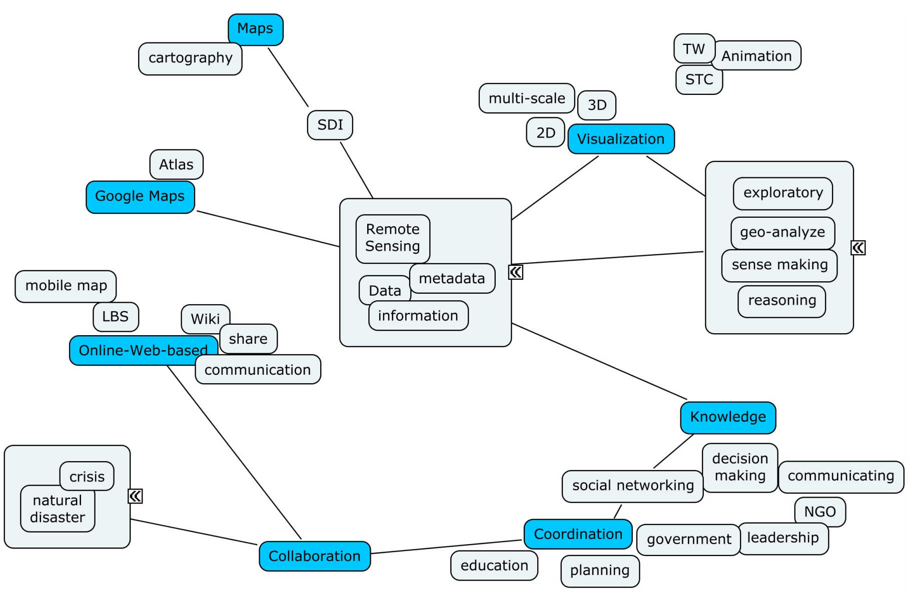


Figure 4–9. The Concept of GCCM from an Analysis/Analytics Perspective

The ECM provides a structure that helps to explain how the GCCM participants arrived at different configurations of key tag nodes with respect to the concept of GCCM. On the extrapersonal side of the model, GCCM comprises a phenomenon that can be described in many ways in terms of its structure and content (e.g., collaboration through maps, open sourcing of data and applications, coordination and collaboration for building knowledge, multi-scale 2D and 3D visualization, and so on, as in Figure 4–7, Figure 4–8 and Figure 4–9. Tags generated by the participants encompassed not only the structure and content of GCCM but also GCCM as an entity and phenomenon. These tags were simple lexical representations, but taken together they formed patterns that revealed referential totalities perceived by the participants. The care-structure of the participants shaped their individual understanding of those referential totalities, but it was the solicitude dimension of the care-structure that enabled them to reshape their individual schemas into a set of shared cultural schemas.

4.3.1 Thrownness and Projection of Understanding

The students involved in the concept mapping exercise were from diverse academic backgrounds—geography, information science, management science, geographic information systems (GIS), and application development. In determining the semantics of the tag set the students were projecting their own understanding of the seven most frequently used tags in ways that reflected referential totalities based on their circumspective concerns. So, before we had even begun to make explicit the connections between the tags as part of the concept mapping exercise, the students were “ahead-of-themselves.” The exercise enabled them, as Dasein, to “press themselves into possibilities” as Heidegger might say, based on their respective projections of their understanding of the tags generated initially by the graduate student participants during the review of the workshop presentations. Pressing into possibilities as part of their engagement as Dasein is an example of their thrownness.

Because of their diverse backgrounds, the specifics of their thrownness in terms of projecting their understanding was unique for each participant, but as we discovered through our tag-generation discourse their thrownness fell into three general categories. The students used these general categories—social network, application, and analysis/analytic—as the situated perspective from which they would create their concept maps.

4.3.2 Mood and "Finding"

Tags indicate where one's concern dwells, what sort of involvement one has with something. Tags form entry points into our complex of cognitive and cultural schemas that shape our ontological commitments to the world in which we are immersed. The most popular tags generated by the graduate students for GCCM were indicators of where their concerns dwelled. The tags generated were also influenced by the second constitutive aspect of care—mood.

The entire concept mapping exercise took longer than anticipated. It was conducted in the late afternoon of the last day of the workshop, which had seen 15 presentations about GCCM from a diverse group of academics. The exercise consisted of generating tags for each presentation from which we would take the most frequently mentioned to create a concept map. Fatigue had become a factor by the time we separated into groups to conduct our concept mapping exercise, as the absorption of so much diverse information contributed to the mood of the individual students. This fatigue started to reveal itself as generating the tags from the review of each presentation began to go off track and more and more tangential discussions were arising among the group. In order to complete the tag generation part of the exercise, I had to draw them back into focus several times.

We completed the tag generation, although the last five or six presentations discussed were somewhat rushed. When the tag generation was complete, the students felt a bit of relief, especially as they had a few minutes break while my co-facilitator and I determined tag frequencies and identified the most popular tags. The brief respite allowed the student participants to alleviate some of their fatigue before moving on to the concept mapping part of the exercise.

As the students segregated into the three perspectival groups—social networking, application, and analysis/analytics—they experienced a renewed sense of purpose and a challenge set forth by the need for discourse to attenuate their thrownness and the projection of their own understanding of the connections between the tags. Time became a factor in that the entire group was required to rejoin the main workshop to present their concept map findings.

Because Dasein is “always already” situated in some ongoing nexus of activity, we are thrown into experience with an already-given orientation. Dasein is always “finding itself in a world whose principle contours are not of its own choosing and as oriented towards that world in a manner that it likewise has little control over” (Cerbone, 2008, p. 60). The students participating in the concept mapping exercise experienced several contours not of their own making—listening to presentations, engaging in a concept mapping activity, being required to rejoin the main workshop at a particular time. All of which had a concomitant effect on their mood. Whether that mood is considered positive (e.g., invigoration of an intellectual challenge) or negative (e.g., fatigue from the number of presentations), it was always something in which the students would “find themselves in” and never without. Their moods colored how things appeared to them—fatigue inducing tedium at the generation of tags after the ninth or tenth presentation review, discourse opening opportunity for creative self-expression of their understanding of GCCM, urgency to reach consensus and finish the mappings for presentation to the main workshop. Any one of these outcomes could have been altered by differences in thrownness and mood by the participants, individually and collectively.

> Moods reveal what Heidegger calls 'thrownness', which emphasizes the ways in which Da-sein finds itself already engaged and oriented in ways over which it had no say. Though the shape of my existence is an issue for me, and so presents itself as something that is responsive to my own choices and decisions, that this past, this upbringing, this orientation to the world (both in general and this

> specific way here and now) is who I find myself to be. What I ultimately choose to make of it is another matter, but any such choosing will always be on the basis of thrownness and never will be such as to circumvent or do away with that thrownness altogether. Da-sein is 'thrown possibility', which nicely summarizes the first two constitutive aspects of care. (Cerbone, 2008, p. 61)

4.3.3 Solicitude, Discourse and Interpretation

Part of the care-structure involves our seeking out social validation of our individual understanding through discourse and interpretation. In its discursive sense it is the making explicit in language the implicit understanding we have developed conceptually as embodied beings. In its interpretive sense it is the strengthening (and/or weakening) of different relationships of the referential totalities manifest as ready-to-hand and present-at-hand in our conceptual networks. The concept mapping activity, done in small groups of three or four individuals, exemplified this seeking out social validation of understanding via discourse and interpretation and the maps created represent not only the connections between concepts (i.e., interpretation) but also the discourse that enabled their development. This seeking out for validation our interpretations through discourse is what Heidegger labels solicitude. We solicit the interpretations of the referential totalities of others using language so that we may compare them to our own understanding of these totalities.

For the participants, interpretation of the tags through discourse made explicit what was already implicitly present in understanding. The individual tags were already “replete with significance by virtue of [their] place in the referential totality” (Cerbone, 2008, p. 62). The referential totality was shaped by the particular perspectives, arising out of the students’ thrownness and mood, adopted by the students for articulating the relationships between the tags. Heidegger makes it clear that:

> In interpreting, we do not, so to speak, thrown a ‘signification’ over some naked thing which is present-at-hand, we do not stick a value on it; but when something

> within-the-world is encountered as such the thing in question already has an involvement which is disclosed in our understanding of the world, and this involvement is one which gets laid out by interpretation.
>
> The ready-to-hand is always understood in terms of a totality of involvements. This totality need not be grasped explicitly by a thematic interpretation. Even if it has undergone such an interpretation, it recedes into understanding which does not stand out from the background…. In every case this interpretation is grounded in something we have in advance—in a fore-having…. When something is understood but is still veiled, it becomes unveiled by an act of appropriation, and this is always done under the guidance of a point of view, which fixes that with regard to which what is understood is to be interpreted. In every case interpretation is grounded in something we see in advance—in a fore-sight…the interpretation has already decided for a definite way of conceiving it, either with finality or with reservations; it is grounded in something we grasp in advance—in a fore-conception.
>
> An interpretation is never a presuppositionless apprehending of something presented to us. (Heidegger, 1927, pp. 191-192, H. 150)

Such is the case with the concept maps generated through the exercise. The seven most frequent tags which the groups were required to use, were not simply present-at-hand pieces of equipment that had a 'signification' thrown over them as they were interpreted through discourse. They certainly did not have a particular value stuck upon them that was consistently applied across the groups. Rather, the interpretation of the tags was grounded in a fore-having, the implicit understanding each participant to the discourse brought to the activity. The fore-sight possessed by the groups enabled the unveiling of understanding by providing an explicated point of view—a perspective—about the nature of GCCM. As the group members engaged in discourse, their fore-conception became manifest in how they represented the relationships between the required tags and any other tags they decided were important to add to the concept map as a way of explicating GCCM from their adopted perspective.

The three semantic network graphs created by the GCCM mini-workshop participants clearly illustrates that technologists (applications group), information analysts (analytic/analysis group), and social scientists (social networking group) coming to the same concept from different domain perspectives create very different graphs. The groups adopted different representational strategies in building their concept maps. They were required to use the seven most frequent tags, but they were also allowed to use any other tags that had been generated. And they needed to indicate how the tags were connected. The strength of the connections that reflected their understanding of the referential totalities were indicated in different ways—sometimes there was a direct and clearly labeled connection between two required tags, sometimes there was a third tag that was used to connect them, and sometimes there were simple clusters of tag nodes that had no defined edges. The latter was especially prominent in the analytic perspective map, which used many more tags from the original list than the other maps:

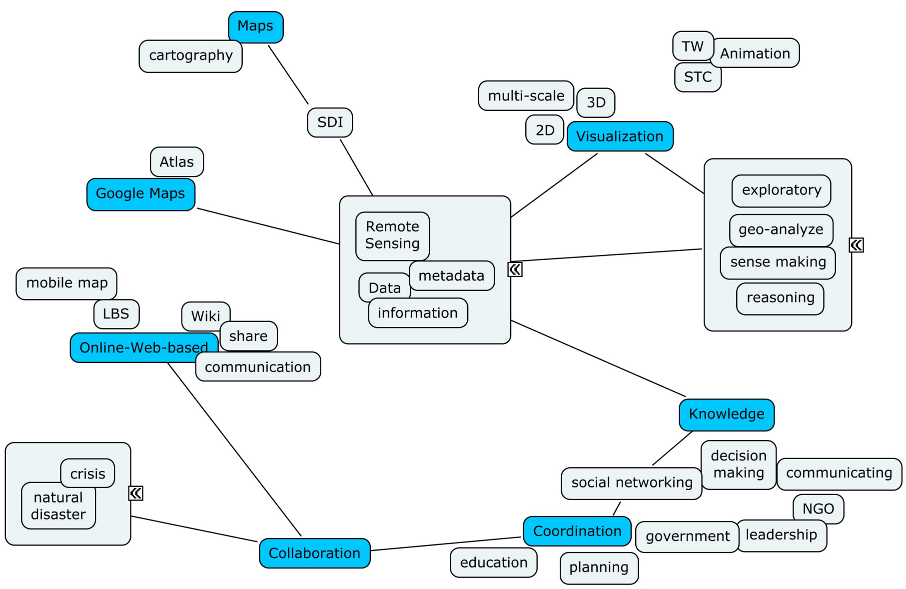


Figure 4–10. The Concept of GCCM from an Analysis/Analytics Perspective

As can be seen Figure 4–10 above, the key tag node of *Visualization* is loosely grouped with *2D, 3D* and *multiscale*, which indicate types of visualizations; is connected to another loose grouping of *exploratory, geo-analyze, sense-making* and *reasoning*, which indicate uses of visualizations; and, is connected to a third grouping of *remote sensing, metadata, data* and *information*, which indicate the sources of the visualizations. The use and clustering of many more tags indicates a concern with a larger set of referential totalities as part of the implicit understanding that each of the group members brought to the discourse, which would facilitate a greater solicitude by others by allowing them to engage their own implicit understanding of the referential totalities, whether they were participants in the workshop or not.

The applications perspective map was much more explicit with respect to their implicit understanding of the referential totalities. If one considers that application development for information technologies requires explicit specifications as part of the design process, this hardly seems surprising. There is a utility to the solicitude that creates a more clearly defined set of relationships within the referential totality.

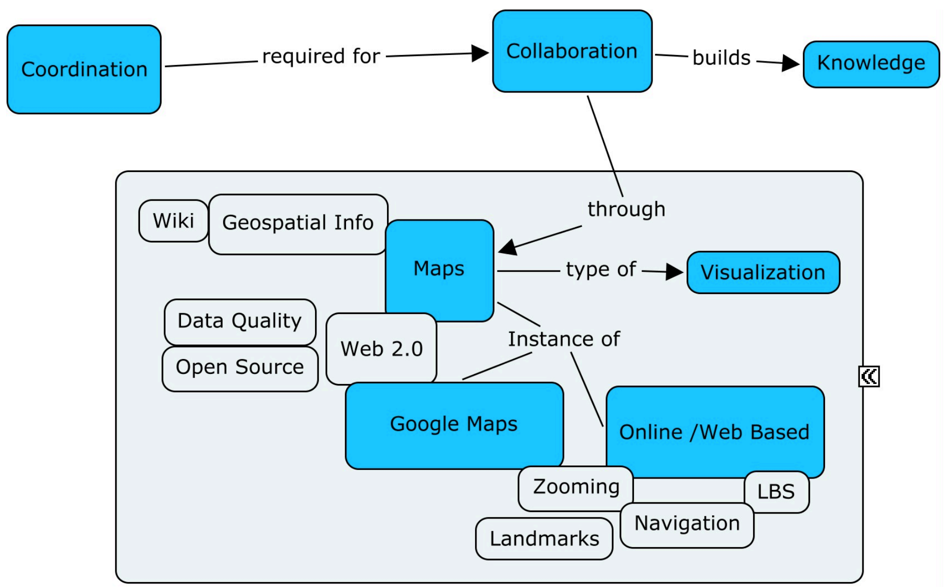


Figure 4–11. The Concept of GCCM from an Applications Perspective

There is still clustering of nodes in the applications perspective mapping, but the connections between the key tag nodes are not only more explicitly articulated (e.g., "required for," "builds," etc.), but also indicate directionality of the discourse. The narrative that a non-group member might create upon encountering this map is more easily accomplished. "Coordination is required for Collaboration, which builds Knowledge. Collaboration happens through Maps, which are a type of Visualization, two instances of which are Google Maps and

Online/Web-based maps." There are some clustered and overlapping tag nodes that are closely related to some of the key tag nodes. More interestingly, the key nodes of Map, Visualization, Google Maps, and Online/Web-based (and their associated clustered nodes) are grouped into (i.e., ontologized as) a larger ontological whole, which is likely to be the focus of application development. Indeed Google Maps is an application, while LBS (location-based services), Zooming, Navigation, and (locating) Landmarks are functions that facilitate the use of online and web-based maps in support of GCCM. The ontological grouping is also spatially located below the human processes of Coordination, Collaboration, and Knowledge, which it presumably, and here metaphorically, supports.

The patterns of tag relationships portrayed in the concept maps reflect particular perspectives—analytic, social networking, applications. Each perspective has a different set of referential totalities related to the key tag nodes that were included the concept map representations. The interpretation of the key tags sets of referential totalities was arrived at through discourse, where the implicit understanding of the individuals was made explicit and validated through discourse, resulting in the concept maps. This seeking out validation of our implicit understanding through discursive explication is an enactment of the solicitude dimension of the care-structure.

4.3.4 Falling and Temporality

It makes little sense from a Heideggerian perspective to try to isolate the care-structure from its temporal roots as if the moments of our experience were isolatable from the moments immediately prior or immanently manifesting. This notion applies not only to moments but also to larger scale phenomena such as personal histories. Past, present and future are always operative in *Dasein's* ongoing experience and existence. Falling is Heidegger's term for understanding the temporality aspect of the care-structure. Falling allows us to become absorbed into our experience, i.e., we are always falling into the next moment from the previous one such that we are continually engaged in a circumspection that allows us to integrate these moments into an ontological whole.

Such is the case of the GCCM workshop participants. The entire concept mapping exercise, from tag generation to presentation and discussion of the concept maps, is an example of falling. The prior experiences of the participants in terms of thrownness and mood affected the activity in which they were engaged, which was done in view of some future activity or goal—tag generation to create concept maps, create concept maps to present, present concept maps to larger audience for discussion, discussion to develop a shared understanding of GCCM, a more aligned understanding leading to innovations in technologies and organizational processes that were more holistic and accommodating of the referential totalities, and so on.

Being absorbed in whatever particular activity enables us to be circumspective of the referential totalities involved with our activities. Recall the example above of the carpenter's workshop and the differences in referential totalities into which the carpenter, the termite inspector and the novice were falling. They each paid attention to different equipment—the hammer, the nails, the wood of the building structure—as determined by their respective care-structures, which encompassed their past, present and future temporalities. The same can be said for the GCCM workshop participants whose absorption into the concept mapping activity revealed tags as patterns of referential totalities, whose nature was affected by the thrownness and mood of the participants as they were absorbed into the solicitude of discursive and interpretive activity of generating a concept map using a particular perspective and concomitant set of referential totalities, and which was produced with an eye towards the future and shaped by the goals of the workshop.

4.4 Tagging as Practice: Building Conceptual Networks

This section focuses on several issues that arise when we consider tagging as practice. The first concerns the relevance of identity to tagging and has implications for the ways in which folksonomies are researched, analyzed and used. Rather than labeling tagging systems as collaborative, I argue that they are more appropriately considered as collective—at least as they are currently constructed and analyzed. I use the tags gathered in the second case study to illustrate the important differences that arise between the collective and collaborative monikers that are attributable to a care-structure derived as cultural identity. In turn, these differences prompt a reexamination of the semiotic basis upon which current folksonomy research is undertaken.

It is the concernful circumspection of our experience that allows us to be in the world as a multiplicity of identities:

> Dasein's facticity is such that its Being-in-the-world has always dispersed itself or even split itself up into definite ways of Being-in. The multiplicity of these is indicated by the following examples: having to do with something, producing something, attending to something and looking after it, making use of something, giving something up and letting it go, undertaking, accomplishing, evincing, interrogating, considering, discussing, determining…. All these ways of Being-in have concern as their kind of Being. (Heidegger, 1927, p. 83; H. 56)

Creating tags is an act of concernful circumspection for at least one of our cultural identities, for at least one of the ways of our Being-in. In the case of the IST graduate students, each has multiple cultural identities that influence the conceptual networks they built and were reflected in the tag sets generated through their essays and conceptual connections survey. One particular concept—*information*—was, unsurprisingly, very prominent in their autobiographical and advisor essays. The ways in which they understood information varied and what became salient for them in terms of referential totalities was influenced by their identities—country of origin, particular research focus (i.e., on which side of the ITP triangle they perceived themselves to be), their status as first or second year graduate students, their prior undergraduate and graduate studies, and so on.

Recalling the idea of individuals forming a junction point, the notion of identity and multiplicity of perspectives is important in our understanding how cultural schemas manifest. Individuals can manage multiple identities in the same or multiple contexts (Talmy, 2001). People living in multicultural environments often encounter situations that require them to acquire different cultural schemas and to switch between these cultural schemas depending on their immediate sociocultural context (Chiao, et al., 2010). We can shift our perspective effortlessly between national, familial, peer and other identities to make sense of particular phenomena (i.e., frame it in relation to ourselves). Fauconnier and Turner (1998) claim that "frames structure our conceptual and social life and, in their most generic and schematic forms, create a basis for grammatical construction." Words are themselves viewed as constructions, and meaning is an intricate web of connected frames. Although cognitive framing is reflected and guided by language, it is not inherently linguistic—people manipulate many more frames than for which they have words and constructions. It is the individual's salient, contextualized identity in relation to the phenomena that allows for sense making of the phenomena. When making meaning of a particular phenomenon, individuals will rely upon the cognitive and cultural schemas that are integral parts of their salient, contextualized identities. Tags facilitate personal recall but also they facilitate the recall of one's identity inasmuch as they facilitate recall of the tagged entity.

In the case of IST graduate students, they were engaged in a process of creating a set of shared schemas and shared vocabulary about Information Science as part of their colloquium course. A shared vocabulary is negotiated over time and evokes cultural schemas within an individual's cognition. A shared vocabulary has meaning to the cultural group because the semantics emerge through the evocation of the ontological (i.e., schemas) via the ontic (i.e., tags).

The stabilization of tag patterns over time (Golder & Huberman, 2005) is analogous to the stabilization of cognitive schemas as cultural schemas. The collective tags of a folksonomy will certainly reflect the dominant cultural schemas of a broad population, but the assumption that collective tags represent a shared (cultural) conceptualization, interferes with discerning minority cultures, whose schemas may overlap with but are not necessarily entirely consistent with those of the dominant cultural group. In the absence of perspective and cultural identity information about users, folksonomies can be considered as reflections of cultural schemas only for dominant cultural groups and only in the broadest possible sense of "cultural group" (Saab, 2010). Aggregating the tags for the concept of information among IST graduate students results in the tag set[24] depicted in Figure 4–12:

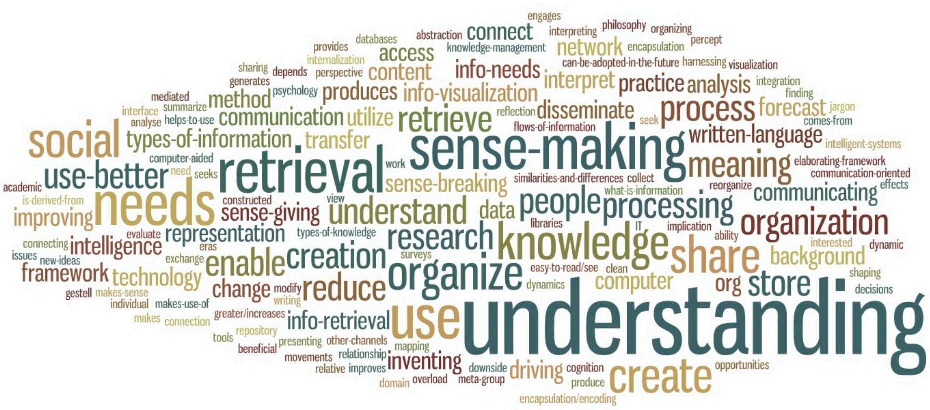


Figure 4–12. Tag set for the concept "Information" generated by IST graduate students

As can be seen clearly in the tagcloud above, *understanding*, *retrieval*, *sense-making*, *use* and *needs* are the most frequently associated tags and is indicated by their larger font size. But can we derive an emergent semantics from this tag set and claim that it is representative of how

[24] All tag sets created for the concept deconstruction exercise involving IST graduate students were created using *Wordle*, an online tag cloud generator available at http://www.wordle.net/.

graduate students in Information Science understand the concept of information? The ECM predicts greater accuracy of emergent semantics if cultural identities are included as part of the folksonomic calculus. This is clearly illustrated in the case of IST graduate students, where the greatest overlap with the collective tag set was with the Chinese students who outnumbered the USA students 12 to 9. Among the most salient tags—*understanding, retrieval, sense-making, needs* and *use*—for the "IST students" cultural group, the Chinese cultural subgroup had three of the five, whereas the USA cultural subgroup only had one of the five. The Indian cultural subgroup had the last one of the five. (See Figure 4–14 for the tag sets associated with country of origin.)

However, the difficulty we face with the aggregation of tags is the fact that individuals utilize multiple cultural identities. I may share some cultural schemas but not others with particular persons. I may create different tags for the same entity based on different cultural identities and different cultural schemas. Discerning cultural identity within and across individuals is not an easy task, as individuals may not even recognize the cultural identities they are using in creating the tags. However, if we are to discern the emergent semantics of folksonomies, we must include the perspective from which the person is creating the tags.

In addition to completing the conceptual connections survey, the IST graduate students also provided identity-related information about themselves—country of origin, year of study, IST research focus, prior educational background, and work experience. Using these as a basis for segregating the collective tag set in Figure 4–13, we can see differences in how they view the concept of information:

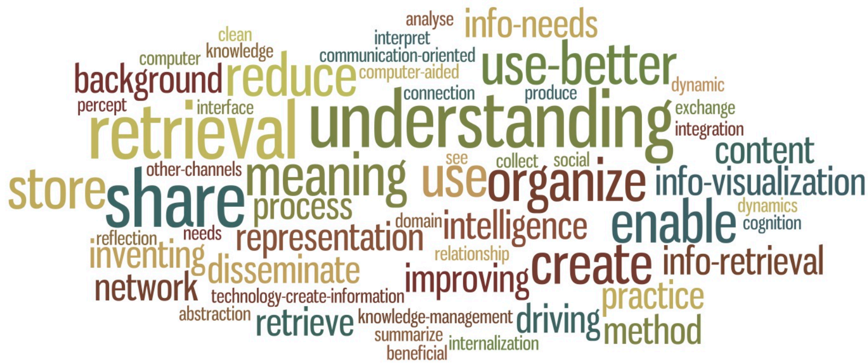
(a)

(b)

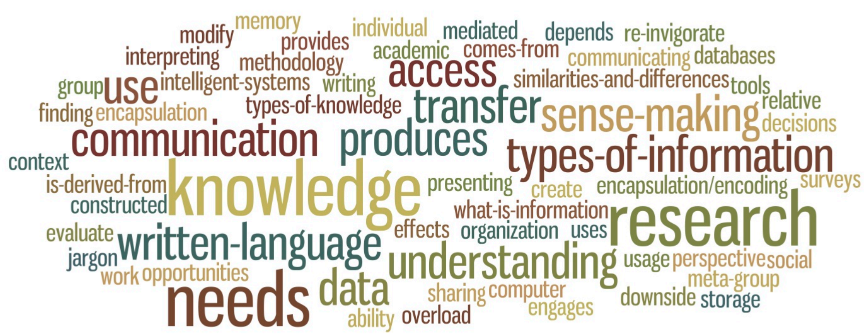
Figure 4–13. Tag set for "Information" created by (a) 1st year IST graduate students and (b) 2nd year IST graduate students

It is easy to see that there is a difference between how 1st and 2nd year IST graduate students understand the concept of information. To 1st year students sense-making, needs, knowledge, understanding, use better, enable and reduce are the most salient concepts linked to *information*. To 2nd year students *process, representation, types of information, understanding* and *organization* are the most salient. *Understanding* is the most prominent tag in the combined tag set in Figure 4–12, but it becomes less significant than other concepts in the disaggregated sets. If we disaggregate the tags for *information* based on country of origin we find different sets of associations:

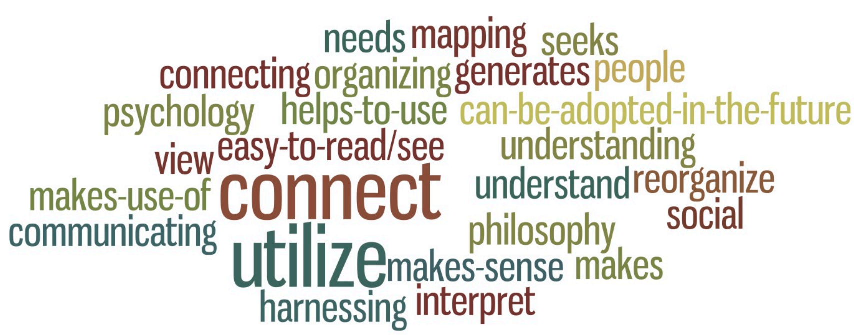
(a)



(b)



(c)



(d)

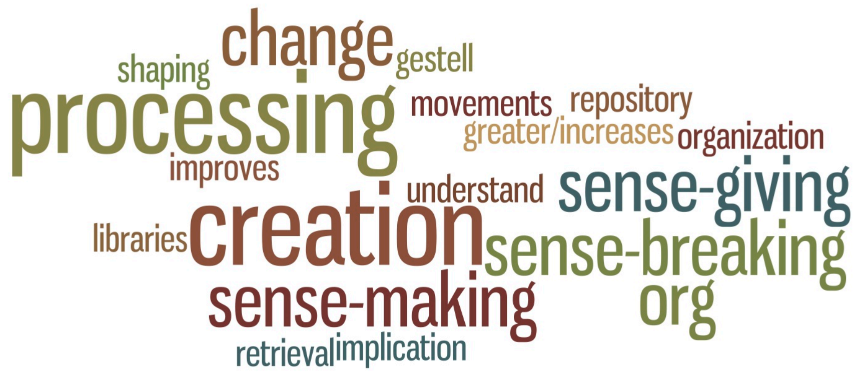


Figure 4–14. Tag sets for "Information" created by IST graduate students whose country of origin is (a) China, (b) USA, (c) Korea, and (d) India

Chinese students tend to associate *understanding, retrieval,* and *share* with the concept of information. USA students tend to associate *knowledge, research,* and *needs* with it. Koreans: *connect* and *utilize*. Indians: *creation* and *processing*. While these are only the most prominent or salient associations for students, they rest in a much larger field of tags with differing strengths of association among these cultural identities, (again, as indicated by their font size). But perhaps the starkest differences in identity can be seen in the research focus of the graduate students based on which side of the ITP triangle they situate themselves on—Information-People, Information-Technology, or Technology-People:

(a) Information-People

(b) Information-Technology

(c) Technology-People

Figure 4–15. Tag sets for the concept of "information" based on research focus: (a) Information-People, (b) Information-Technology, and (c) Technology-People

Those who focus on Information-People are generally interested in human information behavior and studying the ways in which people and organizations utilize informational and sociotechnical systems. They are the “social theorists” who deploy particular theories to frame their research. Their educational backgrounds are the most diverse and include engineering, physical and social sciences as well as interdisciplinary study. Their “researcher” identity links information closely with *access, framework, forecasting, analysis* and *understanding*. The Information-Technology focused students, most of whom have computer science or software engineering backgrounds, associate *technology, representation, types of information,* and *people* most closely with the concept of information. These associations focus primarily on the how information is structured in technological systems and how people are able to use it. The third group, Technology-People, tends to focus in the area of human-computer interaction where cognition is a primary concern and the design of improved technological interfaces (e.g., graphical user interfaces or gestures for touch screens) is a common undertaking. Their prior educational background was primarily interdisciplinary, with a couple engineering science majors. They associate information with *knowledge, inventing, improving, transfer, produces, sense-making, driving* and *needs* most closely.

There are many more identities and combinations of identities we can apply to the disaggregation of the tag set for information. However, our goal here has been to demonstrate that cultural identity has significant implications for tagging as practice. The above disaggregations in Figure 4–13, Figure 4–14 and Figure 4–15 clearly demonstrate the utility of including cultural identity in discerning the semantics of tag sets. This demonstration highlights an issue with current research with respect to folksonomies and the semantics of tag sets: the fact that folksonomies as currently constructed are collective entities, and as such deal only with the extrapersonal structures of the ECM, as would be the case in trying to discern the semantics from the collective set of tags in Figure 4–12. If we want to truly use folksonomies for semantic interoperability, we need to include the intrapersonal schemas outlined by the ECM.

In this chapter I applied a Heideggerian frame to the tag sets generated in relation to this dissertation. The ECM was used to analyze the tag sets to reveal the collective nature of folksonomies and argue that the ECM can help us to structure tag sets to include the intrapersonal dimensions, thereby creating tag sets that are more collaborative and allow for more easily discerned semantics. In the next chapter, I summarize the contributions made by this dissertation in the field of Information Sciences and Technology.

Chapter 5

Contributions

This research establishes an alternative philosophical foundation for understanding "information" in our sociotechnical systems. It grounds ontology in a phenomenological analysis rather than in the classical conceptualization of ontology as category disambiguation. It addresses the difficulties of constructing and using formal ontologies for semantic interoperability among our sociotechnical systems. It draws upon cultural schema theory to understanding the semantics of folksonomies, which if properly structured may serve as a foundation for ontological integration as schematic ontologies. This dissertation offers several novel and innovative contributions to the field of Information Sciences and Technology, including a new model for understanding the emergent semantics of folksonomies, a revision of the traditional semiotic model, and illustration and application of a phenomenology of information.

5.1 Emergent Culture Model

Using a Heideggerian ontology combined with the notion of cultural schemas, I developed a theoretical model called Emergent Culture Model, which integrates the intrapersonal schemas of the care-structure and the extrapersonal structures of folksonomies in a way that illustrates how semantics emerge as part of cultural experience. It allows for making a distinction between the cultural and social dimensions of tags—between their ontological/conceptual and ontic/lexical qualities—and approach semantics from a collaborative rather than collective perspective. This shift in perspective prompted a reexamination of the semiotic approach to discerning semantics in folksonomies and the modification of the triadic relationships of the semiotic model.

5.2 Ontologization of Cultural Landscapes via Semantic Networks

Through the Heideggerian analysis of tags and the introduction of culture and cultural identity to the study of semantics in folksonomies, this research has been able to reconceptualize the relationship between folksonomies and (human) ontologies as the relationship between semantic networks and cultural landscapes. By grounding the findings phenomenologically, we are able to think of ontologies as emergent cultural landscapes for which semantic networks, in the form of tag sets and folksonomies, form entry points. How semantic networks and cultural landscapes are integrated into a seamless whole is explained via ontologization, a phenomenological characterization of the interactions that occur between data, information and knowledge.

5.3 Tags in Heideggerian Perspective

This dissertation demonstrates how tags and tagging function as equipment, as patterns and as practice. In the context of an information system, tags can be seen as signs—a special kind of equipment for indicating. Tags arrayed in a folksonomy comprise patterns that arise from the care-structure, where *thrownness*, *mood*, *solicitude*, and *falling* contribute to the semantics of tags at both individual and cultural levels of identity. Tagging as practice reveals the critical nature of the intrapersonal dimensions of the ECM. Tagging as practice illustrates the complexity of cultural identity based on a shared set of cultural schemas.

5.4 Semantic Interoperability

The Heideggerian analysis offered in this dissertation places the study of ontologies and folksonomies upon a phenomenological foundation that will facilitate the development of semantic interoperability among our sociotechnical systems in ways similar to our human cultural and communication phenomena. Information, rather than considered an objectifiable entity, is considered to be a phenomenology, the core of which consists in the transformation of patterns through an entwined process of individual sense-making and social meaning-making, through which we can discern and understand the underlying data of the pattern as well as the resulting clues. These (pattern, data, clues) in relation to schemas, knowledge and salience are merged into one *being* (hence *onto*logization): *information* as an ontological whole. The re-characterization of information phenomenologically, rather than taken in the traditional schema of "data + meaning," has significant implications for how create semantic interoperability among our sociotechnical systems.

5.5 Idealistic and speculative application of this research

The importance of semantic interoperability among our sociotechnical systems in the near future should not be underestimated. In the next 25 years we expect to see the devastating impacts of climate change upon our planet. The transnational need for communication and the intercultural challenges it poses requires a comprehensive, interdisciplinary approach to create information and communication systems that allow for better coordination of decision-making about resources—food, water, medical—and their associated supply chains. Misunderstanding the scale of change taking place has consequences. If dire predictions (Guggenheim, 2006) have any validity, then the human population of 7 billion will be put under severe stress. Potential massive population shifts are likely to occur because of flooding and the rise of ocean levels planet-wide, affecting populations in Florida, San Francisco Bay, The Netherlands, Beijing, Shanghai (40M), Calcutta and Bangladesh (60M). The possibility of 100 Million displaced persons in just two of those locations is an event the size of which humanity has never confronted.

The geographic dispersion of the climate crisis makes transnational communication and intercultural cooperation necessary. As governments face the need for international collaborative responses to the massive disasters and displacements of large populations, the need for intercultural understanding becomes critically important. Governments, NGOs, non-profit and for-profit organizations of all sizes have roles to play in coordinating the massive and sustained distribution of goods and services to displaced populations. Coordinating their efforts will require the ability to interface with different organizational models (e.g., hierarchical vs. networked) as resources and knowledge move through the human-physical-technological-informational systems. Integrating this variety of information entails more than simply aligning vocabularies and protocols.

To make effective decisions in a multicultural environment, the information to be must be translated with appropriate cultural schemas that have meaning for the individuals involved. The challenge of the climate crisis is as much cultural as it is technological. This inherent flexibility and adaptability of schematic ontologies, developed from folksonomies disaggregated according to cultural identity, would facilitate the use of information systems in the face of the climate crisis. The ability to understand and integrate a multiplicity of schematic ontologies will become an essential component of our human response to the global climate crisis. In a planetary context, information about the effects of climate change will come from a diverse array of sources, filtered and structured according to a diverse array of cultural schemas. Schematic ontologies will help to facilitate this information integration through better semantic interoperability.

The goal of this research has been to provide the theoretical justification for integrating our conceptualizations of culture and ontologies through the use of tags that reflect cultural schemas. With ontologies conceptualized as cultural landscapes and ontologized as semantic networks, the development of schematic ontologies and the sharing of culturally schematic knowledge between and among diverse groups becomes more feasible. Schematic ontologies would allow for the flexibility and adaptability needed to achieve that interoperability, possibly even if the paradigms of the cultures are incompatible or incommensurable. In the example of the Kangaroo Ancestor above, the seemingly incommensurable conceptualizations (a geologic formation and an ancestor) may simply be entry points to a complex set of associated conceptualizations regarding the hydrologic cycle of the surrounding geography, which in turn would dictate what types of interventions may be made in order to sustain the hydrologic cycle of the local region in the face of climate change.

Like the cultural schemas we develop through our being-in-the-world, schematic ontologies would be constantly evolving, allowing for a Gadamerian fusion of horizons to achieve that information integration across domains and that promise of interoperability. In other words, schematic ontology representations devised and displayed using information systems would provide the foundation for the beginnings of hermeneutic discourse involving varying cultural perspectives around a phenomenon of interest.

APPENDICES

Appendix A: GCCM China Survey

<table>
<tr><th colspan="3">First US-China Workshop on Geo-Collaborative Crisis Management Survey</th></tr>
<tr><td>1a. What do you see as the most critical problem(s) to address in optimizing geo-collaborative crisis management (GCCM)?</td><td colspan="2">1b. What is the least critical problem(s) to address?</td></tr>
<tr><td colspan="3">1c. Please provide a quick concept map of five key concepts (keyword tags) that represent <u>your perspectives</u> on the most significant challenges for GCCM. Then, for each key concept link up to three more tags that help explain it.</td></tr>
<tr><td colspan="3">1d. Describe in 3-5 sentences what you think GCCM is and what it is about.</td></tr>
<tr><td>2a. What primary information technology or information system do you use in your practice or research in GCCM?

Type (e.g., GIS):

Name (e.g., ArcGIS):</td><td>2b. What are the technology’s particular strengths?</td><td>2c. What are the technology’s particular weaknesses?</td></tr>
</table>

3a. Please rank the following 11 perspectives and approaches in terms of greatest importance for optimizing technological support for GCCM. Please add and rank your own if not included in the list below. (1 = highest importance, 12 = lowest importance)

___ geography ___ information science ___ cognitive science ___ management science ___ inter-agency coordination ___ synchronization of response ___ models of group decision making ___ risk assessment ___ geospatial data infrastructure ___ geospatial data services ___ collaborative technologies ___ analysis of geospatial information	Include and rank your own here:

Demographics

4a. With what institution are you affiliated?	**4b.** In what field do you practice/research?
4c. In what field was your degree?	**4d.** What is your area of practice/research (in relation to GCCM)?
4e. In what year did you receive your degree?	**5a.** What is your country of origin?
5b. What is your country of residence?	**5c.** Cultural Identity: c Chinese c American c Other (specify):

5d. If you are bi-cultural, how would you rate your ability to facilitate between Chinese and American cultures? (Circle One. 1=not good at all, 5=expert with lots of experience)	1	2	3	4	5

6a. Would you be willing to participate in an interview to discuss the workshop on GCCM and your perspectives offered in this survey? (Confidentiality & Anonymity will be assured.)	Yes	No

6b. If Yes, please provide your contact information so that we may contact you for an interview.

Name:

Email:

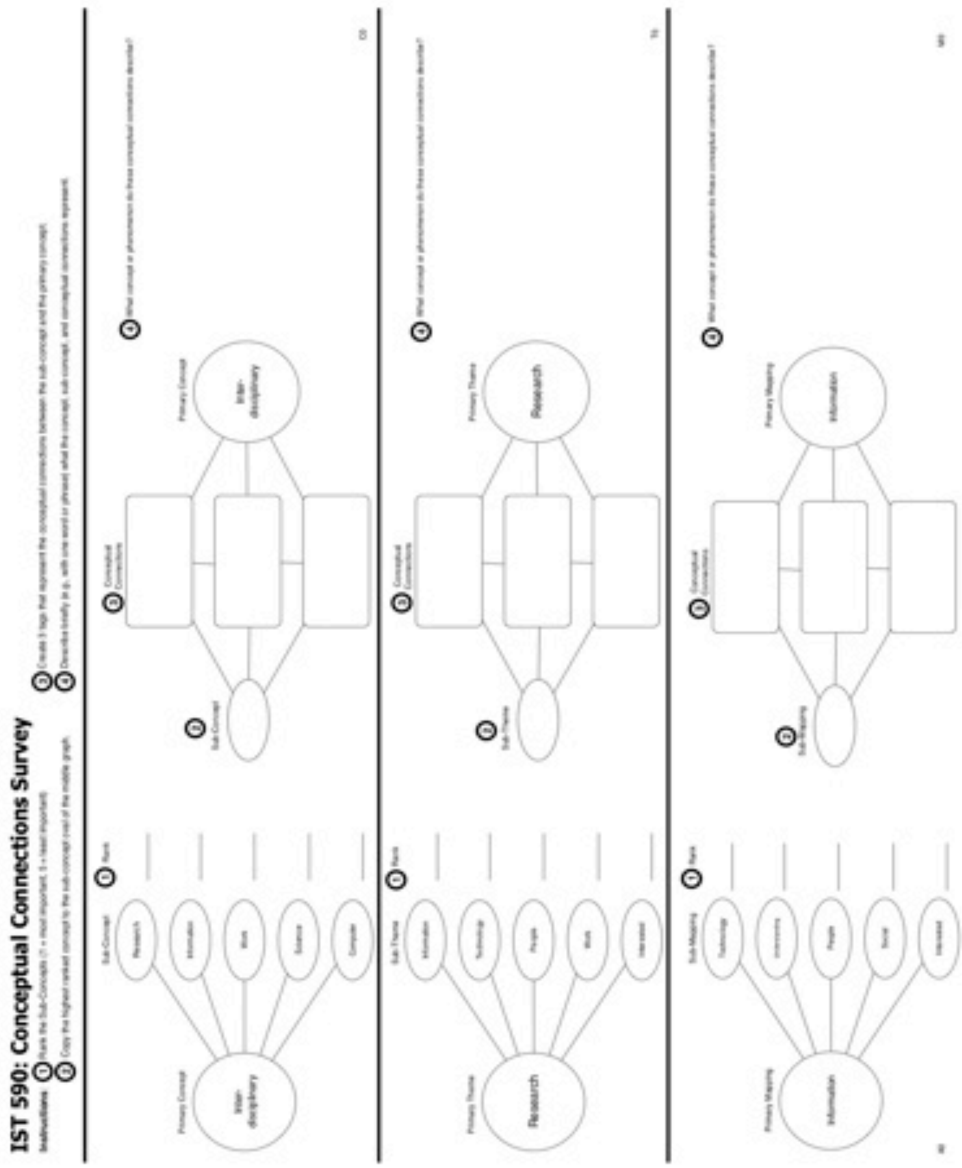
AIM:

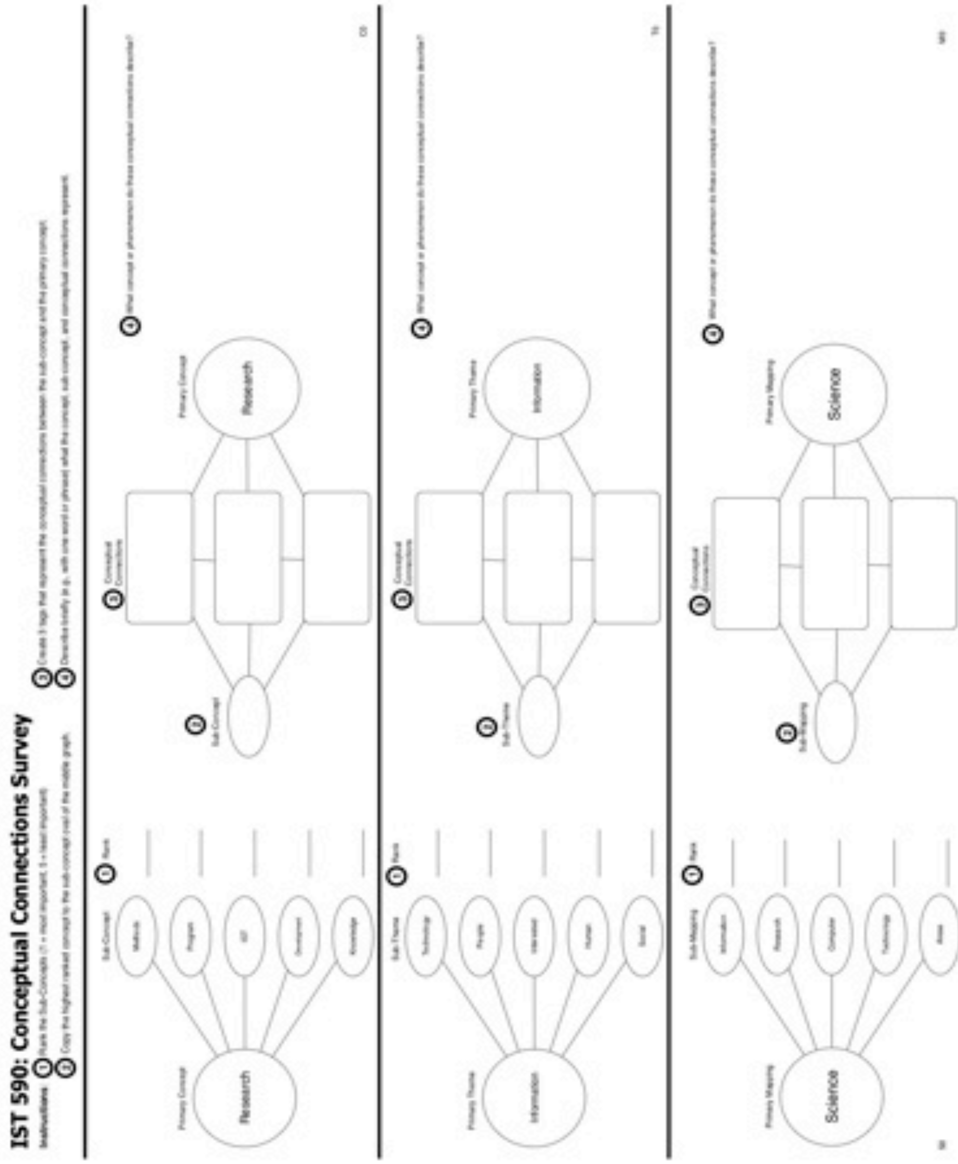
Phone:

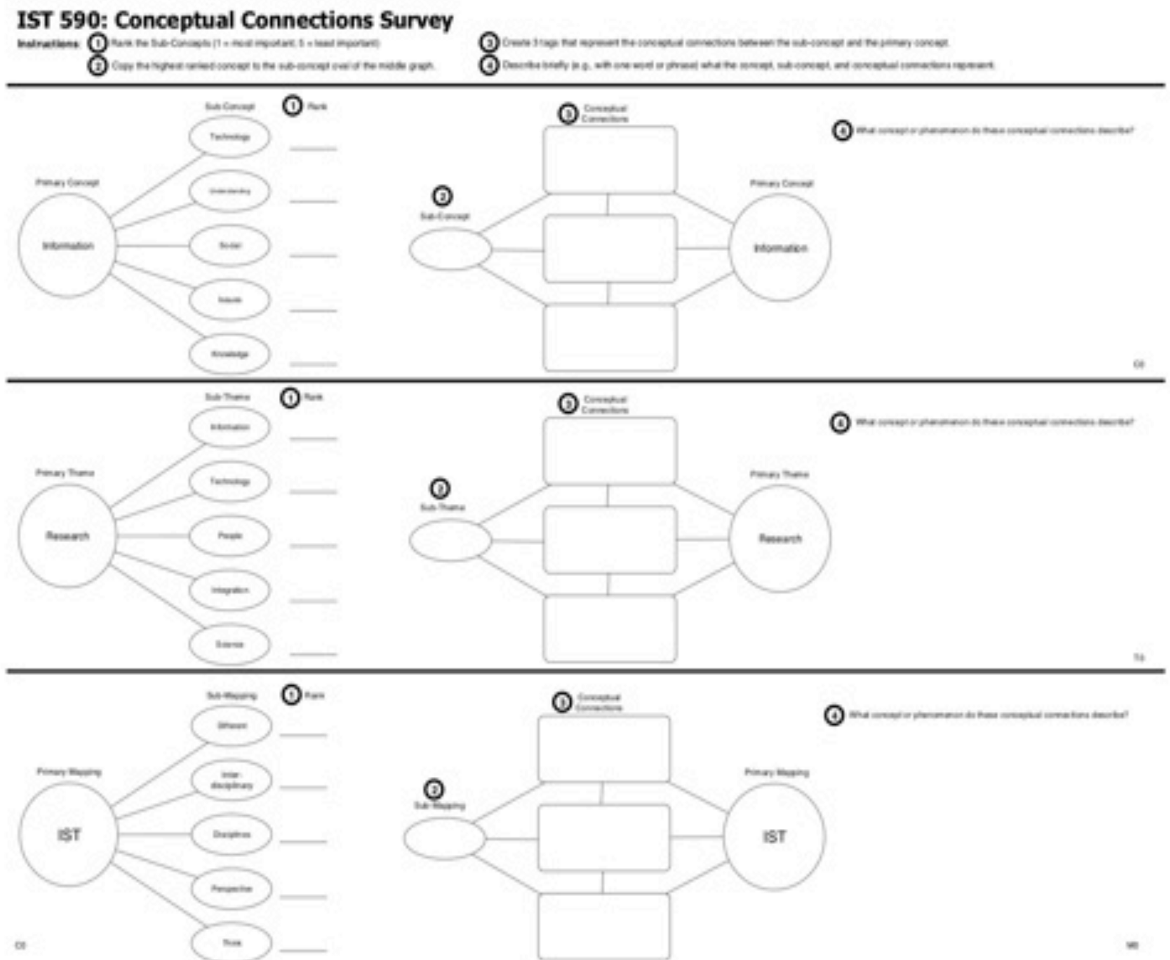
Address:

Thank You!

Appendix B: Conceptual Connections Survey




IST 590: Conceptual Connections Survey
Research
Information
Science
Research
Information
Science


IST 590: Conceptual Connections Survey
Instructions
Rank the Sub-Concepts (1 = most important, 5 = least important)
Copy the highest ranked concept to the sub-concept oval of the middle graph.
Create 3 tags that represent the conceptual connections between the sub-concept and the primary concept.
Describe briefly (e.g., with one word or phrase) what the concept, sub-concept, and conceptual connections represent.
Primary Concept
Information
Sub-Concept
Rank
Technology
Social
Knowledge
Conceptual Connections
What concept or phenomenon do these conceptual connections describe?
Primary Theme
Research
Sub-Theme
Information
Technology
People
Integration
Science
Primary Mapping
IST
Sub-Mapping
Inter-disciplinary
Disciplines
Perspective
Time

Appendix C: Tags associated with the concept "GCCM"

Table 5-1. Frequencies of tags associated with the concept "GCCM" among graduate student participants in the GCCM mini-workshop

Tag	Frequency	Tag	Frequency	Tag	Frequency
coordination	5	communication	1	navigation	1
maps	5	communication core	1	open source	1
online-web-based	5	context awareness	1	operability	1
Google Maps	4	coordination bodies	1	periodic events	1
visualization	4	cultural differences	1	planning	1
collaboration	4	data	1	private/public	1
knowledge	4	data quality	1	public works	1
decision making	3	distributed cognition	1	reasoning	1
natural disasters	3	document analysis	1	recmote sensin g	1
NGO	3	education	1	resources	1
sense making	3	emergency management	1	response	1
Web 2.0	3	environment	1	response time	1
2D/3D	2	events	1	risk management	1
community	2	experiment	1	SDI	1
emergency planning	2	extreme events	1	social network analysis	1
exploration	2	formal/informal	1	space-time cube	1
government failure	2	gap	1	stakeholders	1
information sharing	2	geo-identification	1	survey	1
ontology	2	geospatial data	1	system	1
social network	2	geospatial information	1	tags	1
usability	2	governance	1	temporal data	1
activity awareness	1	GPS	1	time theory	1
adaptation	1	humanitarian	1	time wave	1
agency	1	information	1	triple-space	1
aggregation	1	landmarks	1	trust	1
amateur	1	LBS	1	unmanned vehicle	1

animation	1	leadership	1	US/CHINA	1
atlas	1	mass care	1	user generated content	1
Bertin	1	mental map	1	user tasks	1
building standards	1	metadata	1	user-centered design	1
cartography	1	mobile device	1	usinet	1
China	1	mobile map	1	visual analytics	1
cluster	1	multiscale	1	wiki	1
clustering	1				

Appendix D: Tags associated with the concept "information"

Table 5-2. Frequencies of tags associated with the concept "information" among IST graduate students

Tag	Frequency	Tag	Frequency	Tag	Frequency
retrieval	10	info-retrieval	2	harnessing	1
understanding	10	info-visualization	2	helps-to-use	1
needs	7	intelligence	2	implication	1
sense-making	7	intelligent-systems	2	improves	1
communicating	6	inventing	2	individual	1
social	6	libraries	2	integration	1
knowledge	5	makes	2	interested	1
organize	5	memory	2	interface	1
types-of-information	5	method	2	internalization	1
use	5	network	2	interpreting	1
create	4	new-ideas	2	is-derived-from	1
creation	4	overload	2	issues	1
people	4	practice	2	IT	1
process	4	reorganize	2	jargon	1
processing	4	repository	2	knowledge-management	1
share	4	representation	2	makes-sense	1
understand	4	seeks	2	makes-use-of	1
access	3	similarities-and-differences	2	mapping	1
analyse	3	technology	2	mediated	1
computer	3	transfer	2	meta-group	1
connect	3	usage	2	methodology	1
enable	3	view	2	modify	1
interpret	3	abstraction	1	movements	1
meaning	3	beneficial	1	need	1
org.	3	can-be-adopted-in-the-future	1	opportunities	1
organization	3	clean	1	organizing	1
produces	3	cognition	1	other-channels	1
reduce	3	collect	1	percept	1
research	3	comes-from	1	perspective	1
sense-breaking	3	communication-oriented	1	philosophy	1
sense-giving	3	computer-aided	1	presenting	1
store	3	connecting	1	produce	1
use-better	3	connection	1	provides	1
utilize	3	constructed	1	psychology	1
written-language	3	decisions	1	re-invigorate	1
ability	2	depends	1	reflection	1
academic	2	domain	1	relationship	1
background	2	downside	1	relative	1
change	2	dynamic	1	see	1
content	2	dynamics	1	seek	1

context	2	easy-to-read/see	1	shaping	1
data	2	effects	1	sharing	1
databases	2	encapsulation	1	storage	1
disseminate	2	engages	1	summarize	1
driving	2	eras	1	surveys	1
elaborating-framework	2	evaluate	1	technology-create-information	1
encapsulation/encoding	2	exchange	1	tools	1
flows-of-information	2	finding	1	uses	1
forecast	2	generates	1	visualization	1
framework	2	gestell	1	what-is-information?	1
human	2	greater/increases	1	work	1
improving	2	group	1	writing	1
Info-needs	2				

Appendix E: GCCM Concept Maps Integrated

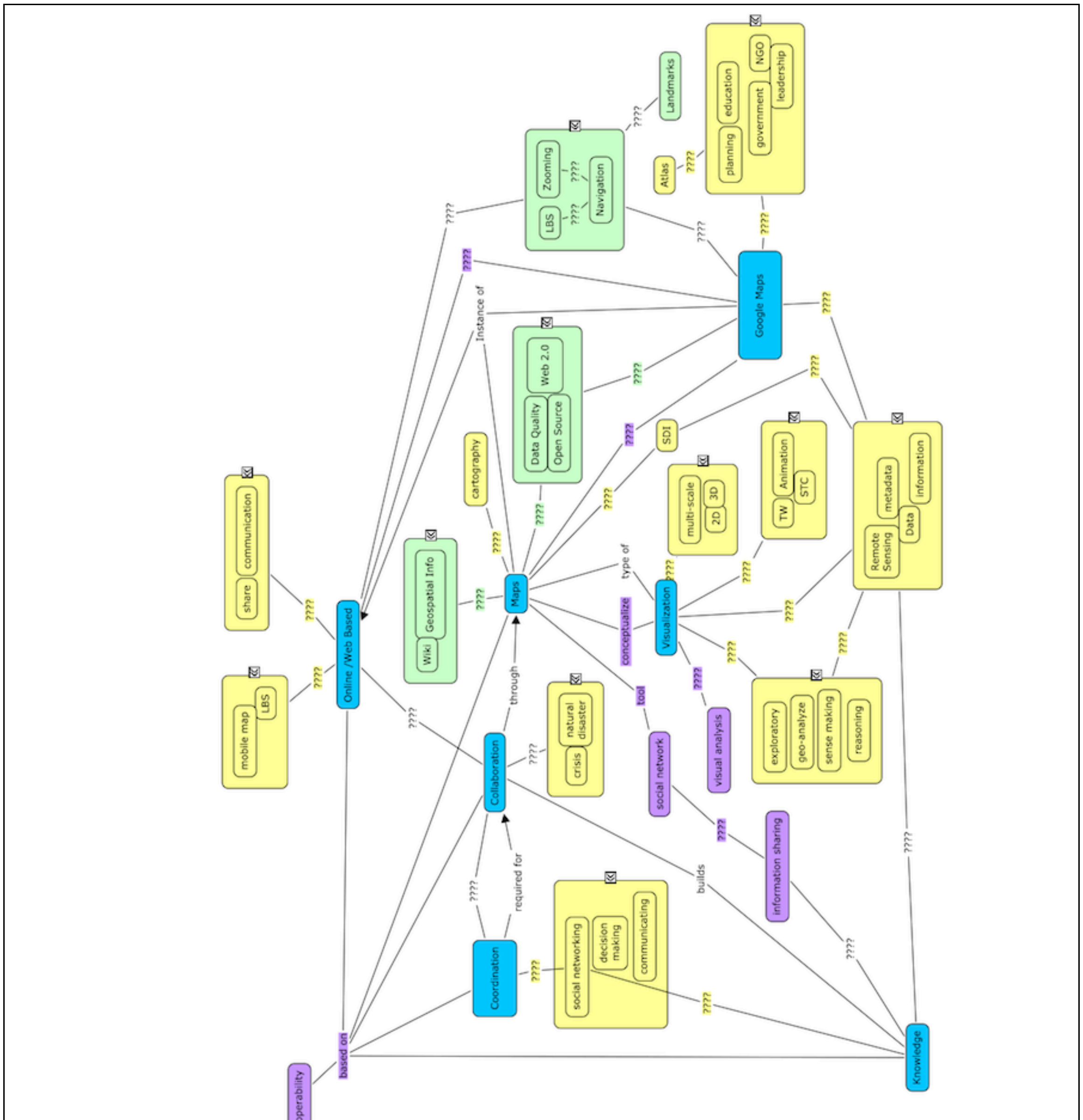


Figure 5–1. Concept map/semantic network graph of GCCM that integrates analytic (yellow), application (green) and social networking (purple) perspectives

Appendix F: Papers published from this research

Saab, D.J. and Riss, U.V. (2011) Information as Ontologization, *Journal of the American Society of Information Sciences & Technology*, (forthcoming).

Saab, D.J. (2011) An Emergent Culture Model for Discerning Tag Semantics in Folksonomies, In *Proceedings of the iConference 2011, February 8-11, 2011, Seattle, WA*.

Saab, D.J. (2010) The Ontology of Tags, In *Proceedings of the iConference 2010, University of Illinois, Urbana-Champaign, February 3-6, 2010*.

Saab, D.J. (2009) A conceptual investigation of the ontological commensurability of spatial data infrastructures among different cultures, *Earth Science Informatics, Special Issue on Spatial Data Infrastructures for the Sustainability of the Brazilian Amazon: Integrating People, Information, and Models*, 2(4):283-297, Berlin: Springer.

Saab, D.J. (2009) Culture as Mediator for what is Ready-to-hand: A Phenomenological Exploration of Semantic Networks, Paper presented at *North American Conference on Computing and Philosophy, NA-CAP '09*, Bloomington, IN, USA, June 14-17, 2009.

Saab, D.J. and Fonseca, F. (2008) Ontological Complexity and Human Culture, Paper presented at *Philosophy's Relevance in Information Science*, Paderborn, Germany, October 3-4, 2008.

Saab, D.J. (2008) On the Importance of Cultural Schemas for Information System Ontologies, Position paper: *First US-China Workshop on GeoCollaborative Crisis Management, May, 2008*.

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