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The Trichotomy of Knowledge: A Basis for Knowledge Management

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ABSTRACT
An information system is a representation of a real or virtual system. We assume that the design of an information system starts with a set of ontological constructs that are then mapped to a set of grammatical constructs. Given this assumption then an ontology of knowledge is a necessary starting point for conceptual modeling in the design of knowledge-based systems. This paper proposes a three-by-three categorization of knowledge based on Peirce’s principle of trichotomy and Habermas’ theory of communicative action. The first dimension is Action, Communication, and Abstraction, and the second dimension is Objective, Social, and Subjective. The resulting nine categories form the basis of a theory of knowledge, called the Trichotomy of Knowledge, which can be used in the design of knowledge management systems.

Keywords
Knowledge, knowledge management, philosophy, information systems design, ontology

INTRODUCTION
Some corporations practice follow-the-sun design where teams of knowledge-workers are distributed across three or four time zones around the world. With proper workflow sequencing and infrastructure support analysis and design can be conducted 24 hours per day, which speeds the development and delivery of new products. The problem is that workers go off-line and then come back on-line facing a different task context. Being able to resynchronize context-dependent knowledge is a central problem of dispersed collaboration. We argue that the design of knowledge management systems should start with an ontology of knowledge. This paper uses the principle of Firstness, Secondness, and Thirdness as developed by Charles S. Peirce (American Philosopher, 1839 – 1914) to generate a triad of categories for knowledge management; which we refer to as the Trichotomy of Knowledge.

The rest of this paper is structured as follows. The next section describes a model of information systems design. Section three explains Peirce’s concept of Firstness, Secondness, and Thirdness and the Principle of Trichotomy. The third section continues with a presentation of a second dimension of knowledge based on Habermas (1984), also as a trichotomy. The result is a three-by-three set of categories, which are referred to as the Trichotomy of Knowledge. Section four compares and contrasts this framework to the four knowledge types of Hirschheim and Klein (2003), which they proposes as a basis for an information systems body of knowledge. The final section is some conclusions and suggestions for future research.

INFORMATION SYSTEMS DESIGN
A fundamental information systems research question is: “How can we model the world to better facilitate our developing, implementing, using, and maintaining more valuable information systems?” (Wand and Weber, 2002, p 363). A partial answer to this question involves research on conceptual modeling grammars. This section proposes that the Trichotomy of Knowledge should be explicitly represented in such a grammar and that this should lead to better information systems in a knowledge economy.

A view of information systems design can be described using Weber’s (2003a, 2003b) concept of representation and interpretation mappings between an ontological relational systems and a grammatical relational systems. The design problem requires an alignment between the constructs and relations of the system ontology with the grammar that is used for the information system. The choice of an ontological basis for information systems design determines the content and structure of the grammar that is used for conceptual modeling of a specific problem domain. It is necessary to develop a representation mapping from the ontological constructs to a set of grammatical constructs. At the same time, the inverse of the representation mapping must exist in order for any resulting information system to be useful in practice; this is called the interpretation mapping. This model is shown in Figure 1.
This paper proposes an ontology that can serve as a basis for knowledge-based information systems design. The next section presents the philosophical background and the proposed three-by-three framework.

TRICOTOMY OF KNOWLEDGE

This section uses Peirce’s Principle of Trichotomy to generate two different triads of categories for knowledge management. It builds on ideas from Peirce and Habermas in describing the structural arrangement and then adopts some common knowledge types for specific entries in the framework.

Trichotomy

Peirce carefully studied the triads of Kant and Hegel’s three stages of thought, but his own analysis led him to conclude that these reflected more basic categories, which he called First, Second, and Third. “First is the conception of being or existing independent of anything else. Second is the conception of being relative to, the conception of reaction with, something else. Third is the conception of mediation, whereby a first and a second are brought into relation.” (Peirce, 1891, p 175) There are two key features of his categories: First, Second, and Third are of equal status; and, it is not necessary to go beyond the three, because Fourth, Fifth, and higher-order relations can always be defined in terms of the three.

Peirce’s principle can be used to generate differing perspectives for viewing entities (Sowa, 2000). Firstness is the properties inherent in something. If x is a variable of type entity, then Firstness can be defined by the monadic predicate P(x), which describes the entity x by its property P. Secondness is a relation or reaction between x and another entity y, which is the dyadic relation R(x, y). Thirdness involves mediation between two entities by a third, which can be represented by the irreducible triadic relation M(x, y, z). Peirce emphasized that the Third could not be represented using two Seconds. Sowa (2000) uses the Principle of Trichotomy to generate his three primitive categories for entities of Independent, Relative, and Mediating.

Most readers who know of the work of Peirce are probably familiar with his three characteristics concerned with the functioning of a Sign—the Sign itself, its Object, and its Interpretant. Consider the diagram in Figure 2 that is based on Peirce (1906), Ogden and Richards (1923), and Sowa (2000) where the term concept replaces Peirce’s Interpretant.

The properties of the object are Firstness and likewise for the sign and concept. The relationship between the sign and object is Secondness. The concept mediates the relationship between the sign and object; and hence, the third order relationship is Thirdness. Note that object, sign and concept are the entities, and the properties and relations are the Firstness, Secondness, and Thirdness.
Two Trichotomies

This paper proposes a two dimensional set of trichotomies of knowledge with the first dimension describing knowledge in terms of independent, relative, and mediating relations based on Sowa (2000). The resulting categories are identified as Action, Communication, and Abstraction. A second dimension is added to the first based on the writings of Habermas (1984). These are his three worlds of the objective, social, and subjective.

The first dimension has Firstness as Action, Secondness as Communication, and Thirdness as Abstraction. Action knowledge allows an actor to change the state of the world, which is a property; this is Firstness. Communication knowledge enables the relationship between two actors and it also is a relationship between the signs that an actor uses and the world of action as an object; this is Secondness. Abstract knowledge involves conceptual frameworks that inform and mediate the relationship of an actor to the world of action; this is Thirdness.

The second dimension has Firstness as Objective, Secondness as Social, and Thirdness as Subjective by way of association with Habermas’ three-world theory in his communicative model of action. These three worlds are to be distinguished from his concept of “lifeworld” and taken together the worlds form a reference system that is mutually presupposed in communication processes between actors. (Habemas, 1984, p 84). We would argue that his three worlds form a Peircian triad of categories.

Habermas (1984) defines the objective world as “the totality of states of affairs that either obtain or could arise or could be brought about by purposeful intervention” (p 87). States of affairs is a property of the world in which actors find themselves; this is Firstness. He then states that the “social world consists of a normative context that lays down which interactions belong to the totality of legitimate interpersonal relations” (p 88). This relation between actor and the shared values and norms of the social world is Secondness. Finally, he defines the subjective world as “the totality of subjective experiences to which the actor has, in relation to others, a privileged access” (p 91). The expression of the actor’s intentions and feelings mediates the strength of the relation between the actor and the objective world; this is Thirdness.

The Trichotomies of Knowledge

The resulting three-by-three categorization forms the basis of a theory of knowledge that can be used in the design of knowledge management systems. The complete framework is shown in Table 1 with the names for the nine categories of knowledge given as the first entry in the interior cells.

<table>
<thead>
<tr>
<th>First (objective)</th>
<th>Second (relative)</th>
<th>Third (mediating)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First (independent)</strong></td>
<td><strong>Second (relative)</strong></td>
<td><strong>Third (mediating)</strong></td>
</tr>
<tr>
<td><strong>Third (subjective)</strong></td>
<td><strong>Applicative</strong></td>
<td><strong>Pragmatic</strong></td>
</tr>
<tr>
<td>Know-when Policies</td>
<td>Purpose (Know-why)</td>
<td>Intentionality</td>
</tr>
<tr>
<td><strong>Second (social)</strong></td>
<td><strong>Procedural</strong></td>
<td><strong>Semantic</strong></td>
</tr>
<tr>
<td>Know-how Work Instructions</td>
<td>Meaning</td>
<td>Potentiality</td>
</tr>
<tr>
<td><strong>First (objective)</strong></td>
<td><strong>Declarative</strong></td>
<td><strong>Syntactic</strong></td>
</tr>
<tr>
<td>Know-what Specifications</td>
<td>Form (Grammar)</td>
<td>Actuality</td>
</tr>
<tr>
<td>Action</td>
<td>Cost-benefit Analyses</td>
<td>Project Roles</td>
</tr>
<tr>
<td></td>
<td>Communication</td>
<td>Abstraction</td>
</tr>
</tbody>
</table>

Table 1. The Trichotomy of Knowledge

Along the action dimension there is declarative, procedural, and applicative knowledge. Along the communication dimension there is syntactic, semantic, and pragmatic knowledge. Along the abstraction dimension there is knowledge of structure, behavior, and function, which are related to Peirce’s (1906) trichotomy of actuality, possibility, and intention. Table 1 also shows some examples of the nine categories of knowledge using the context of project management. It includes knowledge used in a specific project and knowledge about projects in general. The second entry in the cell is another description of the type and the third entry is a specific example of a knowledge artifact for project management.
These types of knowledge have all been previously identified, but this paper provides a unified, philosophically-based categorization that can serve as an ontology for building knowledge-based information system. The next section contains some additional comments on the applicative category and the abstraction trichotomy.

APPLICATIVE AND ABSTRACT KNOWLEDGE

Hirschheim and Klein propose four different types of knowledge to structure an information systems body of knowledge. This section builds on their four types and compares them to the knowledge categories proposed in the previous section.

Hirschheim and Klein (2003) define technical knowledge as dealing with specific ‘rules of skill’ or technique. Ethical knowledge involves the moral value choices. The third type of knowledge, theoretical knowledge, is “much more difficult to capture because it is very abstract.” They go on to say that it “involves conceptual frameworks that help organized large bodies of knowledge” (p 265). The fourth type of knowledge is applicative knowledge, which involves the practical knowledge that is needed to deal with contextual aspects of solving a specific problem. There are two subtypes of applicative knowledge. The first is the kind of knowledge required to move from theory to practice (p 269) and the second consists of “craftsmanship” tacit knowledge (p 270). A comparison with these four types with the Trichotomy of Knowledge is given in Table 2.

<table>
<thead>
<tr>
<th>From Hirschheim and Klein</th>
<th>Trichotomy of Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical</td>
<td>Declarative and Procedural</td>
</tr>
<tr>
<td>Ethical</td>
<td>Function</td>
</tr>
<tr>
<td>Theoretical</td>
<td>Behavior and Structure</td>
</tr>
<tr>
<td>Applicative</td>
<td>Applicative and Pragmatic</td>
</tr>
</tbody>
</table>

Table 2. Comparison of the Trichotomy of Knowledge to Hirschheim and Klein (2003)

Applicative knowledge links the abstraction trichotomy to the declarative and procedural categories. The three subtypes of knowledge in the abstraction category mediate the relationship of an actor with the world of action. These are conceptual structures stored as artifacts in a knowledge-based information system that allow the actor to reason about the structure, behavior, and function of the world of action. The abstraction trichotomy represents a higher level of knowledge that is developed and tested through a cycle of abduction (invents hypotheses), deduction (explicates hypotheses) and induction (tests hypotheses). Applicative knowledge is necessary to apply abstract knowledge to specific situations, but we hold that there is a whole class of knowledge that can be reasoned about in the abstract and this is why there needs to be a separate set of categories for these types of knowledge.

CONCLUSIONS

This paper proposes that modeling the world through the use of the Trichotomy of Knowledge can inform the design of knowledge management systems by calling attention to the need for support of different types of knowledge in a similar way to the knowledge taxonomy described by Alavi and Leidner (2001). There are three specific contributions that this paper makes to the design of information systems that support knowledge management. This first is that it based on an understanding of the writings of the philosopher Peirce and social scientist Habermas, both of whom have much to say about a theory of knowledge. The second contribution is that it explicitly recognizes and accounts for the role of abstract knowledge. Finally, it builds upon the Weber and Wand assumption that representation is the essence of all information systems (Weber, 2003a).

The next steps in this research in progress are to follow the guidelines of design science research (Hevner, March, Park and Ram, 2004) and the example of ontology-driven information systems (Kishore, Zhang and Ramesh, 2004). Specifically, it is necessary to generate a set of grammatical constructs and relations that represent the ontological constructs and relations. The next two tasks are to develop tools and systems in XML for contextual reasoning and to test for the ontological expressiveness of the grammar in particular situations (Wand and Weber, 2002). All three of these tasks are planned.

REFERENCES


