

## Towards a Cultural Ontology for Interorganizational Knowledge Processes

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### **Abstract**

*The explication of national-specific and organizational-specific value systems of the firms involved in interorganizational knowledge management processes is the necessary condition for their success. The term cultural ontology is introduced to refer to such explication. Based on an inter-organizational knowledge-manipulating process model and on framework for studying the cultural influences on knowledge transfer process, the elements of cultural ontology are specified. The cultural ontology specification document includes its domain, purpose, level of formality, scope, possible sources of knowledge, competency questions and the possible reusable ontologies.*

### **1. Introduction**

Globalization, the ever-growing knowledge of customers and competitors and the increased demands for personalization in products and services are but some of the factors that make managing knowledge across national borders of crucial importance in sustaining and enhancing firms' competitiveness (e.g., [41]. However, since no single firm has the full range of knowledge and expertise needed for timely and cost-effective product and service innovation, firms are increasingly setting up various forms of cross-border collaborative arrangement, such as joint ventures, strategic alliances and multinational corporations, in order to access knowledge and capabilities unavailable internally [15].

Knowledge, however, is socially produced and reproduced, and its manipulating processes, i.e., generation, mobilization and application, are constrained

by the social and cultural contexts in which they are embedded. In fact, research on knowledge management initiatives has shown that knowledge and culture are inextricably linked in organizations, and has recognized the role of organizational culture as a major barrier to leveraging knowledge [14, 18, 25]. Therefore, the effectiveness of inter-organizational knowledge processes will be affected by the degree of national [3] and organizational *cultural heterogeneity* between the firms involved.

Schein (1996) defined organizational culture as "a set of tacit assumptions about how the world is and ought to be that a group of people share and that determines their perceptions, thoughts, feelings, and, to some extent their overt behavior" [34]. Therefore, organizational culture can be viewed as the collective tacit knowledge members of the organization use to generate and interpret social behavior. According to Schein (1985), this tacit knowledge comprises values, beliefs and basic underlying assumptions. In the same vein, Hofstede [21] defines culture as "the collective programming of the mind which distinguishes the members of one group or category from those of another." Therefore, making such tacit knowledge explicit and communicable is the ethical responsibility of management in international companies [35]. Such explication can support interorganizational knowledge processes in different ways, such as by specifying explicitly the similarities and differences in the value systems of the firms involved, building a shared vocabulary, and selecting the most appropriate knowledge transfer mode.

The means of such explication is the development of *cultural ontology*. Ontology, from the perspective of the

AI community, is “an explicit specification of *shared conceptualization*” [16], italics added) that aims to facilitate communication between people and organizations and inter-operability between systems and systems engineering [37]. In this context, “conceptualization is an abstract, simplified view of the world that we wish to represent for some purpose” [16]. It involves a system of concepts in terms of which the corresponding universe of discourse is divided into things, processes and relations in different sorts of ways. In the case of *cultural ontology* such conceptualization, which reveals in the ways one behaves when engaging in day-to-day activities, deals with the system of values adopted by members of the organization.

The main objective of this work is twofold. The first is to develop a framework for specifying a cultural ontology in the context of interorganizational knowledge management (KM). The second is to use this framework in defining an ontology requirements specification document and its preliminary conceptual model. The remainder of the paper is organized as follows. After introducing the elements of an inter-organizational knowledge process model, its underlying cultural dimensions are discussed. Next, the definition of cultural ontology is introduced, together with its preliminary conceptual model, and the ways in which the proposed cultural ontology can support inter-organizational knowledge processes are discussed. The paper then concludes by discussing possible areas of future research.

## 2. Inter-organizational knowledge processes and their cultural dimensions

### 2.1. An inter-organizational knowledge process model

Based on the literature review (e.g., [11, 22, 28, 29, 42] and on analysis of several KM initiatives (e.g., [6, 8, 9] K-manipulation processes can be classified into three main categories, i.e., K-generation, K-mobilization and K-application. The first category, K-generation processes, includes all processes by which new knowledge is generated within the organization. There are several types of knowledge generation, namely: *Acquisition* where the new knowledge is acquired from external sources; *Externalization* where the convertible tacit knowledge of the members of the involved firms is conceptualized and articulated; *Discovery* where the knowledge hidden in the data sources of the involved firms (e.g., databases, data warehouses) is discovered; *Synthesis* where the new knowledge is generated either by integrating the newly generated and validated knowledge with the existing knowledge, or by combing the existing knowledge; and *Production (creation)* where the new knowledge is

produced by interacting with the things in cognitive domains of the enterprise [5]. An example of this is the formation of international R&D units [40].

The second category, K-mobilization processes, includes all processes that aim at increasing the visibility or accessibility of existing or newly generated knowledge by sharing it or transferring it from one bearer (the knowledge provider, owner or source) to another (the knowledge seeker or target) through space or time. The knowledge bearer could be artifact, such as technical documents or best practice databases, or human, such as experts in a certain domain.

The last category, K-application processes, includes the processes by which knowledge is embodied in various forms. For example, knowledge can be used to develop a new product/service/business process or to improve existing ones. Associated with these processes are the processes of K-evaluation, which include all the activities that aim at justifying and measuring the business value of the knowledge [39]. The K-evaluation process may initiate a K-identification process which includes all the activities that develop the awareness of the need to create new K-things or to update existing ones.

### 2.2. Cultural dimensions of inter-organizational knowledge processes

In order to study the cultural dimensions of inter-organizational knowledge processes a modified version of De Long and Fahey’s (2000) framework for studying cultural barriers to knowledge management within an organization will be used. According to this framework, there are four areas in which culture influences the behaviors central to knowledge and its manipulating processes. First, culture shapes assumptions about *which* knowledge is worth generating and *how*, in *what* form, and for *what* purpose [41], i.e., *knowledge (K-) valuation*. Second, it defines *knowledge (K-) structure*, that is, *how* knowledge and skills are distributed and utilized within the firm. Third, it creates the organizational context of social interactions for knowledge generation, mobilization and application, i.e., *knowledge (K-) contextuality*. Finally, culture shapes the decision-making processes by which new knowledge is translated into action, i.e., *knowledge (K-) actualization*.

While the De Long & Fahey’s framework is useful in identifying the different areas in which national and organizational cultures influence knowledge-oriented behaviors, it does not indicate the mechanisms by which each of the cultures, which will be treated as two distinct constructs each has its distinct contents and effects (e.g., [4, 13, 36], realize their influences. To make such

mechanisms explicit, Schein's model of organization culture [33] will be used since it can be applied to both national and organizational cultures [36]. According to this model, culture exists at three levels of abstraction: assumptions, values and artifacts. On the surface are artefacts; underneath artifacts lie values, and at the core are the basic assumptions. Basic assumptions represent taken-for-granted beliefs that people share regarding such things as human nature and social relationships, and among social institutions and their environment. Values represent standards or criteria for selecting from alternatives and standards that guide ongoing activities. They define appropriate end-states (terminal values) and the means (instrumental values) of achieving those ends [32]. Artifacts, which are the most concrete components of culture, include physical evidence such as architecture, explicit communicators like mission statements, and implicit communicators like rites and rituals. However, as values are both more accessible than assumptions and more reliable than artifacts, they can be reliably used to characterize organizational culture [23].

Drawing on the previous discussion and on the interorganizational knowledge process model, the national-specific and organizational-specific values relevant to the interorganizational K-manipulating processes are analyzed along two dimensions. The first is the main components of interorganizational knowledge process, i.e., K-generation, K-mobilization and K-application. The second dimension is the area of influence, i.e., K-valuation, K-structure, K-contextuality and K-actualization. Furthermore, these values can be classified into two main groups. The first group includes the national-specific and organizational-specific terminal values of involved firms with regard to topics, types, forms and outcomes of knowledge to be generated, shared or acquired, i.e., those that affect K-valuation. Examples of national-specific values are complementarity (either/or vs. both/and), time-orientation (long-term vs. short-term) [41] and abstractive vs. associative [24].

The second group includes the national-specific and organizational-specific instrumental values that affect K-structure, K-contextuality and K-actualization. With regard to K-structure, national-specific values such as power distance and uncertainty avoidance affect K-mobilization within and between the involved firms [41]. With regard to organizational-specific values, one can distinguish two sets. The first set includes values that underlie *highly diffused* and *group-based* K-structure, such as job rotation, group learning, reduced social

distance between different categories of the workforce and collective ownership of knowledge. The second set includes those values that underlie *task specific* and *individual-based* K-structures, such as job differentiation, individual specialization and individual ownership of knowledge [7, 25]. The first set of values affects the K-inflow, as these values support sharing the newly acquired knowledge between the individuals and organizational entities of the target firm. Moreover, the value of "collective ownership of knowledge" of the target firm determines which transfer mechanisms are to be used. In addition, "trust" is of crucial importance on both the K-outflow and K-inflow sides [7, 31].

The values affecting K-contextuality can be assessed on at least three dimensions [7]: vertical interactions, horizontal interactions, and special behaviours that promote knowledge mobilization and application within and between the involved firms. The first dimension, vertical interactions, deals with values that are relevant to knowledge sharing between different organizational levels such as power distance, verticalness on the national level [3], the acceptability of discussing sensitive topics (openness), and approachability of senior management at the organizational level. The second dimension, horizontal interactions, deals with the set of values that are needed to leverage knowledge sharing among individuals and organizational entities at the same level in the involved firms. This set includes horizontalness at the national level [3], team-oriented values such as team orientation, collaboration, cooperation, group harmony, consensus/agreement, participative decision-making and team accountability on the organizational level. The final dimension deals with the set of values that "shape the context of social interaction to support knowledge sharing and use" [7]. For example, in the case of K-mobilization between two firms, this set includes willingness to share knowledge with other firms on the K-outflow side, and willingness to learn from other firms on the K-inflow side [19]. This set also includes supportive values such as respect for the individual and professional growth opportunities [23], and K-re-use.

Finally, values that support K-actualization are mainly innovation values which include innovation, willingness to experiment, leading-edge technologies, creative problem-solving and tolerance for mistake [23]. Tables (1) and (2) show examples of the national-specific and organizational-specific values relevant to the interorganizational K-manipulating processes.

**Table (1): Examples of the national-specific values relevant to the interorganizational K-manipulating processes.**

	<b>K-Manipulating Process</b>		
	<b>Generation</b>	<b>Mobilization</b>	<b>Application</b>
<b>K-Valuation</b>			
Type	Either/or vs. both/and [41]. Abstractive vs. associative, Tacitness vs. explicitness [24].		
Form	Integration vs. invention [41].		
Outcome	Time orientation [41].		Time orientation [41].
<b>K-Structure</b>			
		Power distance [41].	
<b>K-Contextuality</b>			
Vertical Interactions		Power distance [41], Verticalness [3].	
Horizontal Interactions		Individualism/Collectivism [41], Horizontalness [3].	
Special Behavior		Uncertainty avoidance [41].	
<b>K-Actualization</b>			
			Time orientation [41].

**Table (2): Examples of the organizational-specific values relevant to the interorganizational K-manipulating processes [2].**

	<b>K-Manipulating Process</b>		
	<b>Generation</b>	<b>Mobilization</b>	<b>Application</b>
<b>K-Valuation</b>			
	Values regarding the topics, type and form of knowledge to be <i>generated</i> .	Values regarding the topics, type and form of knowledge to be <i>shared</i> .	
<b>K-Structure</b>			
		Collective ownership, Group learning, Job rotation, Trust, Integration between functions.	
<b>K-Contextuality</b>			
Vertical Interactions		Openness, Approachability, Accessibility.	
Horizontal Interactions		Trust, Team-oriented values.	Team-oriented values.
Special Behavior		Willingness to share knowledge with and to learn from other firms, Supportiveness values, K-re-use.	
<b>K-Actualization</b>			
			Innovation values.

### 3. Toward cultural ontology

One of the main objectives of developing ontologies is to facilitate “communication between people with different needs and viewpoints arising from their differing contexts” [37]. This objective is achieved by developing a unifying conceptual framework that acts as a lingua franca between the different parties involved in the communication activity. In the case of inter-organizational knowledge management, the different parties are the firms involved in K-manipulating processes. Since each firm has its own culture, which is influenced by the national culture in which the firm is embedded [27], and this culture is revealed in its distinct value system, the explication of the national-specific and organizational-specific value systems of the involved firms is the prerequisite for the creation of the mutual and shared understanding necessary for effective interorganizational knowledge management. Such explication of the value systems of firms is what we call *cultural ontology*.

The first step in building a cultural ontology is the identification of its development activities. METHONTOLOGY methodology has been chosen as it provides explicit and detailed guidelines of ontology conceptualization activity i.e., an activity that specifies a conceptualization at the knowledge level and that is independent of formal languages and implementation environments [2, 10]. This activity is important for validating the ontology at the knowledge level by providing *intermediate representations* that can be evaluated by domain experts and human end-users [10]. According to this methodology, there are four main ontology development-oriented activities, i.e., specification, conceptualization, formalization and implementation. The goal of the specification activity is to produce *requirements specification document* for the ontology. Such a document includes items such as the domain, purpose, level of formality, sources of knowledge, and competency questions of the ontology. In conceptualization activity, the domain knowledge will be structured in conceptual models that describe the problem and its solution in terms of the domain vocabulary identified in the ontology specification activity. Since the purpose of this work is not to develop fully a cultural ontology but rather to identify its elements and the roles it can play in interorganizational knowledge management, we will focus on the first ontology development activity,

i.e., its specification. However, a preliminary set of IRs will be introduced.

As the main concerns of the intended cultural ontology are those national-specific and organizational-specific values with respect to knowledge in general and its manipulating processes in particular, and as this knowledge is associated with something in a firm’s domain of interest, three concepts will be introduced, namely, business (B-) thing, knowledge (K-) thing and knowledge-manipulating (K-) process [1]. B-thing is any thing towards which thought or action is directed or is communicated by the members of the firm, e.g., business outcome (products or services), business process and business rule. Each B-thing is associated with certain knowledge that is needed to deal with it or to act upon it. For example, STEP (The Standard for the Exchange of Product Model Data) data architecture has recognized three categories of knowledge to be associated with a product, i.e., classification, marketing and technical [12]. This knowledge is characterized in terms of one or more knowledge thing (K-thing). A K-thing describes the knowledge about the knowledge associated with a B-thing, i.e., the meta-knowledge. Such a distinction between B-things and K-things is important, since the knowledge associated with a B-thing is in constant change and is context-dependent. For example, the knowledge required to manufacture a certain product may change because of the introduction of new technology or the emergence of new marketing demands. Finally, the K-manipulating process is the process that changes the state of a K-thing. For example, during its life cycle K-things can exist in different states that correspond to the states of the knowledge associated with B-things, e.g., “Being identified”, “Being created”, “Being acquired”, “Being synthesized”, “Being externalized”, “Being preserved”, “Being actualized”. The state transitions of a K-thing are caused by performing one or more K-manipulating process [1]. Moreover, each K-thing and each K-process is associated with a set of values that influences the behaviors central to them.

These concepts, together with the cultural dimensions of the inter-organizational K-manipulating processes previously discussed, are considered as the cultural ontology specification activity which yields the specification document shown in Figure (1).

<b>Domain</b>	Organizational culture
<b>Purpose</b>	Ontology about organizational-specific values and relevant national-specific values to be used when information about values relevant to the inter-organizational knowledge processes is required in evaluating the similarities and differences in the value systems of the firms involved.
<b>Level of Formality</b>	Semi-formal.
<b>Scope</b>	<ul style="list-style-type: none"> <li>▪ List of national-specific and organizational-specific values that are relevant to inter-organizational knowledge manipulating processes, such as power distance, uncertainty avoidance, collective ownership, trust, approachability, accessibility, team oriented values, willingness to share knowledge and willingness to learn.</li> <li>▪ Properties that characterize values such as role and relative importance.</li> <li>▪ List of related concepts such as firm, B-thing, K-thing and K-manipulating process.</li> <li>▪ Properties that characterize the related concepts (for example Table (2)).</li> </ul>
<b>Sources of Knowledge</b>	<ul style="list-style-type: none"> <li>▪ Organizational documents (e.g., mission statement, corporate plan).</li> <li>▪ Organizational value survey, Organizational Culture Profile.</li> <li>▪ KM case studies.</li> <li>▪ .....</li> </ul>
<b>Examples of Cultural Ontology's Competency Questions</b>	<p>CQ.1. What is the national-specific value system of firm X with regard to the type/form/outcome of the knowledge about a specific B-thing?</p> <p>CQ.2. What is the organizational-specific terminal value system of firm X with regard to the type/form/outcome of the knowledge about a specific B-thing?</p> <p>CQ.3. What is the organizational-specific instrumental value system of firm X with regard to generating knowledge about a specific B-thing?</p> <p>CQ.4. What is the organizational-specific instrumental value system of firm X with regard to mobilizing knowledge about a specific B-thing?</p> <p>CQ.5. What is the organizational-specific instrumental value system of firm X with regard to applying knowledge about a specific B-thing?</p> <p>CQ.6. What is the organizational-specific instrumental value system of firm X with regard to breadth of the transferred knowledge dissemination?</p>
<b>Potentially Reusable Ontologies</b>	TOVE Ontology [17] and Enterprise Ontology [38] as potential ontologies for representing B-things.

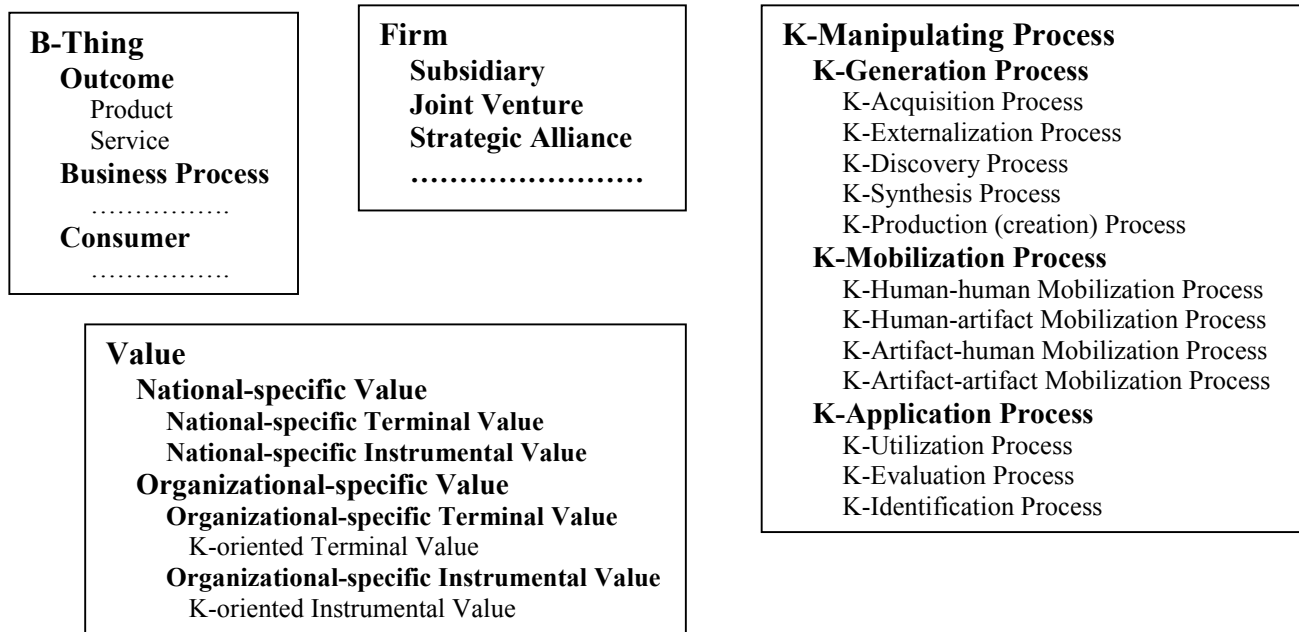
**Figure (1): Cultural Ontology Requirements Specification Document**

According to METHONTOLOGY methodology, the ontology's conceptualization activity includes four main steps, i.e., building a glossary of terms, building concept-classification trees (taxonomies), building binary-relations diagrams, and developing intermediate representations (IRs) for each concept-classification tree [10]. IRs include items such as concept dictionary, which describes and gathers all the useful and potentially usable domain concepts, their meanings, attributes, instances, etc.; tables of instance attributes, which provide information about the attribute or about its values at the instance; tables of class attributes, to describe the concept itself, not its instances; tables of constants, used to specify information related to the domains of knowledge that always take the same value; tables of instances, which define instances; and attributes classification trees,

to graphically display attributes and constants related in the inference sequence of the root attributes, as well as the sequence of formulas or rules to be executed to infer such attributes. Since the full conceptualization of organizational cultural ontology is beyond the scope of this paper, examples of the outcomes of only the first three conceptualization activities, i.e., building a glossary of terms, building concept-classification trees (taxonomies), and building binary-relations diagrams will be presented. Table (3) shows examples of the terms of a cultural ontology. Figure (2) shows examples of concept-classification trees using the subclass-of relations. Finally, figure (3) shows a simple UML diagram that depicts the relationships between concepts of the same or different taxonomies.

**Table (3): Glossary of some terms of the cultural ontology**

Name of the Concept	Description
<b>National-specific Value</b>	A common value shared by people within a given country and can be used to distinguish one country's culture from another such as power distance, uncertainty avoidance and individualism (e.g., [13, 20]).
<b>Organizational-specific Value</b>	"An enduring belief that a specific mode of conduct or end-state of existence is personally or socially preferable to an opposite or converse mode of conduct or end-state of existence" [32].
<b>Terminal Value</b>	A desired goal that an organization seeks to achieve, such as excellence, stability, profitability, or quality.
<b>Instrumental Value</b>	A desired mode of behavior that an organization wants its members to observe, such as being hard working, being conservative, or being honest.
<b>K-oriented Terminal Value</b>	A desired k-oriented goal that an organization seeks to achieve such as k-accessibility.
<b>K-oriented Instrumental Value</b>	A desired mode of behavior that an organization wants its members to observe, such as trust, collaboration and willingness to learn.
<b>Value System</b>	"An enduring organization of beliefs concerning preferable modes of conduct or end-states of existence along a continuum of relative importance" [32].
<b>B-Thing</b>	Any thing toward which thought or action is directed or is communicated by the members of the firm, e.g., business outcome (products or services), business process, business rule, consumers, suppliers, competitors, and partners.
<b>K-Thing</b>	A description of the knowledge about the knowledge associated with a B-thing, i.e., the meta-knowledge.
<b>K-Manipulating Process</b>	Any process that changes the state of a K-thing, e.g., K-externalization, K-socialization (human-human K-mobilization and K-identification).
<b>Inter-organizational K-Manipulating Process</b>	Any K-manipulating process that involves at least two firms.



**Figure (2): Examples of cultural ontology concept classification trees (taxonomies)**

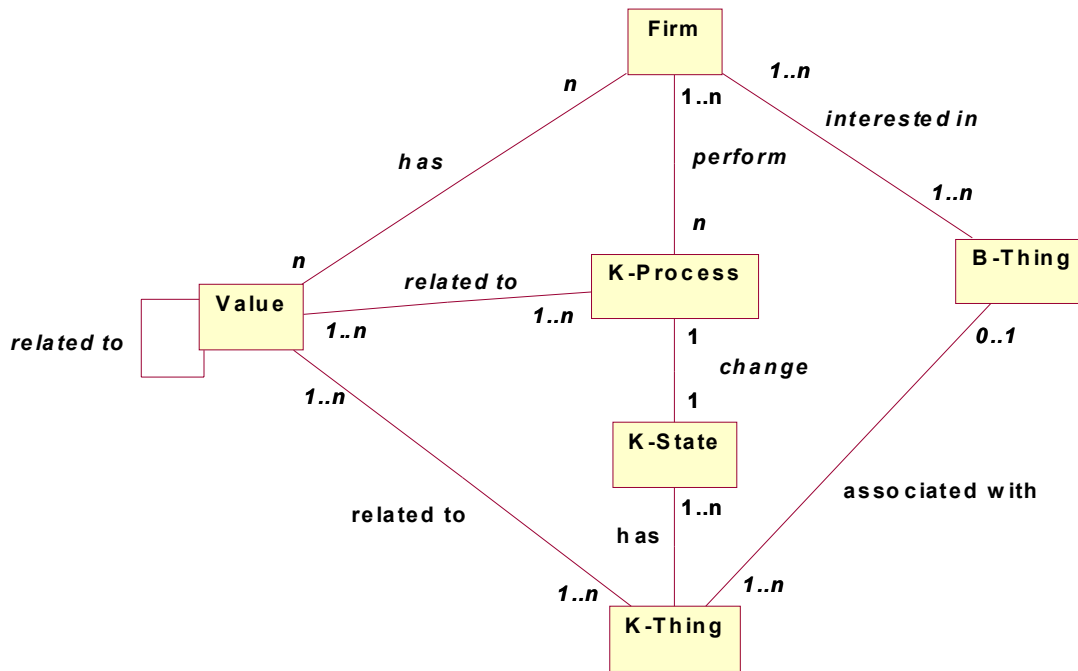


Figure (3): A UML binary-relations diagram

#### 4. The Role of cultural ontology in inter-organizational knowledge processes and value creation: A general view

Inter-organizational knowledge processes can be viewed as a collaboration process in which two or two or more organizations with complementary knowledge interact to create shared understanding that none had previously possessed or could have come to on their own. Therefore, effective collaboration has to take place in order for organizational knowledge of involved firms to be effectively used to create business value. One of the conditions for effective collaboration is the existence of a shared space where different perspectives may be shared and shared understandings generated [30].

One of the main objectives of developing a cultural ontology is the creation of explicit mutual and shared understanding of the value systems of the firms involved in K-manipulating processes. Such explication is essential for identifying the degree of congruence and complementarity of the firms' value systems. For example, the congruence between value systems regarding K-structure (know-how) and those regarding K-actualization (know-why) affects the effectiveness of the overall K-transfer process [26]. Moreover, the "complementarity" of special behavior values, i.e., willingness to share knowledge with other firms on the source firm side and willingness to learn from other firms

on the target firm side, is essential for the knowledge transfer process to be successful. Figure (4) shows the relation between the cultural ontology competency questions and the different elements of the inter-organizational knowledge processes.

#### 5. Conclusion

A framework for specifying and conceptualizing an organizational cultural ontology, as characterized by national-specific and organizational-specific value systems, in relation to inter-organizational knowledge transfer is developed. This framework is based on an inter-organizational knowledge-manipulating process model and on [7] framework for studying cultural influences on knowledge processes.

As the shared and mutual understanding of each other's value system is necessary for performing effective interorganizational K-manipulating processes, the explication of the involved firms value systems becomes inevitable. The term *cultural ontology* is introduced to refer to such explication. Based on this framework, the elements of cultural ontology are specified. The cultural ontology specification document includes its domain, purpose, level of formality, scope, possible sources of knowledge, competency questions and the possible reusable ontologies. Moreover, the competency questions are grouped in such a way that each group includes those

questions that are relevant to a specific component of the model of inter-organizational knowledge management. However, while this work is considered as a first step in structuring the cultural dimensions of interorganizational KM and the specification document serves as starting point to build an organizational cultural ontology, this process cannot be completed without addressing at least two issues. First, there is a need to develop a more detailed and empirically grounded list of those national-specific and organizational-specific values that are relevant to K-valuation, K-structure, K-contextuality and

K-actualization. In fact, there is a lack of theoretical and empirical research in this area. Second, as knowledge and its manipulating processes are anchored around B-things, the selection of an organizational ontology needs further research.

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Interorganizational K-Manipulating Process	Cultural Ontology's Competency Questions
<b>Generation</b>	CQ.1. What is the national-specific value system of firm X with regard to the type/form/outcome of the knowledge about a specific B-thing? CQ.2. What is the organizational-specific terminal value system of firm X with regard to the type/form/outcome of the knowledge about a specific B-thing? CQ.3. What is the organizational-specific instrumental value system of firm X with regard to generating knowledge about a specific B-thing?
<b>Mobilization</b>	CQ.4. What is the organizational-specific instrumental value system of firm X with regard to mobilizing knowledge about a specific B-thing? CQ.6. What is the organizational-specific instrumental value system of firm X with regard to breadth of the transferred knowledge dissemination?
<b>Application</b>	CQ.5. What is the organizational-specific instrumental value system of firm X with regard to applying knowledge about a specific B-thing?

**Figure (4): The relation between the cultural ontology competency questions and the components of the inter-organizational knowledge process model**

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