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Knowledge Management Systems from Description to Prescription: An Actor Network Approach

El-Sayed Abou-Zeid
Concordia University, el-sayed@jmsb.concordia.ca

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El-Sayed Abou-Zeid
John Molson School of Business
Concordia University
Email: el-sayed@jmsb.concordia.ca

Abstract

As the awareness of the importance of managing organizational knowledge grows, the issue of how to build information and communication technology (ITC)-based systems to support knowledge management activities, i.e., knowledge management support systems (KMSSs), has been raised. However, knowledge and its manipulating activities, by their very nature, are socio-technical phenomena in which social and technical factors interweave the ways in which people work. Therefore, the success of any knowledge management support system depends not only on its technical excellence, but also on its compatibility with the social and cultural fabric of the firm in which it is embedded. In this exploratory work it is argued that actor-network theory (ANT) provides theoretical foundations for the KMSS development process. In order to apply ANT in the context of knowledge management, several concepts are introduced, namely, Business Thing, Knowledge Thing and Knowledge Actor, together with a Role ontology.

Keywords

Actor-Network Theory, Knowledge Management, Development Methodologies

1. Introduction

According to the knowledge-based view, the firm is conceptualized as an institution that allows its members, individuals and collectives, to develop their own specialized knowledge and expertise, while establishing mechanisms through which the firm's members coordinate to integrate their specialized knowledge in the transformation of inputs to outputs (R Grant, 1996, 1997). With this view of knowledge as one of the most important resources that contribute to the competitive advantage of a firm, the need has emerged for more systematic approach to building the capacity within a firm to maintain and improve its performance based on the knowledge and expertise of its members, i.e., knowledge management (Pan & Scarbrough, 1999). As the awareness of the importance of managing organizational knowledge grows, the issue of how to build information and communication technology (ITC)-based systems to support knowledge management activities, i.e., *generation, mobilization* and *application*, has been raised. However, in spite of the myriad of descriptive and perspective frameworks that have been developed for knowledge management (Rubenstein-Montano et al., 2001), there is no "design theory" for ICT-based systems intended to support knowledge manipulating processes, i.e., knowledge management support systems (KMSSs). A "design theory", as explicated by Walls et al. (Walls, Widmeyer, & El-Sawy, 1992), must have two aspects - one dealing with the system (description) and the other dealing with the process of designing the system (prescription). In addition, these

two aspects have to be grounded on theories from natural or social sciences, i.e., kernel theories.

However, knowledge and its manipulating activities, by their very nature, are socio-technical phenomena in which social and technical factors interweave the ways in which people work (Alavi & Leidner, 1999; Nidumolu, Subramani, & Aldrich, 2001; Pan & Scarbrough, 1999). Therefore, the success of any knowledge management support system depends not only on its technical excellence, but also on its compatibility with the social and cultural fabric of the firm in which it is embedded. Thus, the adoption of technological determinism, which emphasizes the physical aspects of artifact and favors macro perspective, or social constructivism, which emphasizes the importance of interpretative human actor and favors the micro perspective, as the philosophical foundation for the KMSS development process is considered to be problematic due to a lack of symmetry between social and technological elements (McMaster, Vidgen, & Wastell, 1998; Vidgen & McMaster, 1995). Instead, the development of KMSS has to be conceptualized as the "transformation of a 'lash-up' of heterogeneous, disorderly, and unreliable" (Vidgen & McMaster, 1995) elements into an organized whole. What is needed, therefore, is a theory that treats these elements symmetrically irrespective of their ontology and can prescribe how to form a "hybrid collective" out of them. Such a theory is considered to be one of the "kernel theories" that govern design requirements and design process of any ICT-based systems intended to support knowledge manipulating processes.

To this end the objective of this work is to explore the potential of actor-network theory as one of the kernel theories for constructing a KMSS design theory. It will be argued that using the actor-network theory in conceptualizing the KMSS development process as cultivating the *hybrid collective* of humans and non-humans, technologies and non-technologies (Callon & Law, 1995) is a suitable and useful approach. This concept also captures the open-ended and emergent nature of the process and indicates the suitability of an evolutionary approach.

The remainder of this paper is organized as follows. In the next section, the distinctive features of knowledge management support systems and their development process are discussed. In the following section a brief description of ANT is given. The use of ANT as a basis for a KMSS development methodology will then be considered. The paper concludes by discussing the implications of the proposed approach.

2. Knowledge Management Support Systems (KMSS)

In order to develop a design theory for KMSSs, the work to be supported by them has first to be described. This work can generally be described in terms of the characteristics of three elements: *organizational knowledge, the knowledge manipulating processes to be supported,* and *users and their work context* (Markus, Majchrzak, & Gasser, 2002). The first element, *organizational knowledge,* has the following distinctive features:

- *Action-orientation*: According to Collins (Collins, 1974), knowledge is a capability and thus creates the capacity to do something. Therefore, organizational knowledge is always anchored to business things toward which thought or action is directed or is communicated by the members of the firm (Hislop, Newell, Scarbrough, & Swan, 2000) and is constantly produced and re-produced through its business application (Augier & Vendela, 1999) in order to create business value. One of the implications of the action-orientedness is its *indeterminacy*: As the business environment is in the state of continuous change and as

organizational knowledge whatever its type is engrained in business activities, it is difficult to determine a priori what knowledge will be requested, who will request it, who will supply it, and when and how the knowledge will be used (Abou-Zeid, 2002; Markus et al., 2002).

- *Complementarity:* Organizational knowledge is a combination of two distinct but inseparable types of knowledge: explicit and tacit. Explicit knowledge is the knowledge that can be articulated (represented) in many forms, such as formal languages, mathematical expressions, specifications, and manuals, and consequently can be shared asynchronously. On the other hand, tacit knowledge, which includes, "cognitive skills such as beliefs, images, intuition and mental models as well as technical skills such as craft and know-how" (Nonaka, 1994), is difficult, if not impossible, to articulate and hence difficult to be shared asynchronously. While this definition of tacit knowledge refers to the individuals within an organization, at the organizational level tacit knowledge "is made up of the collective mindsets of everyone in the organization"(Saint-Onge, 1996). However, each type of knowledge does work that the other cannot, and one form cannot be completely converted to the other (Collins, 1993; Cook & Brown, 1999).
- *Distributedness:* Organizational knowledge is spatially and temporally distributed as it is generated, owned and used by *autonomous* members of the organization, e.g., individuals and groups, and mobilized among them (Boland, Tenkasi, & Te'Eni, 1996; Bonifacio, Bouquet, & Traverso, 2002). Moreover, the actions of organization members and their interpretation of knowledge representations (explicit knowledge) are grounded in their *collective* tacit knowledge which has been formed in the course of past socialization and has become basic assumptions (Polanyi, 1983; Tsoukas, 1996).
- *Situatedness*: Knowledge cannot be disembodied from the people who carry it or from the situations in which they engage (Sierhuis & Clancey, 1997). Therefore, using knowledge depends on the situation and people involved rather than on absolute truth or hard facts.

The aforementioned distinctive features of organizational knowledge require that *K-manipulating processes*, the second element, to be *social* and *contingent*. First, since organizational knowledge is distributed and context-dependent, most K- manipulating processes involve social interactions among organization members. Second, as organizational knowledge is action-oriented and situated, the type of its manipulating processes and the patterns of their execution are contingent upon these factors.

These characteristics of organizational knowledge and its manipulating processes call for re-conceptualizing *users of KMSS*, the third element, as *active social actors*. First, the use of knowledge and the interpretation/re-interpretation of explicit knowledge cannot be disembodied from the user. Therefore, *the users of KMSS have to be considered as constituents of such systems who play specific roles in their operations*. Second, because of the distributed nature of organizational knowledge and the sociality of its manipulating processes the user of KMSS is best described as a social actor - defined as "an organizational entity whose interactions are simultaneously enabled and constrained by the socio-technical affiliations and environments of the firm, its members, and its industry" (Lamb & Kling, 2003), p. 218) .

The distinctive features of organizational knowledge and its manipulating processes, together with the concept of active social actor suggest that the dominant capture/codify/store approaches

(Hildreth & Kimble, 2002) for developing KMSS are ineffective (Malhotra, 2002; Swan, Newell, & Robertson, 2000). Instead a knowledge management support system (KMSS) can be generically conceived as the *collection of human and non-human actors that are configured and reconfigured in an organized collective activity in order to leverage organization capabilities in generating, mobilizing and applying both knowledge and knowledge representations*. Examples of human actors are individuals and collectives, e.g., communities of practice, while non-human actors include things such as ICT artifacts, organizational routines and corporate cultures (Mohrman, Finegold, & Klein, 2002; Nonaka & Reinmoeller, 2000).

3. Actor Network Theory assumptions and vocabulary

"Actor-network theory examines the motivations and actions of actors who form elements, linked by associations, of heterogeneous networks of aligned interests" (Walsham, 1999). From the ANT perspective, the explanation of the development of sociotechnical ensembles such as KMSS involves neither technical nor social reductionism, but rather a principle of *analyzing the roles of the human and the non-human within the same conceptual framework* must be adhered, i.e., *the principle* of *generalized symmetry* (Calas & Smircich, 1999; Somerville, 1997). The alignment of actors' interests is achieved through the *translation* of interests and the *enrolment* of actors into the network. Translating involves showing how actors' non-aligned interests may become aligned. Skills, practices, organizational arrangements and contracts may all be part of the process of alignment. Technological and social elements are considered to be tied together into networks, based on the assumption that technologies are always defined to work in an environment that includes non-technological elements, without which the technology would be meaningless and would not work. In the same way, humans use non-human objects (technologies and other artifacts) in all their dealings in the world; our existence is based upon the existence of these objects. Moreover, elements in a network are defined not only by their "internal" aspects, but also by their relationships to other elements, i.e., as a network. This further implies that elements in such a network are not initially defined as human, social or technological; they are referred to as *actor* (or *actant*). This approach also emphasizes the inter-connectedness of the heterogeneous elements that make up an *actor-network*, and this interconnectedness is elucidated in the process of *translation*. Table (1) provides a brief summary of some key concepts of ANT.

4. KMSS: description and prespection

According to Walls et al.'s (1992) framework, an "IS design theory" must have two aspects - one dealing with the description of the system and the other dealing with the process of designing of the system (prescription). The prescription aspect includes a description of procedures and guidelines for system development.

4.1 The Description

From the ANT perspective, KMSS can be re-conceptualized as a *heterogeneous network of aligned interests of a collection of human and non-human actors that are configured and reconfigured in organized collective activity in order to leverage organization capabilities in generating, mobilizing and applying both knowledge and knowledge representations.*

In order to operationalize this definition the actors involved in K-manipulating processes are

classified in three main categories, namely, B-things, K-things and K-actors.

Actor (or Actant)	Actors are entities, human and non-human, that do things (Latour, 1992).
Actor network	Heterogeneous network of aligned interests, including people, organizations and standards.
Enrolment	Creating a body of allies, human and non-human, through a process of translating their interests to be aligned with the actor network.
Obligatory Passage Point (OPP)	A situation or process that must occur in order for all the actors to satisfy their interests that have been attributed to them by another actor, namely, the focal actor. It is useful to note that while the OPP lies in the direct path of the focal actor, other actors have to overcome some obstacles in order to pass through the OPP (Callon, 1986; Latour, 1987).
Representative/Spokesperson	An actor that speaks on behalf of other actors (Callon, 1986).
Translation	Translation is a multifaceted interaction in which actors (1) construct common definitions and meanings, (2) define representatives, and (3) co-opt each other in the pursuit of individual and collective objectives (Somerville, 1997).

Table (1): Summary of some key concepts of ANT

Business (B-) Things: Because of the action-orientedness of knowledge, the concept of business (B-) thing is introduced to represent all things toward which thought or action is directed or is communicated by the members of the enterprise. Examples of B-things are business processes, resources, and business rules. The interests of B-things can be described in terms of the objectives that their representatives think they must attain. For example, the interest of a business process could be to achieve certain level of efficiency and effectiveness.

Knowledge (K-) Things: Each B-thing is associated with certain knowledge needed to deal with it or to act upon it (Robert Grant & Baden-Fuller, 1995). Such a distinction between B-things and K-things is important, since the knowledge associated with B-thing changes constantly and is context-dependent. However, as discussed in the second section, knowledge representations cannot be equated with knowledge, and knowledge cannot be disembodied from the people who carry it or from the situations in which they engage. Therefore, the knowledge associated with B-things is characterized, rather than represented, in terms of one or more knowledge thing (K-thing). A K-thing is a conceptual construct that describes the knowledge associated with a B-thing, i.e., the meta-knowledge.

While B-things are relatively stable, the associated knowledge is in the state of continual change. Therefore, K-things can exist in different states that correspond to the states of the knowledge associated with B-things. The state of organizational knowledge, and consequently the state of associated K-thing, is determined by the values of its attributes. The life cycle of K-thing starts with the “Being identified” state. This state occurs whenever the necessity of having certain knowledge relevant to a B-thing is identified. After being identified the K-thing may have many

states, such as “Being created”, “Being acquired”, “Being discovered”, “Being synthesized”, “Being externalized”, “Being preserved”, “Being utilized”, “Being evaluated”, “Being mobilized”, “Being visible” (Abou-Zeid, 2002; Nonaka & Takeuchi, 1995). The desired states of K-things represent their interests.

Knowledge (K-) Actors: K-actors category includes all other actors, other than B-things and K-things, can play a certain role in knowledge (K-) manipulating activities. K-actors can be human, e.g., expert, community of practice, functional unit, or non-human. Non-human actors include tangible things such as ICT artifacts (e.g., search engine, knowledge base, software agent). They also include intangible things such as organizational culture. While identifying the interests of human actors is straightforward, the interests of non-human actors can be investigated through the examination of the intentions of their human potential delegates (Vidgen & McMaster, 1995).

Depending on the context, an actor can play several roles, such as a *provider* or *seeker* of knowledge, or both at the same time, i.e., *exchanger*. As “a role type characterizes an entity by some role it plays in relationship to another entity” (Sowa, 2000), actor roles can be classified into three main categories, i.e., Actor/Actor (AA), Actor/K-thing (AT) and intermediary. The first category includes the roles actors can play in relation to one another, while the second category includes the roles an actor can play in relation to K-things. The third category includes the roles played by either human or artifact as intermediary between actors or between actors and things. Figure (1) shows the taxonomy of actors’ roles, and Table (2) summarizes descriptions of these roles. Figure (2) shows UML class diagram of ANT conceptualization of KMSS.

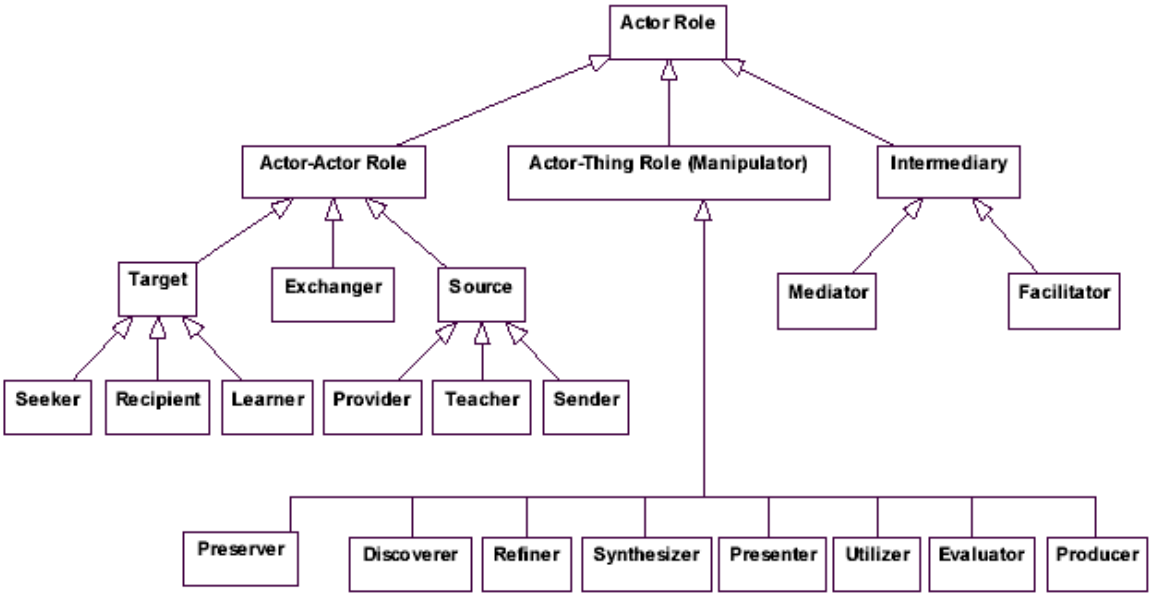

Figure (1): Taxonomy of an actor’s roles

Role	Description
Actor-Actor Roles	
Seeker	The proactive search of knowledge that is initiated by a human actor.
Recipient	The passive role of a human or an artifact as the recipient of the knowledge representation (explicit knowledge) sent by another actor.
Learner	A special case of the recipient role in which a human receive knowledge and knowledge representation offered another actor.
Provider	The role played by a human or an artifact as a repository of knowledge to be searched or asked for.
Sender	The active role played by a human or an artifact in disseminating his/her knowledge or knowledge representation.
Teacher	A special case of the sender role in which a human offer his knowledge to another actor.
Exchanger	The role in which a human shares reciprocally her/his tacit knowledge with another actor.
Actor-Thing Roles	
Acquirer	The role played by human in obtaining the required knowledge from external sources.
Discoverer	The role in which a human or an artifact extracts new knowledge from existing data sources.
Synthesizer	The role in which a human actor combines discrete pieces of explicit knowledge to form new explicit knowledge.
Producer	The role in which a human actor interact with certain business domain in order to create new knowledge.
Refiner	The role in which a human or an artifact refines, e.g., abstracts, labels or maintains, existing explicit knowledge.
Preserver	The role in which a human or an artifact transfers explicit knowledge into storing media.
Presenter	The role in which a human actor or an artifact creates customized presentation of knowledge.
Utilizer	The role in which a human or non-human actor uses knowledge.
Evaluator	The role in which a human actor evaluates used knowledge or required knowledge.
Intermediary Roles	
Initiator	The role in which a human initiates a KM initiative and becomes the spokesperson on behalf of it.
Mediator	The role in which a human facilitates the interaction between another actor and K-thing
Facilitator	The role in which a non-human facilitates the interaction between another actor and K-thing.

Table (2): Descriptions of actors' roles

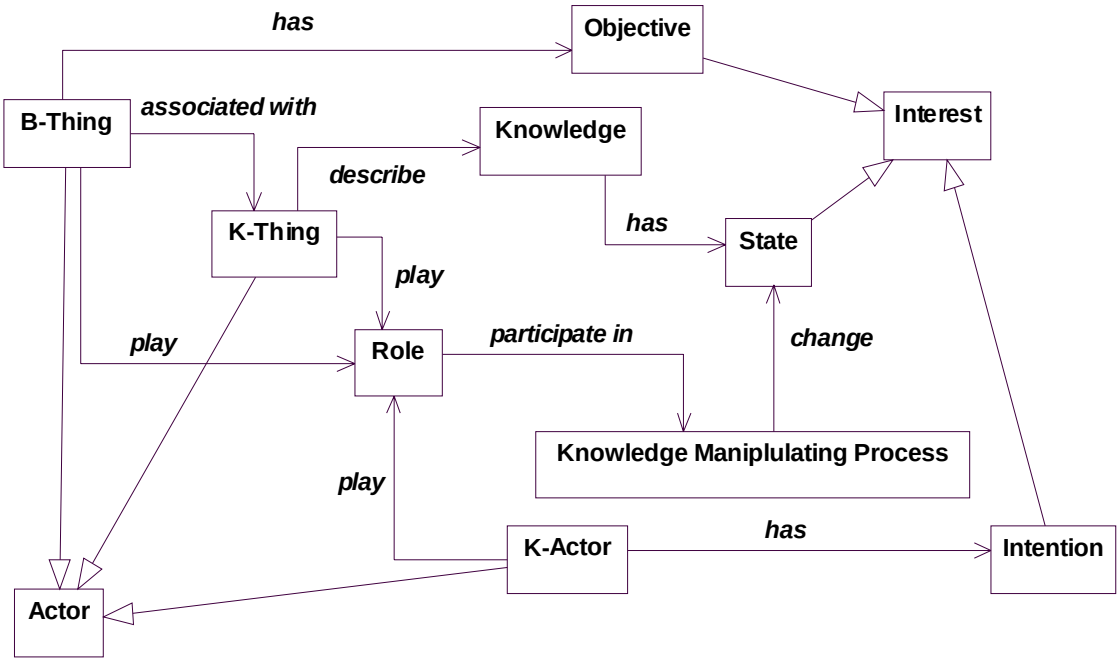

Figure (2): ANT conceptualization of KMSS

4.2 The Prescription: How Does ANT Inform KMSS's Design Theory?

Actor-network theory has been regarded as primarily post hoc analysis and therefore difficult to apply in development practices. However, as argued by several researchers (e.g., (Grint & Woolgar, 1997; McMaster et al., 1998) ANT does have a normative face. From the perspective of ANT KMSS development can be viewed as a continuous chain of *translations* in which a set of actors (focal actor) aims at forming a stabilized heterogeneous network to perform one or more K-manipulating activities.

According to (Callon, 1986) there are four phases (moments) in the translation process: *problematization, interessement, enrolment* and *mobilization*.

- **Problematization**. This is the process during which one set of actors, i.e. the focal actor, defines a problem in such way that the others can recognize it as their problem too. The focal actor also indicates that it has the means of resolving the shared problem and identifies the actors that might become key allies in its quest. Once the shared understanding is reached, the focal actor establishes the conditions that must occur in order for all the actors to satisfy their interests, namely an *obligatory passage point* (OPP).
- **Interessement**. Interessement is a process that aims at the gradual dissolution of existing networks and their replacement by a new network by locking actors identified during problematization into the roles the focal actor proposed for them. It involves carefully scanning other actors' visions, investigating the differences between their own and other actors' interests, trying to find out whether these differences would raise barriers to developing a commonly shared vision, convincing other actors that the interests defined by the focal actor are in fact their interests too, gaining their commitment to a set of goals, and creating incentives for actors such that they are willing to overcome obstacles in the way of passing through the OPP. If the interessement is successful, it will confirm the

validity of the problematization and the alliances.

- **Enrolment.** If successful, interessement leads to the actual enrolment of these actors where the proposed course of action is carried out, consolidating the roles and activities the focal actor originally suggested, and hence establishing of a stable network of alliances.
- **Mobilization**. The mobilization phase signifies the step to wider participation. The earlier steps persuaded only a limited number of actors, who may have been seen as representatives of the larger communities. Once the network has been effectively created, it is *mobilized* and whatever solution the focal actors proposed (e.g., IT-based application, new set of organizational values) gains wider acceptance, albeit subject to the translations that perforce occur.

Therefore, KMSS development process can be conceptualized as *a continuous chain of translations in which various interests are translated into technological solutions as well as organizational arrangements and procedures to be followed to make the system work properly*. Such conceptualization has several implications for KMSS development process. First, developers need to understand the perspectives and interests of all human and non-human actors involved because, ultimately, they will need to inscribe these into ITC-based artifacts and organizational procedures. Second, the four moments of translation suggest that the following tasks play a crucial role in KMSS development process:

- Formulating the organizational K-problem as the misalignment between the interests of B-things' and the interests of associated K-things, i.e., for B-thing to be in state X (the objective to be achieved), the associated K-things (K_1, … , K_n) must be in the states Y_1, …, Y_n (the desired state) (*Problematization*).
- Identifying the focal K-actor (or problem spokesperson) (*Problematization*).
- Identifying the K-manipulating activities needed to transform the states of K-things into the desired states (*Problematization*).
- Identifying the candidate K-actors to be involved in each of the required K-manipulating activities, together with their roles (*Problematization, Enrolment*).
- Specifying the ways in which these roles are to relate to one another in order to perform the required K-manipulating activities (Abou-Zeid, 2003) (*Enrolment*)
- Investigating the current interests of involved K-actors (*Problematization*).
- Determining the conditions that must occur in order for all the actors to satisfy their interests, i.e., an *obligatory passage point* (OPP) (*Problematization*).
- Identifying the obstacles the involved actors have to overcome in order to pass through the OPP (*Problematization*).
- Establishing mechanisms for dissolving existing networks (systems) (*Interessement*).
- Building mechanisms to convince each actor to go through the OPP (*Interessement*).
- Locking allies into the roles the focal actor proposed for them by gaining their commitment to a set of goals and a course of action (*Enrolment*).
- Building mechanisms to maintain and to expand the newly created network (system) (*Mobilization*).

5. Conclusion

We contend that the actor-network theory, with its symmetrical treatment of human and non-human actors, can be useful as one of the kernel theories of KMSS's design theory. As interests are the major driving forces in an organization, KMSS development is conceptualized as a sequence of translation processes in which an alignment of an initially diverse set of interests leads to a stable *hybrid collective* of humans and non-humans, technologies and non-technologies. There are several implications for the KMSS development process deriving from our theoretical orientation. First, human and non-human elements of KMSS must be given an equal voice during the stages of the KMSS development process. Second, as the effectiveness and stability of KMSS rest on the ability to align the interests of the involved actors, the explication of such interests is crucial. However, there are multiple potential representatives for each actor, whether being human or non-human, and each representative speaks on behalf the actor he/she represents from his/her own perspective (Pouloudi & Whitley, 2000). Therefore, the problem of how to choose actors' representatives and how they are allowed to articulate the interests of the actors they represent has to be addressed in future research. Third, the importance of the focal actor in determining the success factors for KMSS (OPP), identifying the candidate K-actors and their interests and mediating amongst them.

References

Abou-Zeid, E. (2002). A Knowledge Management Reference Model. *Journal of Knowledge Management, 6*(5), 486-499.

Abou-Zeid, E. (2003). *A Modeling Construct for Knowledge Management Support Systems.* Paper presented at the The 4th European Conference on Knowledge Management, 18-19 September, 2003, Oriel College, Oxford University, UK.

Alavi, M., & Leidner, D. (1999). Knowledge Management Systems: Issues, Challenges, and Benefits. *Communication of the AIS, 1*(7), http://cais.isworld.org/articles/1-7/.

Augier, M., & Vendela, M. (1999). Networks, Cognition and Management of Tacit Knowledge. *Journal of Knowledge Management, 3*(4), 252-261.

Boland, R., Tenkasi, R., & Te'Eni, D. (1996). Designing Information Technology to Support Distributed Cognition. In J. Meindl, C. Stubbart & J. Porac (Eds.), *Cognition Within and Between Organizations* (pp. 245-280): Sage Publications.

Bonifacio, M., Bouquet, P., & Traverso, P. (2002). Enabling Distributed Knowledge Management: Managerial and Technological Implications. *UPGRADE, III*(1), 24-30.

Calas, M., & Smircich, L. (1999). Past Modernism? Reflections and Tentative Directions. *Academy of Management Review, 24*(4), 649-671.

Callon, M. (1986). Some Elements of a Sociology of Translation: Domestication of the Scallops of the Fishermen. In J. Law (Ed.), *Power, Action and Belief: A New Sociology of knowledge?* (pp. 196-233). London: Routledge & Kegan Paul.

Callon, M., & Law, J. (1995). Agency and the Hybrid Collectif. *The South Atlantic Quarterly, 94*(2), 481-507.

Collins, H. (1974). The TEA Set: Tacit Knowledge and Scientific Networks. *Social Studies, 4*, 165–186.

Collins, H. (1993). The Structure of Knowledge. *Social Research, 60*(1), 95-116.

Cook, S., & Brown, J. (1999). Bridging Epistemologies: The Generative Dance Between Organizational Knowledge and Organizational Learning. *Organization Science, 10*(4), 381-

400.
Grant, R. (1996). Toward a Knowledge-Based Theory of the Firm. *Strategic Management Journal, Vol. 17*(Winter Special Issue), 109-112.
Grant, R. (1997). The Knowledge-Based View of the Firm, Implications for Management Practice. *Long Range Planning, 30*(3), 450-454.
Grant, R., & Baden-Fuller, C. (1995). A Knowledge-Based Theory of Inter-Firm Collaboration. *Academy of Management Best Papers Proceedings*, 17-21.
Grint, K., & Woolgar, S. (1997). *The Machine at Work*. Cambridge: Polity Press.
Hildreth, P. J., & Kimble, C. (2002). The Duality of Knowledge. *Information Research, 8*(1), Available at http://InformationR.net/ir/8-1/paper142.html.
Hislop, D., Newell, S., Scarbrough, H., & Swan, J. (2000). *Innovation Processes and the Management of Knowledge.* Paper presented at the BPRC Conference on 'Knowledge Management: Concepts and Controversies', University of Warwick, Coventry, United Kingdom.
Lamb, R., & Kling, R. (2003). Reconceptualizing Users as Social Actors in Information Systems Research. *MIS Quarterly, 27*(2), 197-235.
Latour, B. (1987). *Science in Action: How to Follow Scientists and Engineers Through Society*: Open University Press.
Latour, B. (1992). Where Are the Missing Masses? The Sociology of a Few Mundane Artifacts. In W. Bijker & J. Law (Eds.), *Shaping Technology / Building Society Studies in Sociotechnological Change* (pp. pp. 225-258). Cambridge, MA: MIT Press.
Malhotra, Y. (2002). Why Knowledge Do Management Systems Fail? Enablers and Constraints of Knowledge Management in Human Enterprises. In C. W. Holsapple (Ed.), *Handbook on Knowledge Management 1: Knowledge Matters* (pp. 577-599). Heidelberg, Germany: Springer-Verlag.
Markus, M., Majchrzak, A., & Gasser, L. (2002). A Design Theory for Systems that Support Emergent Knowledge Processes. *MIS Quarterly, 26*(3), 179-212.
McMaster, T., Vidgen, R., & Wastell, D. (1998). Networks of Association and Due Process in IS Development. In T. Larsen, L. Levine & J. DeGross (Eds.), *Information Systems: Current Issues and Future Changes* (pp. 341-357). Laxenburg: IFIP.
Mohrman, S., Finegold, D., & Klein, J. (2002). Designing the Knowledge Enterprise: Beyond Programs and Tools. *Organizational Dynamics, 31*(2), 134-150.
Nidumolu, S., Subramani, M., & Aldrich, A. (2001). Situated Learning and the Situated Knowledge Web: Exploring the Ground Beneath Knowledge Management. *Journal of Management Information Systems, 18*(1), 115-150.
Nonaka, I. (1994). A Dynamic Theory of Organizational Knowledge Creation. *Organization Science, 5*(1), 14-37.
Nonaka, I., & Reinmoeller, P. (2000). Dynamic Business Systems for Knowledge Creation and Utilization. In C. Despres & D. Chauvel (Eds.), *Knowledge Horizons: The Present and The Promise of Knowledge Management* (pp. 89-112). Boston: Butterworth-Heinemann.
Nonaka, I., & Takeuchi, H. (1995). *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*. New York: Oxford University Press.
Pan, S., & Scarbrough, H. (1999). Knowledge Management in Practice: An Exploratory Case Study. *Technology Analysis & Strategic Management, 11*(3), 359-374.
Polanyi, M. (1983). *The Tacit Dimension*. Gloucester, Massachusetts: Peter Smith.
Pouloudi, A., & Whitley, E. (2000). Representing Human and Nonhuman Stakeholders: On

Speaking with Authority. In R. Baskerville, J. Stage & G. J (Eds.), *Organizational and Social Perspectives on Information Technology* (pp. 339-354). Boston: Kluwer.

Rubenstein-Montano, B., Leibowitz, J., Buchwalter, J., McCaw, D., Newman, B., & Rebeck, K. (2001). A Systems Thinking Framework for Knowledge Management. *Decision Support Systems, 31*, 5-16.

Saint-Onge, H. (1996). Tacit Knowledge: The Key to the Strategic Alignment of Intellectual Capital. *Strategy & Leadership, 24*(2), 10-15.

Sierhuis, M., & Clancey, W. (1997). *Knowledge, Practice, Activities and People.* Paper presented at the AAAI Spring Symposium on Artificial Intelligence in Knowledge Management, Stanford University.

Somerville, I. (1997). Actor-Network Theory: A Useful Paradigm for the Analysis of the UK Cable/On-Line Sociotechnical Ensemble? , http://hsb.baylor.edu/ramsower/ais.ac.97/papers/somervil.htm.

Sowa, J. (2000). *Knowledge Representation*: Brooks/Cole.

Swan, J., Newell, S., & Robertson, M. (2000). *Limits of IT-driven Knowledge Management Initiatives for Interactive Innovation Processes: Towards a Community-Based Approach.* Paper presented at the HICSS-33, Maui, Hawaii.

Tsoukas, H. (1996). The Firm as a Distributed Knowledge System: A Constructionist Approach. *Strategic Management Journal, 17*((Winter Special Issue)), 11-25.

Vidgen, R., & McMaster, T. (1995). *Black Boxes, Non-Human Stakeholders and the Translation of IT Through Mediation.* Paper presented at the IFIP WG8.2 Working Conference on Information Technology and Changes in Organizational Work.

Walls, J., Widmeyer, G., & El-Sawy, O. (1992). Building an Information System Design Theory for Vigilant EIS. *Information Systems Research, 3*(1), 36-59.

Walsham, G. (1999). GIS for District-Level Administration in India: Problem and Opportunities. *MIS Quarterly, 23*(1), 39-66.