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The Emergence of Information Systems: A Communication-Based Theory

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An information system is more than just the information technology; it is the system that emerges from the complex interactions and relationships between the information technology and the organization. However, what impact information technology has on an organization and how organizational structures and organizational change influence information technology remains an open question. We propose a theory to explain how communication structures emerge and adapt to environmental changes. We operationalize the interplay of information technology and organization as language communities whose members use and develop domain-specific languages for communication. Our theory is anchored in the philosophy of language. In developing it as an emergent perspective, we argue that information systems are self-organizing and that control of this ability is disseminated throughout the system itself, to the members of the language community. Information technology influences the dynamics of this adaptation process as a fundamental constraint leading to perturbations for the information system. We demonstrate how this view is separated from the entanglement in practice perspective and show that this understanding has far-reaching consequences for developing, managing, and examining information systems.

Keywords: Emergence of Information Systems, Language, shared understanding, process theory, language community

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THE EMERGENCE OF INFORMATION SYSTEMS: A COMMUNICATION-BASED THEORY

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Abstract

An information system is more than just the information technology; it is the system that emerges from the complex interactions and relationships between the information technology and the organization. However, what impact information technology has on an organization and how organizational structures and organizational change influence information technology remains an open question. We propose a theory to explain how communication structures emerge and adapt to environmental changes. We operationalize the interplay of information technology and organization as language communities whose members use and develop domain-specific languages for communication. Our theory is anchored in the philosophy of language. In developing it as an emergent perspective, we argue that information systems are self-organizing and that control of this ability is disseminated throughout the system itself, to the members of the language community. Information technology influences the dynamics of this adaptation process as a fundamental constraint leading to perturbations for the information system. We demonstrate how this view is separated from the entanglement in practice perspective and show that this understanding has far-reaching consequences for developing, managing, and examining information systems.

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Introduction

How does information technology (IT) impact organizations and how does organizational change affect IT? What are suitable and rigorous theoretical approaches to answering these questions? As Markus and Robey (1988) illustrate, these questions mark the genesis of the discipline of Information Systems Research (ISR) with Leavitt and Whisler (1958)'s seminal paper "Management in the 1980's". The resulting body of knowledge of ISR for information systems (IS) experts is made up by distinctive knowledge about IS applications and IS development (ISD) process knowledge (Hirschheim and Klein 2003; Iivari et al. 2004). Whereas the so-called "technological imperative" (IT determines organizational structures) was prevalent during the early days of ISR, partially due to the high costs of the technical components (Aron 1969; Gorry and Scott Morton 1971; Zani 1970), today the social aspects and the "organizational imperative" (organizational structures determine IT) are often the focus of research attention (Baets 1992; Chan et al. 1997; Teo and King 1997) because many researchers and practitioners argue that the technology is generally reliable and well tried (Avison and Fitzgerald 1995, p. 6; Carr 2005).

Markus and Robey (1988), however, show that neither the technological imperative nor the organizational imperative are empirically evident. They propose a third perspective – the "emergent perspective" – which argues in favor of complex interdependencies between organization, IT, and other potential factors. From this point of view, an inIS is a *socio-technical system* in a specific organizational context, which includes both technical and organizational sub-systems (Bostrom and Heinen 1977). Therefore an IS is complex and multi-causal by nature (Leavitt 1965); it emerges from the mutually transformational interactions between IT and the organization (Truex et al. 1999). If neither the technological imperative nor the organizational imperative are causally stringent and empirically evident, both IT and organization must be influences on the emergence of an IS. An IS is not the IT alone, but the system that emerges from the mutually transformational interactions between the IT and the organization, the result of an IT enabling an organization, as much as an IS is the result of an organization enabling an IT (Lee 2004, pp. 11-12). Many researchers suggest that more attention should be given to the social act and the dynamics of adaptation of IS by human agents (Avgerou et al. 2004; Vaast and Walsham 2005). The resulting understanding recognizes that it becomes increasingly important to study the meanings that human agents ascribe to IT, given the local context in which they are to use IT, and in which their meanings about the application systems are constructed (Kjaergaard and Jensen 2008). This implies a focus on social processes and change, including issues such as meaning construction, cognition, learning, and sense-making.

Some approaches have been presented in ISR over recent years as an answer to these challenges. Among these, major strands are Structuration Theory, Complexity Theory, or Actor Network Theory. Structuration Theory, for example, is seen as the dominant social theory used in ISR today (Jones and Karsten 2008). However, in contrast to this dominating role, sociology and social theory offer a multiplicity of diverse competing and complementing social theories (Bourdieu 1977; Dahrendorf 1968; Habermas 1984; Latour 2005; Luhmann 1995; Touraine 1981). Structuration Theory offers a range of substantial and useful concepts that can be used as a lens for "viewing and explaining the world" (Gregor 2006, p. 613). Its concepts may need to be extended with additional constructs and theories, however, in order to yield fruitful hypotheses for ISR (Markus and Silver 2008, p. 620).

Taking this into account the research question we ask is: *How can we conceptualize the relation of IT and organization and the emergence of socio-technical systems over time?* In this paper, we propose and conceptualize a mid-range theory for "explaining and predicting" (Gregor 2006, p. 620) patterns of social processes and change in the relation between IT and organization, which is embedded in the emergent perspective. We suggest that social acts of "communication" are crucial for understanding emergence in socio-technical systems. At the core of our proposal we place the conjecture that socio-technical systems emerge continuously by adaptation of linguistic communication. We develop our theoretical explanation in the form of a process theory (Markus and Robey 1988). By developing a process theory, we recognize the dynamics and complexity of causal relationships and position ourselves as standing in the tradition of the emergent perspective and structurational approaches.

The paper is structured as follows. First, we critically review existing work in ISR in the tradition of three research streams on technology in organizations. We then develop our theory on the emergence of socio-technical systems by groups adapting their linguistic communication and discuss our findings in relation to influential theories in ISR, especially research on technology in organizations. We finish our paper and give an outlook on further research.

Theoretical Background and Related Work

Research Streams on Technology in Organizations

Research on technology in organizations can be characterized in multiple ways depending on purpose and point of view. We follow Orlikowski and Scott (2008)'s review who identified three research streams that are distinguished by their theoretical stance towards technology and are summarized in Table 1.

Table 1. Research Streams on Technology and Organizations (cf. Orlikowski and Scott 2008, p. 457)

	Research Stream I	**Research Stream II**	**Research Stream III**
Ontological Priority	Discrete Entities	Mutually Dependent Ensembles	Sociomaterial Assemblages
Primary Mechanisms	Impact; Moderation	Interaction; Affordance	Entanglement; Performativity
Logical Structure	Variance	Process	Relationality
Key Concepts	Technological Imperative; Contingency	Social Constructivism; Structuration	Actor-Network; Mangle of Practice
View of Social and Technical Worlds	Humans/organizations and technology are assumed to be discrete, independent entities with inherent characteristics	Humans/organizations and technology are assumed to be interdependent systems that shape each other through ongoing interaction	Humans/organizations and technology are assumed to exist only through their temporally emergent constitutive entanglement
Examples	Blau et al. (1976) Huber (1990) Aiman-Smith & Green (2002)	Barley (1986) Prasad (1993) Boudreau & Robey (2005)	Callon (1986a; 1986b) Pickering (1995) Suchman (2007)

Research stream I resonates well with Markus and Robey (1988)'s technological and organizational imperatives. In this stream of work, technology is treated as a specific and relatively distinct entity that interacts with various aspects of the organization. Many of the studies in this stream either posit technology as an independent variable having a range of effects on multiple organizational outcomes (the dependent variables) or view technology instead as a moderating variable that variously influences the relationship between organizational variables and certain outcomes. We do not discuss this research stream in detail because it is neither causally stringent nor empirically evident (Markus and Robey 1988).

Research stream II is identical with the emergent perspective advocated by Markus and Robey (1988). Technology is understood as part of the complex process through which organizing is accomplished. Here, the focus is not on organization or technology as discrete entities but on the dynamic interactions between people (or organizations) and technology over time. These interconnections are understood to be embedded and emergent, and thus not fully determinate (Avgerou et al. 2004; Ciborra 2001). Work in research stream II promotes that a detailed understanding of dynamic organizational processes is required in addition to knowledge about the intentions of human agents and the features of technology (Zammuto et al. 2007).

Research stream III is stated by Orlikowski and Scott (2008) to be "promising" and organized "under the banner of 'sociomateriality'". Instead of seeing actors and technologies as primarily self-contained entities that influence each other either through impacts or interactions, the focus is on "agencies that have so thoroughly saturated each other that previously taken-for-granted boundaries are dissolved."(p. 455). Humans (or organizations) and technology are assumed to exist only through their temporally emergent constitutive entanglement of the social and the material: "people and things only exist in relation to each other" (Orlikowski and Scott 2008, p. 455). This perspective is essentially a form of ontological relativism; humans or technologies have no inherent properties, but acquire form, attributes, and capabilities through their interpenetration.

Research stream II manifests itself in ISR mainly in structurational approaches. Structuration Theory is a theory of social action, which claims that society should be understood in terms of action and structure; a duality rather than two separate entities (Jones and Karsten 2008; Poole and DeSanctis 2003). Adapted to the IS field, this means that, on the one hand, IT artifacts are objectively real in the sense that they have embedded objective features and components, such as the hardware or the software. On the other hand, IT artifacts are also socially constructed in the sense that new structures emerge in human action as human agents interact with IT artifacts. Structuration Theory has influenced several theoretical proposals in IS research, for example, Adaptive Structuration Theory (AST, DeSanctis and Poole 1994) or the Model of the Duality of Technology (Orlikowski 1992). The differences between these approaches are the subject of vigorous, sometimes strident debate (Jones and Karsten 2009; Poole 2009).

Researchers in research stream III argue that one of the major problem of most structurational perspectives is their "ontology of separateness", that is, that they treat technology and humans as essentially different and separate realities (Orlikowski 2010b). This is why the third stream is advocated to show merit because it supposedly overcomes this separateness. However, if we adopt a purely sociomaterialist view (Orlikowski and Scott 2008), IT artifacts and human agents have no inherent properties, boundaries, or meanings. This then raises the question of where we draw the line between things for analytical purposes or in practice (Faulkner et al. 2010). Moreover, having a relativist ontology such as sociomateriality, which contends that properties of entities must be considered as subjective interpretations, raises also the question how we can produce knowledge at all (Weiss 2000). According to Orlikowski (2010b), the answers to these questions are "entanglement in practice" and "agential cuts" that are performed and temporarily stabilized through human practices. This is said to be exemplified, for example, in Actor Network Theory (ANT, Latour 1987; Latour 2005).

In a seminal paper, Marcus and Silver (2008) criticize that such proposals undermine the basic assumption that IT itself can play a causal role. We acknowledge the interplay of organization and IT, "not as the necessary result of a powerful technological infrastructure, or as principally reflecting the interpretations and interactions of the human developers or users" (Orlikowski 2010b, p. 136). Nevertheless, for us, the only consequence is that it is never clear a priori and independent of context whether an observed phenomenon should be treated as technical or social (Bijker 2010, p. 67). This view is relativistic only in the sense of methodology (Bijker 2010, p. 68). In this we agree with Pinch (2010) in that the "mutual interaction between social groups and technologies such as with the formation of a new social group around a new technology does not, however, necessarily lead to the more radical position that humans and non-humans are equivalent or that every effect of technology on humans needs to be brought into the analysis" (p. 85); this is the "opposite of magicians who make things and people disappear. Our goal is to make things and the humans who interact with them reappear" (Pinch 2010, p. 87). Therefore we share reservations about such proposals and follow the call for other concepts that refer to relations between IT artifacts and human agents (Markus and Silver 2008; Poole and DeSanctis 2004).

The "Missing Link": Communication

The previous section shows that there is a wide diversity of views about what technology exactly is and how best to conceptualize it (Faulkner et al. 2010, p. 1). Taken for granted the fundamental position that technological artifacts possess a 'dual nature' (Kroes 2010), being objects that, so to speak, "belong simultaneously to both the physical and the mental realms" (Faulkner et al. 2010, p. 4), a rigorous conceptualization of the interaction between technology and humans/organizations so far has been only rudimentary addressed in all research streams. How do humans and technology interact with each other? What are modes of operation? What are observable relations and identifiable patterns? In order to study the linkages between human agents and technological objects, we propose to look at the most obvious and natural, but at the same time, the most complex phenomenon of human interaction: language and linguistic communication.

Language is a mode of communication based upon symbolic reference and involving combinatorial rules for representing logical relationships among these symbols (Deacon 1997, p. 41). Our human brain is designed for that form of communication (Christiansen and Chater 2008; Deacon 1997; Kock 2004). Therefore it is widely recognized that language and speech are important for understanding human behavior because of human beings' uniqueness as a symbolic species (Pinker and Jackendoff 2005): "If one were to ask a panel of scientists and laypersons what accounts for the remarkably complexity of human cognitive abilities, social institutions, and culture, the most common response would almost certainly be 'Language'" (Tomasello 2008, p. 342).

Human knowledge and thinking, therefore, may also be tremendously influenced by language (Chater et al. 2009; Christiansen et al. 2009; Everett 2005). For example, English and Russian color terms divide the color spectrum differently, and Russian speakers are quicker to discriminate between two colors when they fall into different linguistic categories (Winawer et al. 2007). Similar results have been found in studies on the visual brain processing of color with English speakers (Regier and Kay 2009). This is not to say that language imposes any limits on our intellectual abilities (as posits the much-disputed Sapir-Whorf hypothesis); however, there is growing evidence that habits of speech can create habits of mind that affect more than the knowledge of language itself (Deutscher 2010, p. 234). (Note that this touches the ongoing and classic debate between language and perception in the cognitive sciences. For an overview we refer to Kay and Regier 2006.) Sense-making, too, is also an issue of language and speech; situations, organizations, and environments are "talked into existence" (Weick et al. 2005a, p. 409). Sense-making, to the extent that it involves communication, takes place in interactive talk and draws on the resources of language in order to formulate and exchange, through speech, symbolically encoded representations of these circumstances (Taylor et al. 1996; Taylor and Robichaud 2004; Weick et al. 2005a). A situation is "talked into being" through interactive exchanges between organizational actors to produce a view of circumstances including the people, their objects, their institutions and history, and their sitting in a finite time and place (Taylor and Van Every 2000, pp. 33-34). If a person, for example, "makes sense" of a new technological object she or he may do so by speaking about it to others.

At least partly because there is written language, which may be looked at and examined, we intuitively think of language as some kind of object itself (Tomasello 2008, p. 342). But it is not an object any more than a university, a government, any institution or game is an object in any interesting sense. If any, it is a "social object", a characteristic it shares with money: "Social objects are always … constituted by social acts; and, in a sense, the object is just the continuous possibility of the activity" (Searle 1995, p. 36). Speech, for example, is also a part of language, but certainly no object. Speech refers to the processes associated with the production and perception of sounds used in spoken language (Deacon 1997, p. 41). Language, or linguistic communication, is thus "a form of social action constituted by social conventions for achieving social ends, premised on at least some shared understandings and shared purposes among users" (Tomasello 2008, p. 343). Human collaboration and culture, and also technology, are as complex as they are mainly because they are typically organized and transmitted via linguistic conventions: "Human collaboration for building skyscrapers and creating universities, for example, is unimaginable without conventional forms of communication for setting the shared goals and subgoals and formulating the coordinated plans to achieve them. Human collaboration is the original home of human cooperative communication, but then this new form of communication facilitates ever more complex forms of collaboration in a revolutionary spiral" (Tomasello 2008, p. 343).

Language's emphasis on communication makes clear that it is a social fact and a group phenomenon: language is not just a way to communicate, but a way to cooperate as well, a device that people use to coordinate their behavior with one another so as to achieve some purpose (Malone and Crowston 1994; Pinker and Jackendoff 2005). For example, the literature is rife with evidence that organizational life is characterized by a substantial amount of communication: in meetings, conferences, and social events that fill the everyday life of workers and managers (Daft and Wiginton 1979; Ford and Ford 1995; Malone and Crowston 1994; Mintzberg 1973; Nahapiet and Ghoshal 1998; Prescott and Visscher 1980; Quinn and Dutton 2005; Taylor and Van Every 2000; Tsoukas 2005; Tsoukas and Chia 2002). Organizations or society as social systems arise autopoietically from the self-organizing communication processes of individual human actors (Luhmann 1995; Seidl 2007; Seidl and Becker 2005, pp. 29-33): "What we call 'the organization' is generated in the same conversation where individual actors find their identity" (Taylor and Van Every 2000, p. 171). Organizations are collections of decision elements and the channels by which they are connected – the neurons and their processes in the brain, men and their communications in the firm (Beer 1981, p. 231, p. 231).

With this in mind, some earlier researchers have drawn attention to the importance of language for ISR (Flores et al. 1988; Flores and Ludlow 1980; Goldkuhl and Lyytinen 1982; Lyytinen 1985; Winograd and Flores 1986). Similarly, the application of linguistic approaches to organizations has been considered by a number of other IS researchers as a necessary advance in IS theory (Clarke 2001; Land 1985; Rzevski 1985; Tully 1985). Language-based communication is taken as suitable basis for understanding and designing IS (Winograd 2006). Moreover, linguistic studies treat all "cultural processes as processes of communication" (Eco 1976, p. 8), thus providing a link between technology and humans/organization. Building on this, we likewise suggest that linguistic communication provides a conceptual bridge between IT artifacts and humans/organizations. There have indeed been studies in ISR on the relationship between different languages and IT (Holmqvist 1989; Holmqvist and Andersen 1987; Kaasbøll 1987; Per-

nille and Ojelanki 2009; Wynn et al. 2002), and the important role of language in IT-based communication systems has been a special concern of the Language-Action Perspective (Auramäki et al. 1992; Auramäki et al. 1988; Flores et al. 1988; Goldkuhl and Lyytinen 1982; Schoop 2001; Winograd and Flores 1986), of Symbolic Interaction studies (Gopal and Prasad 2000), or Organizational Semiotics (Clarke 2001). Interestingly, we also identified some related attempts in research stream II and III. This includes, for example, the emergence of forms of communications as analyzed for online co-operations of development teams (Orlikowski and Yates 1994) or in forums of online communities (Fayard and DeSanctis 2008). We are not aware, however, of any study in the two streams that similarly sees linguistic communication as the fulcrum of the interaction between technology and humans/organizations, or that offers theoretical insights on social processes with an emphasis on linguistic communication and the changing interplay between technological objects, language, sense-making, and meaning construction.

A Theory of Adaptation of Communication in Groups

The core idea of our theory is that human agents in organizations adapt their domain-specific languages to new or changed situations if required. For doing so we, firstly, describe the process of adapting linguistic communication in groups of human agents and, secondly, show how control of this adaptation process is realized by self-organization of group members. We then explain how linguistic communication of humans is linked to technological objects and vice versa.

The Foundation: Language Critique

Lyytinen (1985) argued early on that we need a deeper understanding of how to combine language views to intervene successfully in the communication practices of our organizations. He showed how different language views can be incorporated into ISR. He distinguished five particular language views that are summarized in Table 2. The five views differ fundamentally in their assumptions about the nature of language and should be chosen contingently for a given context.

Table 2. Different Language Views in ISR (Lyytinen 1985)

Language View	Level	Linguistic Phenomena Covered	Primary Function of Language
Fregean Core	Not important	Semantics (syntax)	Denotional
Chomskyan Grammar	Individual	Syntax, semantics	Ideational
Piaget's Schema	Individual	Semantics	Cognitive
Skinnerian Response	Individual	Pragmatics	Behavioral
Ordinary Speaking	Group	Pragmatics	Interactionistic sense-making

We base our theory on *Language Critique*, a branch of the philosophy of language known as the "Erlangen School" (for reviews see Butts and Brown 1989; Kamlah and Lorenzen 1984; Lorenzen 1987). Language Critique argues in the constructivist tradition that human beings use language to disclose the world (Kamlah and Lorenzen 1984, p. 33). Every perception of the world is language-bound so that language becomes the mediator between reality and an individual (Wittgenstein 1953, § 2). Nothing is an object "inherently"; it only becomes an object as we talk about it. For this reason we use language to represent some meaning that we conceive (Bühler 1990). Unlike radical constructivists (von Glasersfeld 1995), however, the Erlangen School promotes "methodological constructivism" and attempts to create a circular-free foundation for sciences and scientific languages (Kamlah and Lorenzen 1984, pp. x, 16; Lorenzen 1987, pp. 5-7). The Erlangen School is, therefore, decidedly not ontological relativist (Scherer and Dowling 1995). This puts Language Critique in between the Skinnerean Response view and the Ordinary Speaking view (see Table 2). The focus of Language Critique is on pragmatics, behavior, and interactionistic sense-making.

Adopting Language Critique, therefore, allows us to treat language as a social object and observable relations between human agents and groups, where language's primary function is to allow symbolic, social interaction (Gopal and Prasad 2000; Lyytinen 1985). The application of these linguistic concepts to the socio-technical interaction between humans and technology allows us to characterize inherent limitations of this interaction. Wwe share this interpretation of language with the often adopted but also disputed Language-Action Perspective (Allwood 1998; Ljungberg and Holm 1997).

Structure of Language Community Adaptation Process

The following fictitious setting shows that organizational life is very rich in linguistic communication and briefly demonstrates the basic relation of organization and IT:

Example *A logistics company operates an enterprise system to give technical support to its business processes. The employees of the logistics company execute work activities in business processes, such as transportation, handling, and storing, according to standard operating procedures. They coordinate their activities by communicating with each other, either directly or, technically mediated, by using the enterprise system and other technology. Samples of communication include written statements, (for example, documents such as delivery documents) and work-related vocal utterances in the execution of business processes (for example, conversations and talks about the state of shipping depots). This also includes all the business-related activities of employees using the enterprise system and other IT (for example, the recording of entries, or bookings).*

Language Critique offers the concept *"Language Community"* to explain why and how a group of people is able to understand each other, and to establish the conventions making the syntax, semantics and pragmatics of signs (Kamlah and Lorenzen 1984, pp. 45-47): a *Language Community* is a group of people that shares the relation of concept (meaning of a thing) and sign in a *Term* (a sign which has meaning) as the knowledge of how to use this Term.

Terms are agreed-upon predicators (Carnap 1956, p. 6); we state something about an object to which we point, in that we assert or deny a predicator of the object (Kamlah and Lorenzen 1984, p. 18). The explicit separation of "sign" and "meaning" helps us to avoid the problem of specifying the much disputed construct "concept" as an abstract cognitive unit of meaning (for a discussion, see Margolis and Laurence 2006). We are only interested in the combination of sign and concept in a Term.

In the words of Kamlah and Lorenzen (1984), since "discourse as actualized activity pursues the particular end of mutual understanding, we may say of language … that as a system of signs it promotes mutual understanding. For this very reason it is, in a unique way, a 'know-how' held in common, the possession of a 'language community'" (p. 47). The key notion is that within a language community, people acquire specialized kinds of discourse competence that enable them to participate in specialized groups (Faigley et al. 1985, p. 20).

Example (cont'd) *The enterprise system embodies parts of the logistics company's domain-specific language. The employees of the logistic company share (1) the knowledge about business processes (for example, logistics-related activities needed for transportation, handling, or storing), and (2) the knowledge of how to use the enterprise system and other IT (for example, activities related to using the enterprise system).*

The domain-specific language that is needed to understand and operate logistics processes, for example, is used by the employees in communication. This is called a *Terminology*. A Terminology is a set of technical Terms in a subject field, practice, or domain; it is the "common knowledge" of a Language Community. Terminologies are codes which allow people to communicate efficiently because they make redundant the iterative specification of all the Terms that embody them (Moldoveanu 2002). As standardized languages, they permit the communication of large amounts of information with minimal exchanges of symbols (March and Simon 1958, pp. 161-169). This decreases the costs of coordination and communication (Crémer et al. 2007; Selten and Warglien 2007).

Example (cont'd) *In work situations, the employees communicate and coordinate their activities by using company- or domain-specific language and jargon (a Terminology). For example, consider the following utterance: "I am storing this PLC in the auxiliary bin location. Could you enter this in Amadeus asap?" We assume that the speaker believes that the listener has no problem understanding the meaning of "PLC", "auxiliary bin location", "asap", or "Amadeus" – which are Terms of the of the domain specific language – and that the latter knows exactly what reaction is expected, which IT artifact to use and so forth. This is an example of "communication in the workplace".*

Based on Holten (2007) and summarized in Figure 1, we structure the process of adapting a Language Community in case of environmental changes in three phases: antecedent conditions, language construction, and outcome conditions. The process as a whole is triggered by *changing environmental conditions* (Virany et al. 1992). Human agents recognize and act on changing environmental conditions, altering their established interpretative schemes and adapting their domain-specific language.

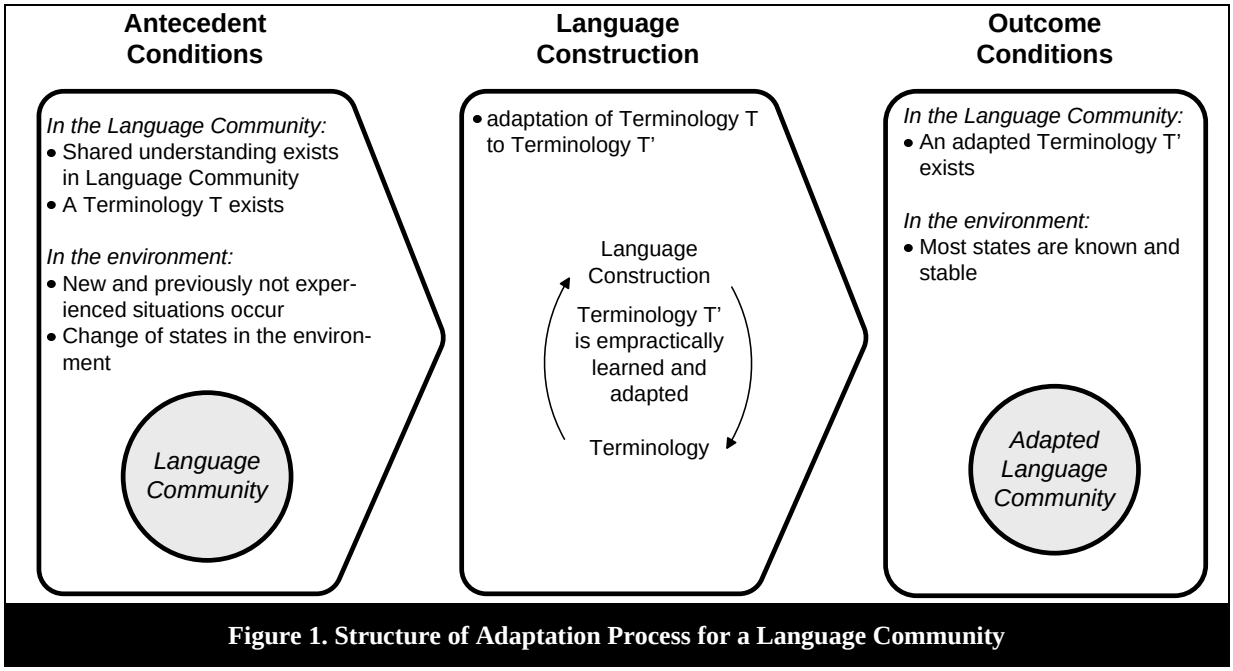

Figure 1. Structure of Adaptation Process for a Language Community

If environmental conditions change, there are two cases of relevance for members of a Language Community:

(1) The situation is known to the group. The group members have a shared understanding, established *interpretative schemes*, and Terms to describe this situation and states in domain-specific linguistic statements. These interpretative schemes are "the modes of typification incorporated within actors' stocks of knowledge, applied reflexively in the sustaining of communication" (Giddens 1984, p. 29).

(2) The situation is new or unknown to the group. They have no established interpretative schemes and lack the Terms, along with the relevant shared understanding, to describe this situation and states in domain-specific linguistic statements.

In the first case, the group of people forms a Language Community and the given Terminology enables them to engage in so-called *Terminological Discourse* about situations in the known world. In the second case the group does not form a Language Community for a new situation. The established interpretative schemes do not provide the concepts, and the Terminology-in-use does not provide Terms required to handle the new situation properly. Consequently, the group has to use words (signs) in pre-terminological, natural language for descriptions, conversations, and communication. The only prerequisite for this is the human faculty of language and speech. The meaning of these words (signs), however, may be ambiguous because of conflicting interpretative schemes. They are not agreed-upon Terms.

New Terms arise through *predication* from pre-terminological statements by people using signs in a specific context or situation. Following Kamlah and Lorenzen (1984) we call this operation *Language Construction*, which is described in the center of Figure 1. Language Construction aligns the meaning of Terms and relies on "the very accomplishment of acting and living together". In the words of Kamlah and Lorenzen (1984, p. 36), what " 'walking' or 'eating' is, 'sawing' or 'plowing' or 'roasting', 'controlling oneself', 'agreeing', 'praying', 'loving' and so on: we learn these things linguistically only along with the activities themselves, at the same time." (p. 36)This is also called *Empractical Learning;* people have to experience what the meaning of a Term in specific situations really is (Bühler 1990, pp. 176-179). Empractical Learning, acting and living together, has to take place in the case of Language Construction. This is, of course, a variant of an iterated learning model (Brighton and Kirby 2001; Smith

2004), where individuals acquire their linguistic competence based on observations of the linguistic behavior of other individuals.

Just from perceiving an object and hearing a word that supposedly describes that object, a word learner cannot know the intended meaning of the word due to referential indeterminacy; language speakers cannot have at hand all the concepts and perspectives that are embodied in the words of the language they are learning – they have to construct interpretative schemes over time through language use, using constraints to make a limited list of initial mappings and later rule out all except one (Deacon 2005; Tomasello 2008; Wellens et al. 2008, pp. 1-2). What a "computer" is, what a "rose" is, what "rattling", "pointing", "funny" are, all this has to be learned by the partner-in-discourse through examples and counter-examples, that is, these Terms have to be "introduced by example" (Kamlah and Lorenzen 1984, pp. 17-18). In organizations these examples, in the form of linguistic statements (uttered or written), are used during the work of a human agent, for example, by colleagues commenting on her or his current activity. The speaker tries, using language, to draw the attention of a hearer to a particular object or activity in a shared scene, and they then give each other feedback as to whether this interaction was successful.

Extension of Terminology defines the group's ability to terminologically adapt to new or formerly unknown situations. If the members of a Language Community engage in Language Construction to extend their Terminology they extend the "known world", the one that can be "talked about" (*Introduction of New Term)*. Extension of Terminology, by defining the relationship between the new Term and other Terms, means stating which Terms represent super-ordinate concepts, or specifying further attributes of a Term, and changes the known and expressible world. For example, "this bassoon is a woodwind instrument" (Kamlah and Lorenzen 1984, pp. 23-26 and 36-38). In contrast the pure introduction of synonyms (new words for existing concepts) does not change the known and expressible world.

Language Construction extends and changes Terminologies and leads from a Terminology T to a Terminology T'. An arbitrary sequence of Language Constructions leads from Terminology T^1 to Terminology T^n in n-1 steps (Holten 2007).

Control of Language Community Adaptation Process

Not every change in environmental conditions leads to an adaptation of a Language Community's Terminology. The best we can say is that environmental changes *might* cause the Language Community to act and to adapt the Terminology. We therefore need to clarify when and why Language Communities adapt to changing environmental conditions. We describe our concepts and explanations using the theoretical background, typology and terminology of general systems theory and cybernetics (Ashby 1964; Boulding 1956). Systems theory and cybernetics provide methodological rigor (Bailey 1994; Pickering 2002; Porra et al. 2005).

In the following, we regard a group of people forming a Language Community as a system. Changing environmental conditions are events in the environment of a Language Community (the system in focus). Perturbatory events give rise to new states and situations not previously encountered by the system. This provokes changes in the structures of the system. A *Perturbation* (P) is any interaction between system (Language Community) and environment that increases *environmental variety* (V_{EN}). Variety is the number of distinguishable states, elements and connections between the elements differentiated by an observer (Ashby 1964, p. 126). Perturbations from the environment do not determine what happens inside the system; rather, the changes are brought about by the disturbing event but determined by the structure of the disturbed system due to structural coupling (Maturana and Varela 1987, pp. 95-96); perturbations are those stimulating "irritations" that trigger internal operations in the system (Seidl 2005, p. 23). Consequently, they are influences on the system from the environment that take the form, not of inputs, but of disturbances that upset the balance of the established stasis of the system (Taylor 1995, p. 8).

Example (cont'd) *As a major new customer – a wholesale trader with significant market power – acts out in the scenery, this marks a new situation for the employees of the logistics company and changes their environmental conditions. The customer insists that the employees of the logistics company use their electronic inventory system via remote access. The inventory system is a new IT artifact for the employees of the logistics company (assuming that employees of the logistics company have no prior experience of the customer and the inventory system or did not participate in its development). In general, we can expect that the employees do not know this IT artifact at first. Neither do they know the wholesaler's company- or domain-specific language.*

A Language Community as a system can be in two major modes of operation: normal operation and adaptation. In

the *mode of normal operation*, human agents as members of the Language Community draw on their established interpretative schemes, using their contextual pre-knowledge and understanding of a situation that is manifested in their Terminology, to select and *filter* out those elements of environmental variety that constitute noise – meaningless data which cannot be interpreted according to these interpretative schemes (Boisot and MacMillan 2004).. However, if the *number of stimuli* (S) rises, a threshold point may be reached where the selection and filtering of environmental variety can no longer be handled by the human agents. Rising stimulus variety then turns the event into a Perturbation for the system (see Figure 2). This *individualization of filtering* out noise is in line with the concept of Language Community since members of a Language Community know what is worth communicating and what other members are likely to know and believe to be true about certain subjects (Faigley et al. 1985, p. 20).

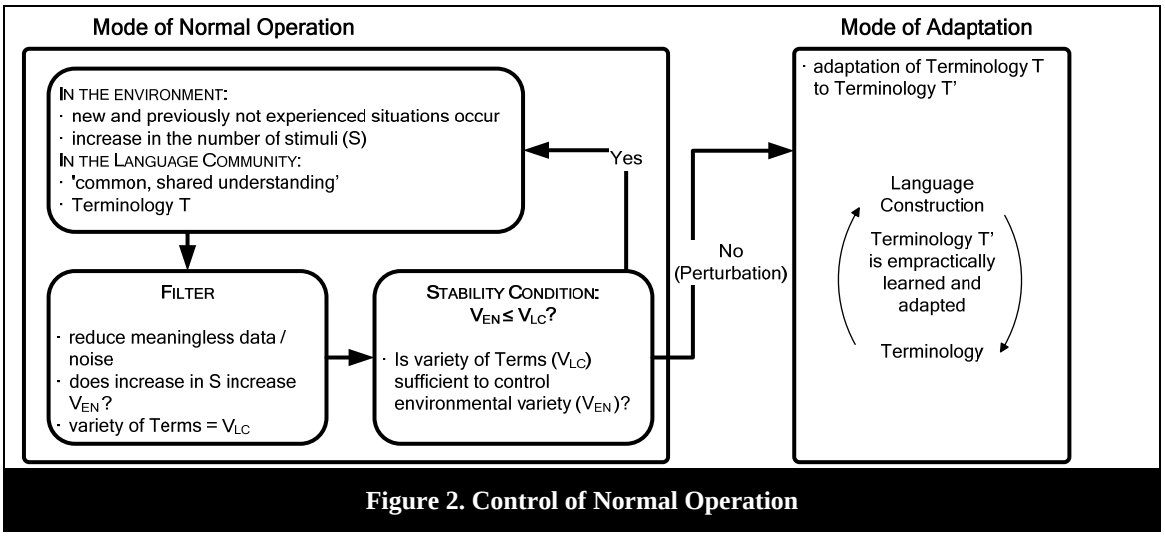

Figure 2. Control of Normal Operation

An event becomes a Perturbation for the system if the environmental variety rises beyond a threshold. Given the Terminology (T) of the Language Community remains unchanged, the *variety (number) of Terms of Terminology T* (V_{LC}) remains unchanged. Then the rising environmental variety breaks the *stability condition of a system* ($V_{EN} \leq V_{LC}$) forced by the law of requisite variety (Ashby 1964, p. 207). The law states that only variety can absorb variety. In case of an unchanged Terminology (T) and rising environmental variety ($V_{EN}\uparrow$) the members of the Language Community do not have enough Terms – not enough (requisite) *internal variety* (V_{LC}) – to describe the new situations and states that are caused by the changing environmental conditions. The stability condition is broken (which leads to $V_{EN} > V_{LC}$) and the system turns from the mode of normal operation to the mode of adaptation (Holten 2007). Figure 2 shows this control of the mode of normal operation in the form of a feedback control loop.

Example (cont'd) *As a reaction to this situation, the management team of the logistics company develops new job descriptions, standard operating procedures and training manuals to specify new work activities and business processes; the employees of the logistics company undergo training with the wholesaler's inventory system. Trainings and the new job descriptions are developed properly. Nevertheless, the employees come across unknown situations in their daily work with the new inventory system where the employees have to figure out what the meaning of messages, signs or notes really is. For example, how should the employees of the logistics company know that "AIDC" in the inventory system refers to "Automatic Identification and Data Capture" and means methods of automatically identifying objects, collecting data about them, and entering that data directly into the inventory system?*

In more general terms: because of the Law of Requisite Variety, a system has to regulate its internal variety as a (re-) action to variety-increasing Perturbations in order to return to systemic stability. A system threatened by Perturbation and increasing environmental variety needs the power to absorb this additional variety (Beer 1965). Consequently, the variety of stimuli impinging upon a system must be countered by the variety of responses that the system can muster. Beer (1965) showed that in complex systems such as social systems, the process of adaptation to changing environmental conditions can only be achieved by processes of *self-organization*. We argue that new stimuli that are deemed important in the enactment and sense-making processes (Weick et al. 2005b) by members of the Language Community trigger the necessary (re-) actions of self-organization in the Language Community. This is illustrated in Figure 3.

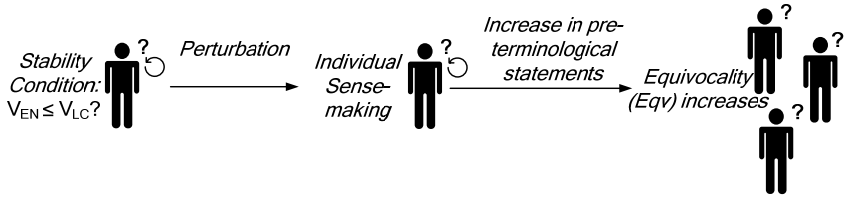

Figure 3. Trigger of Self-Organization

Firstly, the stability condition ($V_{EN} \leq V_{LC}$, Figure 2 and Figure 3) is controlled by every individual human agent. If the stability condition is broken (a Perturbation occurred), individuals absorb this uncertainty by transforming and replacing the complex, unknown world into an individually known world (Luhmann 2005, p. 99). Agents engage in sense-making and enactment processes that create new individual interpretative schemes. This is observable in more pre-terminological statements in natural language because individuals ascribe different words and signs to concepts and meanings and vice versa (for example, the abstract, mental concept of a unified enterprise application system can be described by different signs "enterprise system" versus "ERP system"). A higher degree of pre-terminological statements mirrors an increase in *equivocality* (Eqv ↑). Equivocality, or ambiguity, means the existence of multiple and conflicting interpretations of a situation (Daft and Lengel 1986; Daft and Macintosh 1981; Weick 1979, pp. 4-9). The meaning of a message or statement is not clear due to greater variety, greater ambiguity, or simple ignorance, and because of differences in sense-making and cognition between individual human agents that construct different interpretative schemes.

Example (cont'd) *Sometimes – in cases of misunderstandings or missing knowledge – a colleague can help, sometimes a customer's employee is asked for advice and sometimes the employees have to find out themselves how things work. To really understand the wholesaler's company- or domain-specific language, the employees have to experience in concrete situations, possibly guided by employees of the wholesaler, what the meaning of signs in the inventory system is. In the next months, the employees of the logistics company learn and adopt some words of the wholesaler' "language" or jargon and, additionally, they introduce some new terms themselves in order to talk about uncommon situations and states. Employees adopt words that are used in the inventory system to describe states of their daily work – for example, "AIDC" to describe the automatic identification of objects. Their daily work has been fundamentally changed due to the introduction of the inventory system, as has their communication.*

If equivocality further increases, at some point a threshold is reached where the process of empractically learning and aligning terms within the group is initiated (see Figure 4).

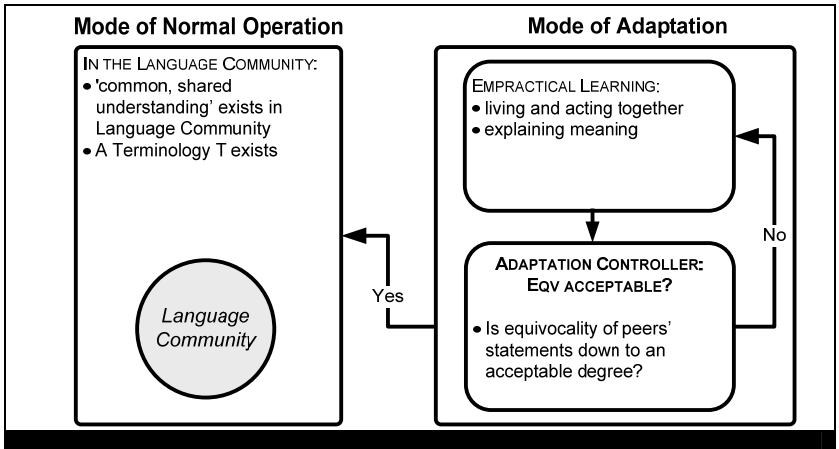

Figure 4. Control of Adaptation Process

This process of empractically learning and aligning new terms will go on as long as the individual humans in the group feel the degree of equivocality to be too high,. In fact the *degree of equivocality perceived by individual human agents* is the implementation of the self-organizational controller for this adaptation process. The adaptation of

the Terminology by members of the Language Community as a reaction to Perturbations forms the fulcrum of our theory with regard to emergent, self-organizing behavior. Essentially, we argue that the (re-) action of the members of a Language Community to Perturbations comprises a series of Terminology modifications that lead to new or modified agreements on the meaning of Terms and changes the mutual knowledge about the world shared by the Language Community (Holten 2007).

Example (cont'd) *These processes of learning the new situations last for about one year. After the first year of collaborating with the wholesaler there are only few situations where the logistics company's employees do not know how to handle a specific case. The usage of the inventory system has to be learned by the employees in concrete work situations. This leads to numerous conversations and communication about the inventory system in specific contexts. Other members can only observe the real activities and provide feedback. As a result, a new socio-technical system emerges with an adapted company- or domain-specific language for the logistics company*

As a result, we suggest the following propositions (see Figure 5) to theoretically explain how the self-organizing process of adapting communication in groups is controlled:

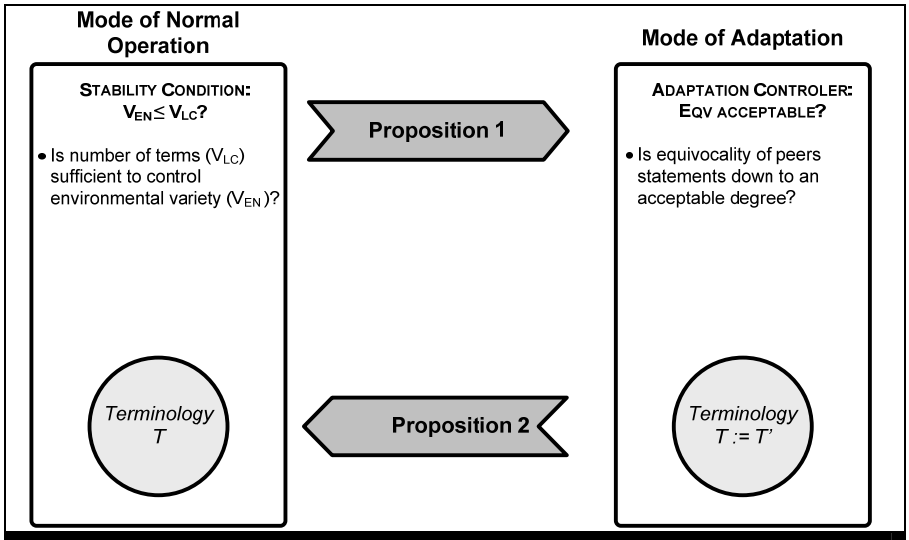

Figure 5. Adaptation Process of Language Community

Proposition 1 *In case of changing environmental conditions, sense-making processes of individual human agents may reach an intensity that environmental events are perceived as Perturbations and Terms in the Terminology of the Language Community are not sufficient. This breach of the stability condition turns the Language Community from the mode of normal operation into the mode of adaptation.*

Proposition 2 *In the mode of adaptation, human agents that are members of the Language Community engage in empractically learning and aligning Terms until perceived equivocality is reduced to an acceptable degree.*

Discussion

Implications for the Relationship between Technology and Organization

We suggest to conceptualize the social sub-system of an *IS as a Language Community.* Because an IS is, fundamentally, a technologically mediated social interaction system, it is aimed at creating, sharing and interpreting a wide variety of meanings (Hirschheim et al. 1995, p. 13; Truex et al. 1999). The technological sub-system of an IS includes application systems with IT artifacts for solving an organizational task. The social sub-system is composed of human individuals in an organizational setting as users of application systems, with the allocation of responsibilities for organizational tasks. IT is only able to play a limited role in an organization by capturing, storing, forwarding,

and processing data. The organized human behavior depends on making sense of this data and a far richer form of interaction than any machinery can account for (Stamper et al. 2000, p. 15). This interaction essentially relies on the linguistic communication of human agents that use a Terminology, and any group of people that shares a Terminology is a Language Community. An IT artifact, then, can essentially only be an *embodiment* of this Terminology, as a linguistic construction or artifact. The purpose of the IT artifact is to support the members of the social sub-system in their actions and activities by transporting, manipulating, and storing data. Thus, every IT artifact can also be understood as a linguistic construction based on Terms that are intended to (but do not necessarily have to) or should correspond to the Terminology of the IS as a Language Community. As a theoretical consequence, the group of people belonging to the Language Community "owning" the IT artifact as a linguistic construction can be identified and compared to the group of people faced with the same IT artifact. For the former group, we have an "information system" in the literal meaning of the word. In contrast, the latter group may contain individuals not belonging to the Language Community; those are then just confronted with an IT artifact that they do not understand properly.

Our theory has important consequences for the understanding of the relationship between technology and organization because we suggest that the self-organizing process we described explains the interplay between technical objects and human agents/organization. Three major consequences for the relationship between technology and organization arise from our theory:

(1) *Technical objects can enhance the efficiency of communication.* For example, if IT artifacts are seen as an embodiment of a Terminology, they can be used to transmit data more efficiently. In comparison with pre-terminological, natural language, a Terminology has a smaller number of signs or symbols (Terms), all having precise meanings for all members of the Language Community. Terminologies make redundant the iterative specification of all the Terms that embody them (Moldoveanu 2002) and allow for more efficient communication because the meaning of linguistic statements does not have to be defined repeatedly (Crémer et al. 2007; Loreto and Steels 2007; Selten and Warglien 2007). They permit the communication of large amounts of information with minimal exchanges of symbols (March and Simon 1958, pp. 161-169).

(2) *Technical objects can constrain or hamper the self-organizing process of adapting Language Communities*. For example, IT artifacts as embodiments of a Terminology might lead to a sclerosis of communication, where human agents stick to their established interpretative schemes and ignore (un-) willingly any changes in the environmental conditions. This can result in "social inertia", where no matter how hard you try, nothing seems to happen (Keen 1981, p. 24). A persistent Terminology for communication, enforced by existing IT artifacts, potentially enforces this behavior and constrains the self-organizing process of adapting the Terminology to changing environmental conditions. These kinds of constraints would characterize so-called "bad organization" (Ashby 1962, p. 267) and are potentially dangerous for the long-term viability and flexibility of an organization in case of Perturbations.

(3) *Technical objects can enable or cause the self-organizing process of adapting Language Communities*. For example, the development of a completely new IT artifact (in-house development of applications) or the implementation of an existing IT artifact in a new setting (implementation of standard software) can become Perturbations that causes the members of an IS as a Language Community to engage in self-organizing processes..

Implications for the Emergent Perspective

Our theory explains how human action leads to the alignment of concepts and meanings. In general, the emergent perspective gives ontological priority to the role of human agency in technological change. Ongoing interaction of human choices, actions, social histories and institutional contexts are of main interest (Orlikowski 2010a, p. 131). Therefore, the focus is on interpretations of IT to understand its influence on collaboration as well as interpretations and actions of developers creating IT. Because structures are linked to communication by interpretative schemes of human actors, these interpretative schemes are "the modes of typification incorporated within actors' stocks of knowledge, applied reflexively in the sustaining of communication" (Giddens 1984, p. 29). Consequently, our approach is also compatible with concepts of AST (DeSanctis and Poole 1994, pp. 136-137). In a seminal paper, Markus and Silver (2008) redefine key concepts of AST. For example, they propose the concept of *symbolic expressions* as a relational concept bridging IT artifacts and how users may interpret them(p. 623): "Things can only function as signs for members of shared culture or *language communities*. Thus the concept of symbolic expressions is clearly a relation between an IT artifact and a specified user group and, therefore, not a property of the artifact itself" (Markus and Silver 2008, p. 623, emphasis added). In accordance with our theory, we agree with Markus and Silver (2008)

that there is a conceptual gap between IT artifacts and actors' interpretations of them, which can be closed using a relational concept linking IT artifacts with a defined actor or group.

Our theory, especially the constructs "Term", "Terminology", and "Language Community" are clearly related to and add further detail to Markus' and Silver's (2008) concept of "symbolic expression". Because an IT artifact, seen as a linguistic artifact, should be an embodiment of a Terminology, we can relate human action and technology by linking both using language. Hence, we do not follow a mechanistic or deterministic approach while we accept technical objects and human agents as tangible entities. Consequently, our perspective is also contrary to viewing organizational and IT design as akin to a consciously planned, rational process by designers and managers. It is a well-known caveat that organizations very seldom evolve as planned or intended. Users as social entities, although characterized and tangible, cannot be completely formalized and understood. Hence, they have agency and can change in uncontrolled ways. As a result, the socio-material relations are not static because human agents as social entities are intrinsically autonomous and dynamic.

"Emergence" in our approach becomes manifest in communication and domain-specific languages (Terminologies) of Language Communities. This view is narrower than the *entanglement in practice perspective* proposed by Orlikowski (2010a), which comprises approaches in ISR following the relational ontology. For example, ANT (Callon 1986a; Latour 1987) is an influential example of an entanglement in practice perspective (Orlikowski 2010a) and used in many IS research studies (Scott and Wagner 2003; Walsham and Sahay 1999). Referring the summary of ANT key concepts compiled by Walsham et al. (1999, p. 42), the relation and differences of our theory and ANT is characterized as follows:

1. A major focus of ANT applied in particular contexts is to trace and explain the processes whereby relatively stable networks of aligned interests are created and maintained. Following ANT, successful networks are created through the enrollment of a sufficient body of allies and the translation of their interests so that they are willing to participate in particular ways of thinking and acting that maintain the network (Walsham and Sahay 1999, p. 42). In contrast, our theory does not look at the relation of the stability of working networks and aligned motivations but focuses on the stability and adaptation of Terminologies as domain-specific languages. We explain why and how Terminologies as domain-specific languages emerge and ask for the influence that changing environmental conditions can have. In our theory, motivations belong to the environment of the system we are interested in. In ANT, motivations are at the center.
2. We accept that there are motivations for collaborative working groups. However, in contrast to ANT, we do not focus at those motivations; they are excluded from our consideration. The rationale for this restriction is that the mechanisms of aligning concepts and meanings we described are strictly independent of any motivation in the sense of ANT. In our theory, these interests and motivations have the potential of becoming Perturbations for the Language Community. They are, however, strictly part of the system's environment with no direct "controlling power" concerning the adaptation process.
3. Actors in ANT include human beings and non-human actors such as technical objects, especially software code and models. Following our theory, conceptual models and software code are designed through linguistic actions and are (written-down) statements. These are called *marks* in Language Critique (Kamlah and Lorenzen 1984, p. 46). Marks as written-down or printed writing-signs are actualized as linguistic activities by the one who produces the marks in writing them, and again actualized by the one who reads them (Kamlah and Lorenzen 1984, pp. 46-51). This means that human agents exclusively can be actors in our approach. The rationale for this restriction is that our theory relies on humans' ability to language and speech as a prerequisite. This is not fulfilled for technical objects such as models or software code.[2] The same holds for the concepts "delegates" and "inscription" used in ANT. Delegates are actors who stand in and speak for particular viewpoints that have been inscribed in them, for example, software as frozen organizational discourse (Walsham and Sahay 1999, p. 42). In our interpretation, these ANT actors are not actors but marks.

[2] The fundamental operation in Language Critique is *predication* relating elements of two infinite sets (the infinite set of signs and the infinite set of concepts or meanings) into one term. This operation is not computable based on the Turing machine as the formal theoretical model restricting capabilities of computers until today. The formal reason, shown in Holten (2003), is that predication as an operation deals with sets which are not recursive enumerable. Since human ability to language and speech requires predication as fundamental operation it cannot be computable. Therefore technological artifacts cannot be actors in the sense of our theory.

4. Software as "frozen organizational discourse" is interpreted in ANT as an inhibitor of change, which displays properties of irreversibility. The degree of irreversibility in a network depends on the extent to which it is subsequently impossible to go back to a point where alternative possibilities exist. To a certain degree, the ANT concept of "irreversibility" is compatible to environmental constraints in our theory. If decisions are irreversible and have to be taken as facts, they possibly constrain the process of self-organized adaptation of a Language Community. For example, if terms and concepts are fixed (frozen) in an enterprise system, these terms constrain the adaptation behavior of a group in the sense of a cost factor. Nevertheless, the group will still be able to adapt its Terminology – but this self-organizing process may become more expensive and difficult than without frozen concepts. Therefore we see frozen organizational discourse (for example, software code and conceptual models) as belonging to the environment of the system. The same holds for the ANT concept called "immutable mobile". If irreversible elements do exist in the network these do constrain the system for a while, they transcend time and place, for example, software standards (Walsham and Sahay 1999, p. 42).

Another influential work on emerging social learning systems is proposed by Wenger (1998; 2000) and his research on "Communities of Practice". Wenger introduces the concepts of "boundaries" and "boundary objects", which are, for example, applied in recent works on IS development (Bergman 2009; Bergman et al. 2007). In relation to our theory this social theory has a far broader perspective. In our theory knowing as an act of participation in social learning systems is reduced to language and discourse and conceptualized by Language Community. Nevertheless, as in Wenger's approach the competence to use domain-specific language in our theory is always in interplay with a person's experience (Wenger 2000, pp. 226-227). Social learning is in our case conceptualized as empractical learning in the mode of adaptation. Concerning the central concept "Community of Practice" Wenger (2000, p. 230) proposes "enterprise", "mutuality" and "repertoire" as constituting dimensions. Our approach is best related to "repertoire" but is further limited to the usage and development of domain-specific languages as the repertoire of a Language Community. Nevertheless, we share the importance of language with Wenger's conceptualization of "boundary". In our case, the knowledge to use a domain-specific language defines the boundary of the Language Community. We operationalized the "stability condition" and the "adaptation controller" and clarified how theses boundaries are made up and how a Language Community does develop. Furthermore we clarified using the concept of "Perturbation" how a Language Community changes from mode of normal operation to the mode of adaptation. Wenger (2000, pp. 235-237)'s "boundary objects" can be translated into "marks" and "terminological discourse" in our case and "brokering" between CoPs is translated into a Language Community made up of subsets of two other Language Communities. The same holds for boundary objects in design (Bergman 2009; Bergman et al. 2007). The advantage of our theory related to Wenger's approach is that both modes of operation are directly empirically observable based on language and discourse of a group of persons. In our, as in Wenger's approach, language is a core element. Wenger's approach is broader but our theory is more precise and operationalizable on the operational level.

Emergent approaches in general have been criticized because they avoid reifying technology and downplay technological properties and affordances (Faulkner and Runde 2009; Orlikowski 2010a). Orlikowski (2010a, p. 133), for example, argues that this human-centric focus inhibits assigning agential power to the distinctive technological capabilities that interact with human interpretations and social action. As discussed above, this ontological priority of emergent approaches is classified as an "ontology of separateness": technology and humans are essentially different things that need to be joined together (Orlikowski 2010a, p. 134). This ontology has been challenged by approaches using an alternative "relational ontology". The main argument is that humans and the environment are entangled and interwoven, so that it is no longer possible to separate sociological from technological realities. As Introna (2009, p. 26) states it we "are thoroughly hybrid beings, cyborgs through and through"[3]. While agreeing that we need relational concepts to link technology and human/organizations, we already stated that we have reservations against such a relativist ontology. For us the relation of technology and human organization is merely a question of epistemology and not of ontology. The system we talk about (as a *description* of things we experience) and – as a consequence – its environment are defined by us as observers (Ashby 1964, p. 126) and are in no way ontological realities by themselves. But based on the separation of sign and meaning we accept ontological realities independent of our descriptions. As we stated, Language Critique provides "methodological constructivism" to explain that human beings use language to disclose the world (Kamlah and Lorenzen 1984, p. 33). Additionally we showed how human action itself controls the self-organizing processes of adaptation of the social sub-system. Therefore, we indeed believe that "technology and humans are essentially different things that need to be joined together" (Orlikowski 2010a, p. 134), and we showed that this can be done based on linguistic communication.

[3] Cited after Orlikowski (2010a, p. 134)

Implications for Research on Communication Forms and Emergence

Emergence in our theory, manifested in adaptation of Terminologies, is also different from previous work that regarded communication in the context of emergence (Fayard and DeSanctis 2008; Orlikowski and Yates 1994). Fayard and DeSanctis (2008), for example, analyze the emergence of communication forms in online forums based on "language games" developed by Wittgenstein (1953; 1969). The emergence of Terminologies, which forms the core of our approach, is closely related to the construct of language game. A language game is composed of words and actions and "must be understood as discursive practices that are socially enacted and intrinsically linked to actions" (Fayard and DeSanctis 2008, p. 681, p. 681). Our theory describes and explains *how* words, meanings, and practices are aligned for a group of people. The concepts of "empractical learning" and "adaptation control" were introduced for this purpose. Fayard and DeSanctis (2008, p. 681) claim that online forums are an "extreme" example of language games, where language plays a more important role than in other language games. We argue that this is true for every IT artifact related to an organization. Following our theory, an IT artifact is an embodiment of a Terminology and serves members of a Language Community by transporting, manipulating, and storing data, which ultimately are linguistic symbols. Therefore, we call for a refinement of Fayard and DeSanctis (2008, p. 681)'s proposition. For example, there are *degrees* to which language games are more or less extreme when IT artifacts are in use in an organization. We introduced the constructs "stability condition", "filtering", "Perturbation", "empractical learning" and "adaptation control" to clarify how these degrees of language games are operationalized in a Language Community. We suggest that this *degree of extremity* of a language game depends on the degree to which physical activities are related to communicational activities. One extreme – online forums as in the case of Fayard and DeSanctis (2008) – goes without physical interaction; but any other less extreme degree might be found in contemporary organizations. Therefore, as Fayard and DeSanctis (2008, p. 681) state for Wittgenstein's language games, our theory as well involves much more than speech acts (Austin 1962; Searle 1971).

Fayard and DeSanctis (2008) show that the *complexity* of Wittgenstein's language games varies with the number of words, potential actions, rules of the game, and roles taken by players. Related to this four-tuple (words, actions, rules, roles) characterizing a language game, our theory is reduced to a three-tuple (words, actions, roles). The words-actions relation is the core of the pragmatic usage of words, which are related to actions and technical objects in the experienced world of a group of people. This relation stems from Language Critique and is used in recent studies as a measure of complexity as well (Rosenkranz and Holten 2010; Rosenkranz et al. 2009). In addition, we introduced two modes of operation for Language Communities (mode of normal operation, mode of adaptation) in our theory and explained that the system's change in mode of operation is influenced by every member's linguistic actions. These influences on the Language Community's mode of operation relates to the concept of role in Wittgenstein's language game. In contrast to language games, our theory does not look at rules.

Compared to "genres" (Orlikowski and Yates 1994), Language Communities in our theory and the communities of Wittgenstein's language games do organize themselves (Fayard and DeSanctis 2008, p. 681). We introduced the concepts of "filtering", "stability condition" and "adaptation control" to explain how self-organization in adapting Language Communities works. While communication structures in our theory are realized as domain-specific languages and Language Communities, the concept of genre, as proposed by Orlokowski and Yates (1994), deals with forms of texts. For example, Orlikowski and Yates (1994) use discourse analysis to classify conversations as "dialogue", "proposal", "memo" or "ballot questionnaire" based on the structures of online texts. In the study of Fayard and DeSanctis (2008), several types of language games are identified for online forums. In relation to our theory these types or forms of texts correspond to the structure of discourse statements and of marks as frozen statements. In contrast, Terminologies as domain-specific languages in our theory deal with aligned meanings of words used in communicational discourse. Our theory does not look at the structure of statements.

Implications for Information Systems Research

We want to integrate our contribution into the body of knowledge for IS experts. Based on a meta research (Hirschheim and Klein 2003; Iivari et al. 2004) propose to structure distinctive knowledge of IS experts as IS application knowledge and ISD process knowledge. The latter, which defines the field of our theory, is made of expertise of (1) organizational aligning IT artifacts, (2) user requirements construction, (3) organizational implementation, and (4) evaluation/assessment of these artifacts and related changes (Hirschheim and Klein 2003; Iivari et al. 2004). Following our propositions 1 and 2, Language Communities emerge from individual sense-making and group-actions due to changing environmental conditions. This provides the potential for theoretical explanations of all ISD compe-

tences: IT artifacts can, on the one hand, be interpreted as an environmental change that leads to perturbations and adaptation processes of a Language Community. On the other hand, IT artifacts can inhibit the Language Community's self-organizing processes of adaptation because of static and inflexible implementations. Both aspects directly relate to the alignment of organization and IT artifacts (1). The field of requirements construction (2) is best explained as the alignment of Language Communities. Technical experts and business experts finally have to speak the same language. If not, the requirements specifications constructed – IT artifacts which are marks in our sense – will not describe what the business wants in a manner the technicians can understand. So they cannot provide a successful solution. The same holds for the third aspect, organizational implementation (3). Here, as interpreted by our theory, new or changed processes based on new IT artifacts are environmental changes leading to Perturbations of the Language Communities. Adaptation processes as described by our theory will take place. But, and this is by no way surprising following our theory, these adaptations will take (long) time, lead to organizational resistance and likely to not estimated outcomes of the change projects. Finally, assessments and evaluation of changes (4) are obviously related to adaptation processes of Language Communities.

Our theory allows to extend a variety of specific theories within the emergent perspective, especially the AST framework. Existing approaches can be complemented by our model. We provide a parsimonious theory as a foundation for further work in the emergent perspective. For example, our conceptualization might help to explain the adaptation of IS as an autopoietic process (Hirschheim et al. 1991; Truex et al. 1999): the change of a Terminology by Language Construction is enacted and situated in circular, reflexive, and interlinking communication processes of human agents. However, we also advise caution. In terms of Giddens (1984)'s dimensions of the duality of structure, we only deal with signification, interpretative schemes, and communication. As Markus and Silver (2008) note, conditions other than technology – users' capabilities, characteristics and goals, their interpretations of technology, their work practices, and institutional contexts, power, or culture – may play key roles in causal explanations. We agree with Markus and Silver (2008) that the continual emergence of new technologies inevitably requires ongoing conceptual development. Our concepts are intended to allow researchers to develop specific hypotheses and measurement instruments for investigating the processes of communication.

A wealth of possible research settings and applications spawns from our conceptualization. For example, we are interested in understanding whether and how agreement in Language Communities emerges or instead fragmentation occurs, starting from each individual member with having a different understanding of concepts. Moreover, which characteristics of individuals favor or hinder the emergence of agreement? The impact of social and cognitive capacities on communication and construction of a shared language has also been observed by linguistic research (Galantucci 2005; Steels 2006).

Implications for Practice

Some implications of our theory are most interesting for practitioners. Firstly, if Language Communities are self-organizing systems, then the implementation of any IT artifact influences the IS and its self-organizing processes: *every IT artifact can become a Perturbation*, leading to increasing variety and equivocality. We expect members of Language Communities to react accordingly to these disturbances. Therefore we suppose that groups whose members are able to (1) consciously and (2) swiftly change their mode of operation in the case of Perturbations (i. e., when new situations arise) adapt better than groups whose members are unaware, who hesitate and react uncertainly.

Secondly, in a self-organizing system each participant is also a manager of this system. This is called a "heterarchy", the antipode of a "hierarchy" (von Foerster 1984, p. 8). Bavelas (1952) showed in an experimental setting that heterarchical group structures performed better in the task of finding a common symbol than hierarchical group structures because of the *invention of new Terms for communication* (von Foerster 1984, pp. 20-22). We suggest that for members of Language Communities, an efficient adaptation strategy may be to change systematically and swiftly from the mode of normal operation (Terminological Discourse) to the mode of adaptation (Language Construction) if Terms are missing or if misunderstandings do occur in new situations.

In that sense change must not be thought of as a property of organization; rather organization must be understood as a property of change – the attempt so simplify and stabilize a dynamic experience of change by language (Tsoukas and Chia 2002). Our theory can guide the design of effective interventions for developing and introducing new IT artifacts into organizations – IT usage cannot be brought about simply by order; members of a group can only ever be steered and encouraged to adopt an IT artifact by Empractical Learning. As Weick (1979) argues, "[m]ost 'objects' in organizations consist of communications, meanings, images, myths, and interpretations, all of which offer

considerable latitude for definition and self-validation"(p. 157). Our theory suggests that the examination of Language Communities is the key to understanding how organizations and IT interact and co-evolve. Moreover, the development of efficient and effective IT artifacts might need conscious and deliberate "language construction" on the part of the organizational actors. We need a more detailed understanding of those co-evolutionary processes in order to intervene successfully in our daily work practices.

Conclusion

In this paper, we have proposed a theory to explain and predict in a unique and novel way how organizational actors and IT artifacts develop and co-evolve by self-organizing processes. We argue that linguistic communication forms the fulcrum of an IS. IT is only a means to this end. Based on Language Critique, we introduced two modes of operation of Language Communities: Terminological Discourse as the normal mode of operation and Language Construction as the mode of adaptation.

We emphasize that language is an important "variable of interest" (Pondy 2005, p. 133) and should become a central feature of study in ISR. We suggest that our theory illuminates some of the factors that lead to specific behavior patterns in IS. We explain theoretically the characteristics of human actors in IS with regard to their capacity for self-organization and language.

We conclude that our theory contributes to solving the two structural problems of the IS discipline as identified by (Hirschheim and Klein 2003, pp. 241, 260, pp. 241, 260): fragmentation and communication gaps. Our theory provides a means to integrate diverse research fields from sociology, organization and management science and technically oriented areas by providing a communicational basis without being too abstract. We intend to contribute to the development of common ground by simultaneously appreciating the IS discipline's pluralism (Hirschheim and Klein 2003, p. 255, p. 255). Our next step is to confront our theory with empirical data in order to corroborate our conjectures.

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