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Communication in Organizations: The Heart of Information Systems

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Communication in Organizations: The Heart of Information Systems

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Abstract

We propose a theory characterizing information systems (IS) as language communities which use and develop domain-specific languages for communication. Our theory is anchored in Language Critique, a branch of philosophy of language. In developing our theory, we draw on Systems Theory and Cybernetics as a theoretical framework. "Organization" of a system is directly related to communication of its sub-systems. "Big systems" are self-organizing and the control of this ability is disseminated throughout the system itself. Therefore, the influence on changes of the system from its outside is limited. Operations intended to change an organization are restricted to indirect approaches. The creation of domain-specific languages by the system itself leads to advantageous communication costs compared to colloquial communication at the price of set-up costs for language communities. Furthermore, we demonstrate how our theoretical constructs help to describe and predict the behavior of IS. Finally, we discuss implications of our theory for further research and IS in general.

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1 Introduction

Many important questions about IS and organizational design and the employed processes are relevant to practitioners, researchers, educators, and managers. "What makes a 'good' IS design?", "How can IS design be taught better?", "Which characteristics of IS make them most valuable to a company?" The answers can be very difficult to pin down. However, the value in furthering understanding of these issues is enormous.

As Malone & Crowston [1994 pp. 87-99] note, there has been a growing interest in questions about how the activities of complex systems can be coordinated: how will the widespread use of information technology (IT) change the ways people work together? How can actors establish a common language that allows them to communicate in the first place? This question of developing standards for communication is of crucial concern in designing IS in general and cooperative work in particular. Research into these issues seems to be a legitimate area of inquiry. Therefore, during the past few years, there has been a growing tendency of researchers to increasingly pay attention to those ideas that are directly relevant to the social complexity created by and among disparate groups of people who together make up organizations and IS. As Nobel laureate John Mather said, "I'm convinced that over half of the cost of a project is socially (contextually) determined." [Cooke-Davies et al., 2007 p. 50].

Accordingly, we assume that social systems such as organizations arise from communication, a view popularized, for instance, by the German sociologist Niklas Luhmann [Luhmann, 1995, Seidl and Becker, 2005]. 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]. In our view, communicating is what IS do and the communication structure is that part of an organization that is called IS. We therefore examine IS with a focus on the communication structure of an organization. The focus on communication structures is important for the development of an IS theory because we argue that communication is the central operation type of organizations, making it the domain of IS.

The theory that is presented in this paper has two related, but distinct goals. The first and primary goal is to give a formal description of what is required for communication and self-organization respectively to be established in an IS. We believe that laying this formal foundation is critical. A clear understanding of the requirements involved in constructing and maintaining communication and self-organization will allow us to know when we should be surprised that such behavior exists, and when we should be surprised that it does not. The second and more speculative goal is to use the developed formal framework to begin to answer some questions about costs of communication and language that we feel are important for IS. To arrive at more refined models for examining coordination, communication and IS, we have studied Cybernetics and philosophy of language, particularly the theoretical model of self-organization and the concept of language communities. Consequently, we have taken a different route than other research in this field, following the statements of Feyerabend [1993 p. 120] that unconventional routes might yield new insights. The research presented here is more modest and does not propose a revolutionary breakthrough, but hopefully arrives at new insights by looking at IS through integrating models from Cybernetics and philosophy of language.

This paper contributes to the development of IS theory by proposing an explanation of how IS self-organize and how communication structures do develop. The paper proceeds as follows. In section 2 we draw on Systems Theory and Cybernetics as a theoretical framework. To better understand what language is and how it works as medium of communication, we refer to Language Critique in section 3. The core of our theory is developed in section 4. We transfer insights from Language Critique into the domain of IS itself and argue that communication in organizations is one central function of IS. Two main operations which establish an IS are identified, and a characterization of IS as language-centered systems is presented. Afterwards, using a framework in section 5, communication in organizations is linked to the so-called IT artifact in order to specify relations of our theoretical constructs. Then, cost drivers of communication functions are developed to further analyze these theoretical relations in section 6. In section 7 we demonstrate how our theoretical constructs can be transferred into actual research settings, and how they can help to describe and predict the behavior of IS. In section 8, we discuss related and competing approaches and implications of our findings for IS research as a discipline of its own. Finally the conclusions summarize the findings and an outlook for further research is given.

2 Communication and Organization – Systems Theory and Cybernetics

In this fist constructive step, we propose that our theoretical concepts and their relations should be independent of technological progress and any contemporary IT. Therefore, we suggest to frame our theory using theoretical findings from Cybernetics provided by Ashby [1962] and Beer [Beer, 1965]. Since fundamental cybernetic ideas are directly referenced by several organizational and IS researchers [e. g., Benbya and McKelvey, 2006 p. 293, Daft and Wiginton, 1979 p. 182, Gregor, 2006 p. 628, Kawalek and Wastell, 1999, Mumford, 1998 p. 44, Osborn et al., 1977 p. 305, Pondy, 2005 p. 126, Tushman and Nadler, 1978 p. 619], we are convinced that it is a valid approach to go back to the "rough ground" of the original and truly interdisciplinary ideas of Cybernetics – in the words of Wiener [1948], the study of control and communication – to explore their usefulness for analyzing communication in IS and organizations.

We draw on communication between (sub-)systems to clarify what we mean by the word "organization". Especially, we are interested in so-called "big systems". In contrast to small, determined and well-defined systems, the volume of information defining the behavior of big systems such as large and complex organizations and IS is proliferating [Beer, 1965, p. 225]. The theoretical frame to deal with big systems is provided by Cybernetics [Beer, 1965, p. 223]. Communication from one sub-system to another necessarily implies some constraint, some correlation between what happens at the former and what at the latter. If, for a given event at the first sub-system, all possible events may occur at the second sub-system, then there is no communication from the first to the second [Ashby, 1962, p. 257]. Sub-systems (or parts of a system) are called "organized" when communication occurs between them. The natural converse is that of independence, which represents non-communication [Ashby, 1962,

p. 257]. Consequently, the degree of organization can be too high as well as too low [Ashby, 1962, p. 265].

"Organization", understood in this sense, is closely related to the concept of "control". Control in big systems is defined as stable communication between sub-systems, meaning a stable organization. Therefore, control is precisely the stable state of the variety interactions between the nominated sub-systems [Beer, 1965, p. 226]. This perspective regards communication as interpenetrative between sub-systems which are richly interconnected – (in the limit) element by element. For instance, a group of persons is under control in this sense, if the communication structure within that group (its organization) is stable and not changing over time. Two departments as sub-systems of a company are under control if the communication structures interconnecting these departments are stable, that is not changing over time. Finally, a supply chain made of two companies is under control, if these two companies are stably interacting, that is, the communication structures are stable and not changing over time. It is important to note that all properties of an organization are relative to some given environment, or to some given set of threats and disturbances, or to some given set of problems [Ashby, 1962, p. 266]. A system that adjusts its way of behavior relative to changing internal or external conditions is termed *self-organizing* [Ashby, 1947, Ashby, 1962, p. 267]. The question arises why an organization should begin to change, that is, why given communication structures are no longer felt appropriate.

In all cases there must be given, and specified, first a set of disturbances and secondly a goal. The goal is specified as an assigned set of "essential variables" to be held within assigned limits. Alternatively, the goal can be specified as a number of sub-systems so interacting as to achieve some given "focal condition" concerning the stability of their communication structures. Note, in fact the goal is control in the sense introduced above.

Disturbances threaten the goal, that is, the system's outcome is driven outside the limits specified for its essential variables or the stability of its communication structure (focal condition) is disrupted. That is, disturbances threaten the system's control. Therefore the system needs to adapt to the changed environment. Then the organization is judged "good" if and only if it acts so as to keep the assigned set of "essential variables" within assigned limits, or if a number of its sub-systems so interacting as to achieve some given "focal condition" [Ashby, 1962, p. 263]. That is, the organization is "good" if it makes the system stable around the goal assigned by an observer; or – alternatively – the system that remains under control, or is brought back to any stable state (not necessarily the point of origin) in case of perturbations when threatened, has a "good" organization.

The command structure in a big system is self-organizing in this sense. It changes from time to time and its location is a function of the information available to a given concatenation of its parts. It is the information flow that determines which concatenation matters, and that therefore delineates the command centre [Beer, 1981, p. 232]. Now, for big systems the relation of organization and control becomes obvious. Looking at big systems as composed of sub-systems means to understand *systemic stability* (stable variety interaction and stable communication between sub-systems) itself as the o*bject of the systems* instead of holding steady an arbitrarily assigned output – which is the usual criterion of control engineering [Beer, 1965, p. 226]. This means, big systems are under control, if and only if, their communication structures adopt to changing environments to guarantee communication.

The remaining question is how we can design a controller doing all this? What is this controller enabling the big system being self-organizing in this way? What does have enough power to assure adaptability of communication structures (control) for big systems? To answer these questions some group theoretic formulations with respective conclusions are quite helpful. For a start, following Ashby's law of requisite variety [Ashby, 1956, Ashby, 1958], any controller needs the power to absorb the variety proliferated by what is to be controlled. Thus, if a big system (e. g., a company or a group of persons) is to be controlled, we first need a model of that big system. Let us call this model *M*. To enable control, our model *M* has to preserve a one-one correspondence of elements with regard to the big system to be controlled, otherwise control based on this model would not be possible due to Ashby's law. If a one-one correspondence between *M* and the big system is preserved, we group-theoretically speak of an isomorphism [Beer, 1965, p. 225].

Second, we need to understand what is isomorphic (i. e., preserving a one-one-correspondence) to a big system. Our group-theoretic formulation then gives the clue to answer this question. As Beer [1965, p. 225] notes, Cayley's theorem declares that every finite group is isomorphic to a certain group of permutations of itself; one of these is the *identical* permutation. In other words, the isomorphism we seek for the big system is itself. That is, to preserve the one-one-correspondence we need a system as big as the big system itself (one of the permutations of the finite group), and therefore the big system *itself* (the identical permutation) is the model *M* we seek. This must be true since for a given big system it is impossible to create another big system as controller since the resulting total system comprising both big systems as sub-systems would be even bigger. "Hence the big system *M*, to which is clamped another system *A* which is in fact itself, is to be called controlled" [Beer, 1965, p. 225].

Thus, the power to absorb the variety proliferated by the big system to be controlled must be disseminated throughout the big system itself rather then being concentrated in a control box or a manager [Beer, 1965, p. 226]. Therefore we talk about self-organizing systems. To give material substance to the mathematical abstraction of a big system's isomorphism with itself, we could think of cleaving the system in half through its plane. Then every element is twinned, and the idea of what constitutes effective control suddenly becomes blindingly clear. For although there is no means of saying exactly what is included in any sub-system, and although we may be quite unable to analyze the relationships which subsist between the elements of these sub-systems, we shall still be able to talk about control.

Comprehension therefore begins with observations about the way in which sub-systems of the big system interact [Beer, 1965, p. 226].

3 The Heart of Information Systems – Domain-specific Languages

The second constructive step we undertake now sharpens our theoretical constructs. We especially introduce operation types which clarify what we mean by communication. This second constructive step is still independent of contemporary IT. To better understand interactions and communication between sub-systems, we draw on a theoretical approach conceptualizing IS as social systems, operating as so-called language communities [Holten, 2003, Holten, 2007] (section 4). This approach is based on the separation of sign and meaning as discussed for a long time in linguistics [e. g., de Saussure, 1974, Morris, 1971]. To unfold the fundamentals of this approach, we first sketch out the essentials of Language Critique, a branch of constructive philosophy known as the "Erlangen School", of Wilhelm Kamlah & Paul Lorenzen [Kamlah and Lorenzen, 1984, Lorenzen, 1987, Lorenzen, 2000].

Kamlah & Lorenzen argue that language is used to disclose the world [Kamlah and Lorenzen, 1984, p. 33] and is based on two fundamental abstractions: (1) from discourse to language as a system of signs and (2) from sign to concept (Figure 1). First, language and discourse are separated leading to the distinction of schema versus linguistic action. By this, Kamlah & Lorenzen provide a means of separating signs from their linguistic usage [Kamlah and Lorenzen, 1984, pp. 44]. The former leads to a schema of a language, the latter is called discourse and means the repeatedly actualized usage of signs in changing combination and variation. Thus, discourse is an actualized activity, whereas the schema of a language comprises potential activities, defined as activity-schema [Kamlah and Lorenzen, 1984, p. 45].

To separate meaning from sign, Language Critique uses a second abstraction. A concept "is at first no more than a term; however we abstract from the arbitrary sound-pattern of a term when we call it a ‘concept’” [Kamlah and Lorenzen, 1984, p. 72]. Given a term, *concept* is the meaning of this term. If statements are made about signs which are invariant with respect to the changing meaning of these signs, these statements deal with the *sound-pattern*. That is, disregarding the meaning as an abstraction is required to get the sound-pattern of a sign [Kamlah and Lorenzen, 1984, p. 73].

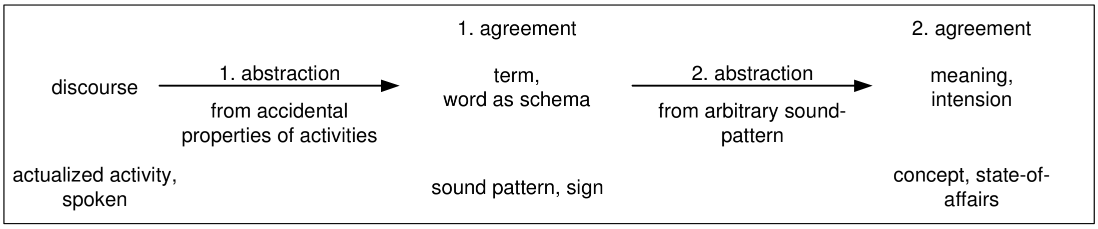

Figure 1 Agreements and Abstractions in the Language Critique Approach [Holten, 2003]

To explain where the conventions aligning syntactics, semantics and pragmatics of symbols in the sense of Morris [1971] come from, Language Critique offers the construct “*language community*”: a new term is introduced by explicit agreement with respect to its usage and meaning [Kamlah and Lorenzen, 1984, p. 57]. That is, there are no languages without users, and the meaning of every language construct for one member is aligned with the other members’ understandings in the language community. Pragmatics is thus directly related to the existence of a language community. Language communities have to be created by introducing symbols and explaining them. This agreement leads to a relation of concept and term and is shared by a language community as the knowledge of using this term [Kamlah and Lorenzen, 1984, p. 45]. In the words of Kamlah & Lorenzen: “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’” [Kamlah and Lorenzen, 1984, p. 47].

Aligning the meaning of terms can not be reached by pointing to things only but relies on “the very accomplishment of acting and living together” [Kamlah and Lorenzen, 1984 p.

36, p. 36]. As Kamlah & Lorenzen [1984 p. 36] explain: “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.” This is called “*empractical” learning* and this words stand for the fact that people have to experience what the meaning of a term in specific situations really is. Then language becomes the mediator between reality and an individual [Wittgenstein et al., 1953].

Once a language community has been created, the members of this language community share the pragmatic dimension of every symbol of this language. All members have the same concept in mind if they are confronted with a symbol of the language and vice versa. In turn, non-members of the language community do not understand the language symbols or they understand them differently. In order to become a member of a language community, an individual must align his understanding of given language signs with that of the language community. Sharing the same language as common knowledge, the members of a language community are able to use terminology in their daily discourse, for instance, domain-specific languages.

In summary, based on Language Critique, two main operations characterize the function languages have for communication in organizations. First, to create a language for domain-specific communication, language constructs need to be introduced and explained. This leads to a language schema and is called *construction*. To really align meanings of terms in language communities, living and acting together is required. Thus, “empractical” learning is part of this construction process. Second, *terminological discourse* is possible for members of a language community only. A prerequisite for language schema construction is human beings’ faculty of language and speech, which becomes manifest in colloquial and standard languages [e. g., Deacon, 1997].

4 Conceptualization of IS as Language Communities

The core idea behind our theory is that a language community creates and adapts language constructs which are required to deal with new, formerly unknown phenomena and situations. This self-organizing process can be controlled solely by the language community itself, since we argue that the restrictions of controlling big systems (section 2) do hold for language communities. Our third constructive step thus actively integrates theoretical ideas of Cybernetics and Language Critique into a new theoretical conceptualization of IS. This original conceptualization of IS helps to explain how communication structures in organizations evolve and adapt.

We assume that efficient information flows require concerted communication between parties involved in work processes, and we conclude that properly designed communication structures are a crucial component of successful organizations. Consequently, we think that it is reasonable to transfer insights from Language Critique into the IS domain itself to better understand how communication based on language does work. We therefore describe the two main operations of a language community and then combine these two into one operation characterizing IS as language communities. An elaborate formalization of this approach can be found in [Holten, 2007] and [Holten, 2003].

Languages as the common knowledge of a language community are called *terminologies* ($T \in \Phi$, Φ the set of all terminologies) in the following and are separated from pre-terminological (standard as well as colloquial) languages ($X \in \Psi$, Ψ the set of all pre-terminological languages), which are the prerequisite for language critical construction and serve as basic infrastructure in our conceptualization to anchor the creation of language communities in real world settings (Figure 2).

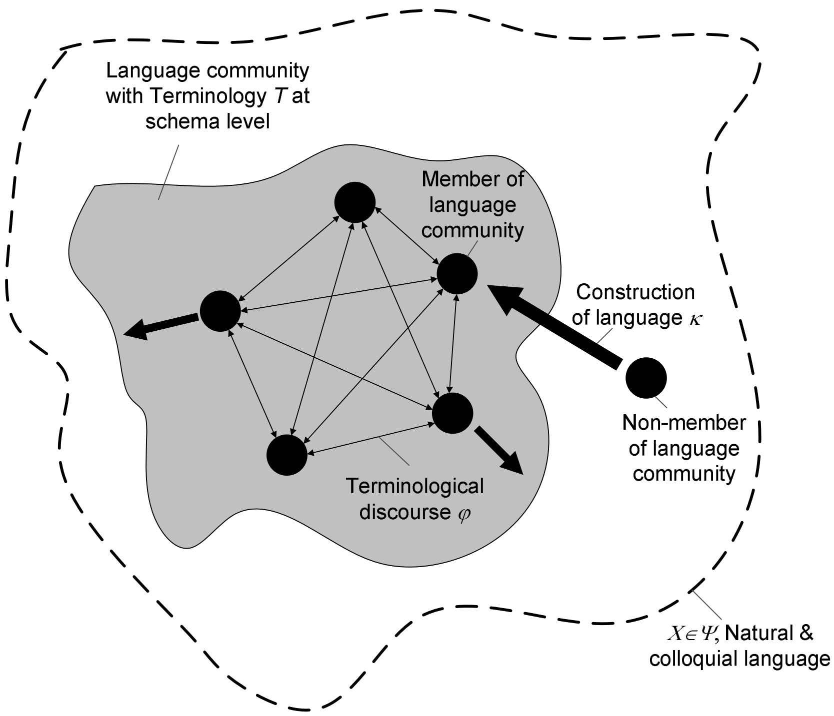

Figure 2 Entering and Adapting Language Communities by Construction

Any terminological or pre-terminological statement on the discourse level (Figure 1) can become a *perturbation* for the language community. Perturbations cause (re)actions of the language community as a system as summarized in Figure 2. An action (α) may comprise a series of terminology modifications on the schema level (symbolized as κ), that is, new or modified agreements on the meaning of terms, as well as terminological statements on the discourse level (symbolized as φ).

First, terminological discourse φ is characterized by the following three possible reactions of the language community. The system really understands what is going on but (1) decides to react *not at all* (neutral reaction), or (2) may say something else (terminological statement) – for whatever reason. (3) The system is not in a position for a correct terminological statement, because the perturbation is – at least partially – perceived based on pre-terminological languages only. A suitable terminological discourse about the situation is not possible.

Second, language critical construction κ is characterized by the following three possible reactions of the language community. (1) The system decides to behave neutral, that is, not to alter the terminology. (2) The system alters the given terminology, because a new term allowing for synonyms is introduced (e. g., possible terminological statements using terminology T are felt to be circuitous or not suitable for other reasons), or because (3) at least one term is missing to describe the given situation correctly on the discourse level. This last reaction defines the system's ability to terminologically *adapt to new* or *formerly unknown* situations. To summarize, terminologies are altered by re-construction κ leading from terminology T to terminology T' (cases 2 and 3). This is called *transition of configuration* and an arbitrary sequence of configuration transitions leads from a terminology T^1 to a terminology T^n in n-1 steps of transition configurations.

Finally, the total reaction (α) of the system on a given perturbation is characterized as follows: Two terminologies T^1 and T^n are related by an arbitrary sequence of configuration transitions, and a terminological statement using the final terminology T^n on the discourse level is the system's final reaction on the given perturbation. It is important to note that reaction α certainly produces a final terminology but that no observer will ever be in a position to command the use of this final terminology to the system. We argue that a language community is a big system in the sense described in section 2, and control of a self-organizing big system strictly is disseminated throughout this system itself.

Now, after having integrated our theoretical foundations from Cybernetics and Language Critique by means of specifying reaction α, we are in a position to *define* an IS as a language community: An *IS is a language community*, made up of a terminology T on the schema level, the discourse level with terminological speech, statements comprising standard, colloquial as well as terminological speech on the discourse level and is characterized by reaction α, reacting on perturbations by terminological discourse (φ) or language schema construction (κ) concerning its terminology [Holten, 2003 p. 65, Holten, 2007].

This conceptualization of IS as language communities directly leads to at least the following consequences for every IS:

1. a *terminology* should exist, directly related to an identifiable set of people belonging to the language community possessing this terminology,
2. *terminological discourse* should be observable,
3. *traces of developing or revising terminologies* should be identifiable.

5 Communication in Organizations and the IT Artifact

As an intermediate step in constructing our theory, we now relate our theoretical constructs and their relationships to the so-called IT artifact [e. g., Benbasat and Zmud, 2003]. So far, we showed that organization is related to communicating sub-systems, and the system is under control if its sub-systems are stably interacting no matter if the environment is changing. In big systems, the control power to bring about this organization must be disseminated throughout the system itself, the big system being self-organizing (section 2).

This has important consequences for the creation of communication structures: the only possibility to influence a communication structure is to influence the system's environmental conditions. The establishment of communication structures is based on empractical learning (section 3) and related to IS conceptualized as language communities (section 4). Therefore, every IT artifact (e. g., a conceptual model or any other form of specification) no matter who created it is part of the system's environmental conditions and leads to reactions of the language community. This means, every IT artifact is at first a perturbation in the sense of section 4 and the relation of IT artifacts and existing communication structures is an indirect one.

The remaining question is how the IT artifact influences the interplay of self-organizing language communities which create and adapt communication structures. To show how our conceptualization of IS as language communities and the IT artifact are related, we propose a framework made up by two dimensions (Figure 3). *Type and instance levels* span up the first dimension, *actualized activity and activity schema* in the sense of Figure 1 the second dimension. Since activity schemas are required on the instance and type level as well, the two dimensions of the framework are orthogonal.

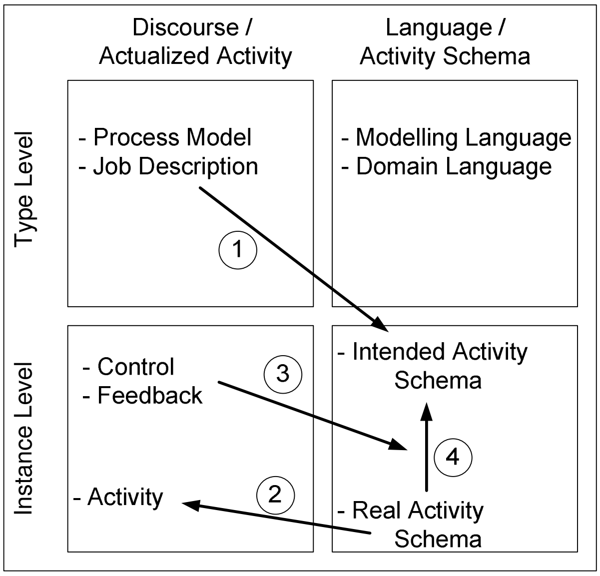

Figure 3. Framework of Altering Activity Schemas

The intention of the framework is as follows: Type level statements, documents and models stand for processes to be supported by IT and are thus representatives of IT artifacts [e. g., Hevner et al., 2004]. These kinds of documents are intended to specify activity schemas for actions on the instance level (arrow 1). Whether these type level statements succeed or not must be judged based on the observation of instance level actions. So, actualized instance level activities which allude to the (not observable) real activity schema (arrow 2) have to be observed, and feedback (arrow 3) is required to align the real and the intended activity schemas on the instance level (arrow 4).

This indirect approach to bring about activity schemas on the instance level is a realization of self-organization in a communicating social system as discussed herein before in section 2. There is no possibility to directly change or even judge activity schemas in people's minds. The indirect approach based on instance level feedback loops is due to the need of empractical learning as specified by Language Critique. Since this indirect approach of altering activity schemas on the instance level as specified by the framework comes at a cost, we further specify the relations of our theoretical constructs using cost functions in the next constructive step in section 6.

6 Cost Drivers of Communication Cost Functions

This fourth constructive step in developing our theory details the relations of our theoretical constructs. These relations enable empirical applicability of our theory and analyses of the effects IT has on communication structures within organizations as well. Our conceptualization of social systems arising from communication [e. g., Luhmann, 1995, Seidl and Becker, 2005] allows us to relate the functionality of a social system to the linguistic actions introduced herein before, a mode of operation, which can be observed empirically.

As discussed in section 4, people enter or adapt a language community by actively learning the usage and meaning of terms (reaction κ, Figure 2) which make up the language community's terminology. Terms shared by the language community as common knowledge are available for terminological discourse. Now, the idea is that the immediate understandability of terms within the language community makes terminological discourse (reaction φ, Figure 2) advantageous compared to colloquial or standard language discourse ($\chi \in \Psi$, Figure 2). This comes at the price of previously having introduced terms through reaction κ. We therefore need to relate our theoretical constructs and to measure this advantage as well.

First, concerning the complexity of what people are talking about, it is important to note that the matter of complexity depends on the intention or state-of-affairs of people's statements, no matter what the state of the real world is. That is, complexity of a situation depends on the subjective understanding of an observer of this situation. This is a logical consequence from Language Critique (Figure 1) and enables us to perform analyses with respect to people's knowledge and understanding. This view, of course, is compatible with interpretivism and the hermeneutic cycle [e. g., Butler, 1998, Klein and Myers, 1999] and with Cybernetics' understanding of complexity [e. g., Ashby, 1962, Beer, 1965] as well. We therefore talk about "perceived complexity" or "relative complexity", indicating that complexity strictly depends on people's ability to describe perceived phenomena. As a consequence, the perceived complexity is higher if people from different language communities are talking about the same things compared to the situation within each language community.

Next, since perceived complexity depends on the number of aspects which describe the phenomenon from the observer's point of view, communication costs grow faster than this number of aspects (Figure 4). This must be true for the following reason: given that statements of a group of people already made clear n aspects of the subject matter, this means that all $n(n-1)/2$ possible relations of these n aspects are clarified by this group of people. Therefore, (1) the total length of statements (*TLS*) concerned with the subject matter, defined as sum of all lengths of the statements concerned with that subject matter, is suitable as a cost measure and, using the notation from complexity theory, (2) this measure grows with order $O(n^2)$ in relation to the number n of aspects standing for the perceived complexity. To state it simple: sophistication is really expensive compared to naivety.

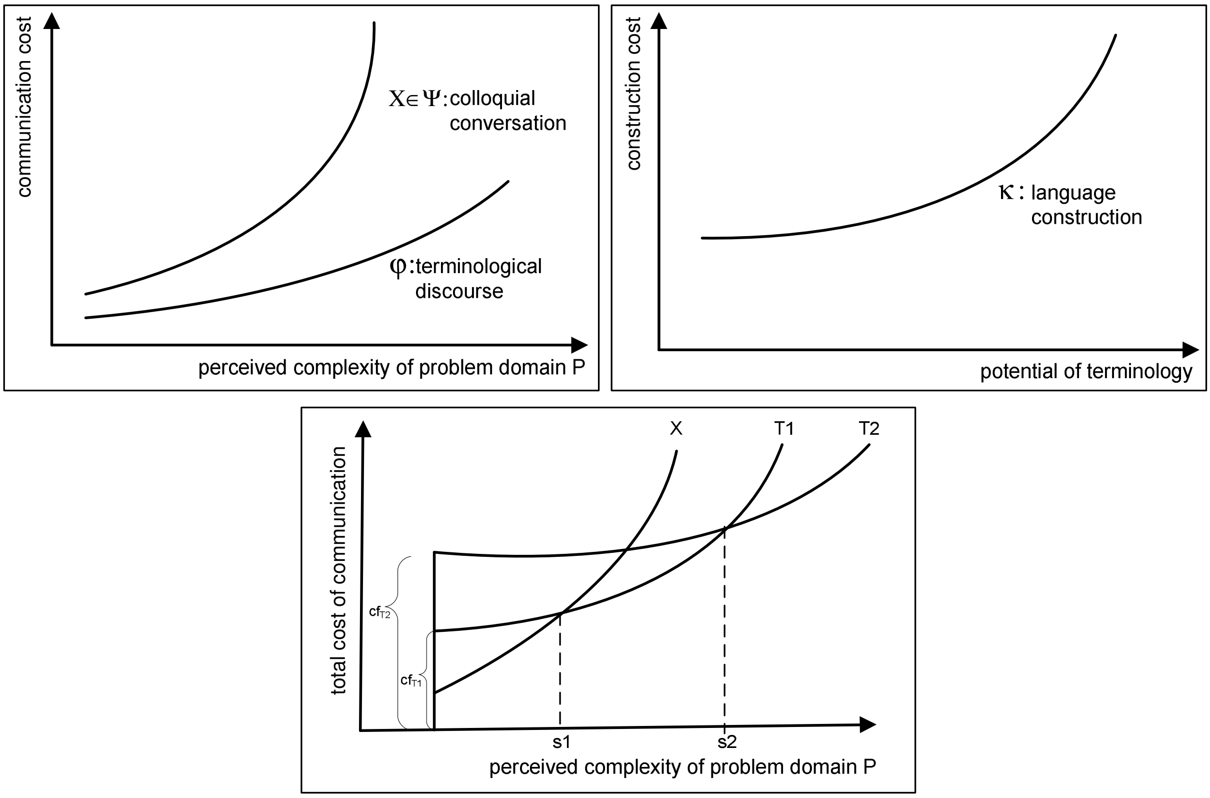

Figure 4. Analysis of Communication Costs

Now, taking communication time as another measure of communication cost, it is obvious that a tailored, domain-specific language used by a specific language community is more efficient in order to coordinate business processes than using colloquial languages and long-winded paraphrases for the same purpose [Nikolopoulos and Holten, 2007 p. 412]. So, for a given domain (1) terminological discourse is more efficient than colloquial speech, and (2) terminological discourse is a meaningful goal because a language community is able to use every term without complex explanations or paraphrases. Additionally, since every single term does contribute to this advantage of terminological over colloquial discourse, it (3) grows with the perceived complexity of what people are talking about (Figure 4).

Nevertheless, savings of communication time using terminological discourse compared to colloquial discourse come at a cost. These costs result from the creation of the domain-specific language and thus are due to language construction and creating the agreement of language communities with regard to the meaning of symbols. Costs of creating a terminology are related to the terminology's potential of expressiveness, measured by the number of terms of this terminology (Figure 4). This number of terms as a measure is reasonable since the creation of the *n-th* term has to ensure consistency with *n-1* existing terms, thereby potentially influencing the whole set of all $(n-1)(n-2)/2$ relations between the existing *n-1* terms. It follows that the complexity of constructing terminologies is, again, of order $O(n^2)$ in relation to the number *n* of terms standing for the potential of the terminology. To state it simple: empractical learning is the price for sophistication.

To summarize, the indirect approach of altering activity schemas on the instance level using the IT artifact as specified in the framework of Figure 3 is related to communication costs (*TCC*, total cost of communication) as the sum of set-up costs (empractical learning) and cost of discourse. The effort of changing people's behavior (set-up cost) is related to the complexity as perceived by people involved and concerned. This complexity, however, is relative to people's knowledge and their ability to understand and terminologically describe the intended situations.

Since the creation of a language community and the corresponding construction of domain-specific languages are set-up costs of terminological discourse, the question arises what potential of domain-specific languages or terminologies is efficient in a situation with a given perceived problem complexity. Efforts of language construction and benefits of terminological discourse should be balanced. We use total cost of communication (*TCC*) as the sum of set-up cost (fixed cost, *cf*), that is, costs due to language construction and creating the agreement of language communities with regard to the meaning of symbols, and costs of discourse (variable costs) to analyze this situation (Figure 4). Both cost fractions are measureable either as communication time or as the length of respective statements.

It shows that any domain-specific language requires a certain degree of perceived complexity to be advantageous over colloquial communication (symbolized by *X*). This is due to set-up costs of domain-specific languages. To be efficient, a more complex terminology *T2* requires situations which are perceived more complex (Figure 4). This is for the reason of higher set-up costs (cf_{T2}) of *T2* compared to set-up costs (cf_{T1}) of *T1* with less potential. Above complexity *s1*, terminology *T1* is advantageous over colloquial discourse *X*, and at least complexity *s2* is required for terminology *T2* to become advantageous over *T1*. To state it simple: empractical learning is not an end in itself.

To summarize, our analysis of communication cost functions reveals that the degree of organization as reflection of communication structures can be too high as well as too low. Since, as argued in section 5, any IT artifact is at first part of the environment of an IS (conceptualized as language community, section 4) its complexity as perceived by people involved and concerned determines if its degree of elaboration is too high or too low. Therefore, it follows that the IT artifact's suitability to stimulate the language community's reaction as intended by the IT artifact's creators depends on its complexity as perceived by the members of the language community the intended changes are aimed at.

We give a final example of two interacting language communities to demonstrate our theory. If, for instance, a first language community is confronted with elaborate specifications of intended business process changes (e. g., business process models as IT artifact) produced by another language community, the implementation of these changes within the first language community (1) will be very expensive and (2) holds very high risks of failure.

Our argument is closely related to both Ashby's law of requisite variety [Ashby, 1956, Ashby, 1958] and the least-effort scale-free theory [Zipf, 1949]. Following Ashby's law varieties (complexities) of controllers and systems under control must be the same and, since control is related to organization as discussed in section 2, the degree of organization can be too high as well as too low [Ashby, 1962, p. 265]. Zipf's least-effort scale-free theory is based on empirical evidence and is concerned with efficient use of language words. He shows that it does not pay to know more words than used in talking or are understandable [Zipf, 1949].

In the next section we draw on findings from existing cases to demonstrate how our theory could help to explain and predict empirical reality. We state that our theory basically is what Gregor [2006 pp. 626-630] calls a theory for explaining and predicting.

7 Demonstration

In this section we demonstrate how our theory can help to explain and predict empirical reality. This chapter is neither an exploratory study [e. g., Eisenhardt, 1989] nor is its intention to test hypotheses [e. g., Lee, 1989, Markus and Robey, 1988]. We just intend to demonstrate (using quite obvious situations) how the reader could transpose our abstract, theoretical constructs into other research settings. Therefore some propositions are presented and tentative empirical evidence using existing cases is provided.

Since IS are conceptualized as self-organizing language communities (section 4), it is not possible to dictate the way and behavior that people use to communicate about the world. It is just possible to influence an organization's environment to stimulate the self-organizing development of communication structures (section 2). We therefore deduce our first proposition as follows:

[P 1]: It is not possible to command activity schemas or languages. The system itself brings about the language and language community required for its internal communication.

Next, since nobody is able to directly understand the meaning of what others intend to express, living and acting together is required in order to interpret, to create or to change language communities, which was called empractical learning (section 3). IT artifacts thus should be related to empractical learning efforts when intended to change people's behavior (sections 5 and 6). Additionally, the effort of organizational change projects should depend on the number of persons involved. The second proposition therefore is:

[P 2]: There are set-up costs of creating language communities. These costs are related to the complexity of the domain and the number of people involved.

Finally, the framework of altering activity schemas (Figure 3, section 5) and the discussion of communication cost functions (section 6) revealed that it is neither sufficient nor adequate to design elaborate specifications (e. g., IT artifacts such as conceptual models) which intend to directly change people's behavior. In contrast, IT artifacts which intend to influence people's behavior should match with people's understanding, experience and knowledge to match their perceived complexity. Our third proposition therefore is:

[P 3]: The system will refuse to use languages or terminologies for terminological discourse if these terminologies have an inadequate potential in relation to the perceived complexity of a given situation.

We draw on facts from three empirical studies to provide evidence for our propositions. The first case is an action research study [Baskerville, 1999] that deals with the reporting system and management communication structure of a logistics company. The project was set up in 2005 and considered as finished in midyear 2007 [Laumann et al., 2007, Rosenkranz et al., 2009]. First, the existing management processes were analyzed and redesigned and the company-wide reporting was adjusted to the new structures. The researchers were involved in the organizational change project, and there was one follow-up interview with the logistics manager in charge. The facts summarized in Table 1 were gained out of this project.

Table 1. Findings from Organizational Change Project

Finding	Evidence for
Completely new problems, where terms to describe the situation are missing, are about 30 to 40 percent. The site manager stresses that this proportion is the state after one year of work on changing the organizational processes. He observes a slowly growing fraction of new problems with missing terms in the meetings and concludes that teams and meetings are well-rehearsed now.	P1, P2
Revised organizational structures and processes are implemented using concrete situations and	P1, P2

instances. The site manager estimates that the fraction of time needed for controlling the understanding of rules, giving further explanations and feedback on the instance level is 60 up to 70 percent of the effort to change the organization. He mentions that there are few misunderstandings when rules and job descriptions are developed, but that it takes long until organizational change has reached each individual person. Repeating explanations are required. Explanations of rules and terms while putting through organizational change are definitely a cost pool of relevance. The site manager estimates these costs as being even higher than 70 percent of the total cost of the project. This percentage includes continuous control of understanding. The site manager stresses that the specification of an organization and the development of revised organizational structures or process models amount at most up to 10 or 20 percent of total efforts. The implementation subject to personal characters of employees is much more comprehensive.	
The newly introduced operation meeting was planned to last 30 minutes a week. In fact meetings took 60 up to 90 minutes in the first year after introduction. After one year the site manager realizes that this meeting can be conducted by the operation manager himself since the organization has learned what the meeting's intension is.	P2
Workers still have to learn and accept warehouse managers as supervisors. The site manager states that this is very difficult since it was different for 4 or 5 years before structures were changed. Nevertheless, he realizes that workers and employees learn the intentions of organizational measures since fewer problems are discussed in the meetings with all employees.	P1, P2

The second study deals with the change of the IT controlling and reporting system in the German subsidiary of a large European banking group [Rosenkranz and Holten, 2007a, Rosenkranz and Holten, 2007b]. The project was conducted as an action case [Braa and Vidgen, 1999] between 2004 and 2006, with researchers being involved. Several follow-up talks and e-mail discussions were conducted afterwards to gain further insights. The following facts as summarized in Table 2 were gained.

Table 2. Findings from IT Controlling Project

Finding	**Evidence for**
The old reporting was purely cost-based. Qualitative aspects pertaining service level agreements or projects are not looked upon. The costs for the IT services supplied are based on internal transfer prices for IT items, collected in a special item catalogue (over 1,000 single items, grouped according to around 85 services), which generally are used for the chargeback of IT costs. These prices are negotiated between the divisional management of the business units and IT management. The charged items are extremely technical and IT-resource-oriented (e. g., measured as costs per CPU second used, costs per GB used et cetera). An IT controller states: "Many [business units] say … 'I didn't understand it anyway' … They [IT] talk of transparency concerning the item catalogue:	P1, P3

everything and every detail is open to analysis. But providing all the detailed information does not create transparency with regard to daily business. In fact, we are drowning in details."	
Employees from the business units have difficulties to understand the IT controlling reports. They are not written in business language and not related to the daily affairs. In addition, the pure number of the provided information generates a feeling of information overload. The IT controller states: "The amounts of data related to this [item catalogue] are much too large for effective IT controlling. The majority of the monthly work comprised data checks/data import and consistency/plausibility checks respectively. The transformation of the item-related IT charging into the – product-oriented – business unit view is not easily comprehensible."	P1, P3
One business unit responsible for internal services appointed two employees with a background in IT who are responsible for the analysis of the IT reports and for the understanding of the item catalogue. This business unit extended the original item catalogue with self-provided descriptions in order to make the items understandable for their non-IT personnel by describing the items they encounter most or deem important.	P1, P2
Employees from other business units inherently knew from previous experience and subjective evaluation which items are important and which are not. The IT controller states: "Units that have to pass their costs in the allocation cascade down to units within market range had to process and analyze the data in detail due to allocation and questions of the market-related units. However, these [market-related units] could carry out a simpler comparison between budget and actual costs, and only when larger discrepancies occurred a detailed analysis became necessary."	P1, P3
Other business units, mostly larger ones directly within market range, ignore the item catalogue and the IT controlling reports completely. They simply wave the IT costs through their internal cost control.	P1
The IT controller states: "The potential for improvement of the charging and the item catalogue has been discussed since … 2006 at [the bank's] group level as well. This discussion has been set in motion and pursued by the new CIO. The result of this is that the item catalogue … will be reorganized in April 2007. The foundations of the new model are fixed prices for IT services. … The complexity … for the customer will be massively reduced, e. g., reduction of items from over 1,000 to circa 100, which reduces the effort and complexity of the allocation." Additionally, an internal project presentation in 2007 says that to a lack of trust in IT creating demands of detail, the current pricing model has become obsolete and the Executive Committee has decided to implement a simplified model.	P3
The reduced item catalogue with items related to business unit needs is appropriate for business use. The IT controller states in February 2007: "…, this time, negotiation took only one month, from mid of September till mid of October. There was no bang, whereas before, they bickered about the costs of single items. It only took two meetings at group executive level."	P3

The third case comprises five e-learning projects which are parts of the long term strategy to apply more e-learning in higher education [Nikolopoulos and Holten, 2007]. The projects ran from 2004 to 2007 at a German university. Researchers were involved and additional direct observations were made. The projects gained the following facts as summarized in Table 3.

Table 3. Findings from E-Learning Projects

Finding	Evidence for
The costs for training and consultation services correspond to set-up cost for the development of a terminology. In an internal WebCT project merely employees of one professorship were involved and the main effort occurred between two actors. In contrast, the focus of the faculty spanning WebCT project lay explicitly on consultation and on inclusion of a big number of new lecturers. Hence, a central coordination center was created in support of the faculty's employees. A common knowledge base could be formed by intensive individual support and trainings.	P2
Another project was created to use the ERP software SAP R/3 in teaching. Only few actors were involved and trained. Anyway, the costs for training and support were high. The more complex software SAP R/3 in comparison to the simple tool WebCT determines these higher costs. To use the SAP software intensive trainings must be conducted. Even the initial trainings took 4 to 5 days per lecturer. In comparison to the learning platform WebCT, which could be used after short instructions, much more knowledge must be transferred.	P2

To summarize, our theoretical constructs seem to be adequate to describe real case IS scenarios with IT involved in organizational change projects. Additionally, we found empirical evidence for our three propositions. We therefore conclude that communication and total cost of communication (TCC) introduced herein before are adequate as indicators for the degree of organization and the efforts due to organization. Furthermore we conclude that the conceptualization of IS as self-organizing language community is suitable to describe and predict the evolution and adaptation of communication structures in organizations.

8 Discussion

Stemming from our theory, what is the rationale for IS research as a separate discipline? Many approaches in the IS field build on theories from other disciplines. Nevertheless, especially behavioral questions already have their own disciplines in the social or cognitive sciences, that is, economics, sociology, management science and organization theory, or psychology. Additionally, designing and engineering IT already has its own discipline as well, namely computer science. Moreover, many theories in the social sciences have already sought to understand communication, interaction and the role of information in organizations [e. g., Daft and Macintosh, 1981, Galbraith, 1977, Levitt et al., 1999, Mintzberg, 1979, Tushman and Nadler, 1978]. This includes “grand” theories such as transaction cost theory from economics [Williamson, 1981], or social theories such as enactment [Weick, 1979, Weick, 1995] or structuration theory [Giddens, 1984]. Likewise, efforts in computer science have tried to transfer insights from these behavioral theories into engineering-driven approaches for developing and designing IT and IS [e. g., Loucopoulos and Karakostas, 1995, Sommerville, 2001]. Therefore, it is a matter of debate if IS research really qualifies as a separate discipline [e. g., Avergou, 2000, Weber, 2003] and how it relates to the IT artifact [e. g., Benbasat and Zmud, 2003].

Our theory proposes that communication is the heart of IS. Of course, this perspective has a tradition in the IS field. Communication is not only often regarded as a fundamental factor [e. g., Gallivan and Keil, 2003, Vlaar et al., 2008] but also considered to be a prerequisite for coordination [e. g., Malone and Crowston, 1994, Nahapiet and Ghoshal, 1998, Quinn and Dutton, 2005] in general. Others have tried to build on communication as the core of theory as well. For instance, Land [1985] argues that language is one of the most important factors in IS research, and Winograd & Flores [1986], using ideas from philosophy of language and linguistics [e. g., Peirce, 1931-1935, Searle, 1996], have developed a theoretical perspective for analyzing group action in IS. The resulting language/action perspective deals with the process of creating a shared understanding in communication. So while we acknowledge this tradition and even a direct relation to Cybernetics – Flores even worked together with cybernetic pioneers such as Stafford Beer [Medina, 2006] – we propose to build on another strand of philosophy of language – Language Critique – and combine this with Cybernetics in order to explain how domain-specific languages – terminologies – evolve as self-organizing systems and generate communication structures. From our point of view, this is the core of IS.

The remaining questions are (1) what makes our theory different from and more useful then other theoretical approaches used so far in the IS field, and (2) what is its position regarding the so-called IT artifact? In the following, we separate our approach from two classes of theories to simplify our argument: computer science theories and social theories. In order to justify IS as a separate discipline, we have to distinguish it clearly from approaches which solely build on one of those kinds of theories.

Concerning the core of IS, engineering IT is in fact a downstream problem. Since our theory does not rely on formal languages or automaton theory at all it is not a computer science or engineering theory in contrast to [e. g., Loucopoulos and Karakostas, 1995, Sommerville, 2001]. Social theories include theories from economics or sociology. Economic analyses likewise stand for downstream problems. Since our theory does not rely on scarcity at all it is not an economic theory, for instance, such as approaches in the tradition of Williamson [1981]. Finally, social or cognitive analyses of human and social behavior related to IT usage are downstream problems as well and belong to the social sciences. A prominent example is the well-known technology acceptance model [e. g., Bagozzi et al., 1992, Davis et al., 1989].

Instead, we have to find a common denominator that allows us to examine the interplay between the social subsystem and the technological subsystem of an IS, a denominator that allows us to shift our focus from examining only one of the two subsystems to the phenomena that appear when *both* subsystems interact [Lee, 2001]. For us, this denominator cannot be the IT artifact alone, since it clearly belongs to the technological subsystem. It cannot be a purely social theory either, since these theories are concerned with the social subsystem. Consequently, for us, it can only be communication: (1) language-based communication is fundamental for the human species and a characteristic of social systems; (2) improvement of communication is the reason for and utility of IT usage.

It follows that using our theory, IT-enabled communication structures within organizations can be explained without assumptions characterizing pure social or computer science theories. Therefore our approach is advantageous compared to only relying on these theories since it omits obsolete assumptions and thus allows for more nomological and rigorous explanations of communication structures within organizations. Additionally, in contrast to approaches based on social science and computer science, our theory is able to legitimate IS as a discipline of its own – in contrast of being "just" an interdisciplinary derivative of social sciences and computer science.

Furthermore, our theory can be classified as type IV theory intended to explain and predict reality [Gregor, 2006]. To summarize: if we understand the nature of communication structures and self-organization as the core of IS research, we can go downstream and analyze a given technology concerning its social implications such as usability or economic value.

9 Conclusions and Outlook

Accepting fundamental philosophical assumptions for research should lead to the acceptance of the same assumptions for communication processes characterizing IS. Language Critique is suitable to analyze communication processes, which in turn generate the IS. Based on ideas from Cybernetics and Language Critique, we characterized IS as language communities and specified two main operations – namely terminological discourse and language critical construction – to show that organization of a system is directly related to communication. Big systems are self-organizing and the control power of this ability is disseminated throughout the system itself. Organizational change should then only be possible by changing the conditions the system itself uses to adopt its communication. This leads to an indirect approach for organizational design. To further concretize this indirect approach and the relation of our constructs, we proposed a framework of communication in organizations. Communication relies on language communities and empractical learning of terminologies. This leads to cost drivers of communication, namely set-up cost of creating language communities which match the complexity of the problem domain. Referencing three empirical studies dealing with organizational change projects, we gave tentative empirical evidence for propositions derived from our theoretical argument. It was shown that it is not possible to command languages and terminologies, that set-up cost do exist and are relevant, and finally that the system itself creates and adapts languages to be used for internal communication and organization. If languages are perceived to be inappropriate for a specific problem domain, the system will refuse to use these languages.

Further research has to clarify which measures can be used for organizational quality and its degrees. We need to provide reliable measures for the total cost of communication introduced and for the perceived complexity of the problem domain. Additionally, more elaborate hypotheses are needed to further test our theoretical argument empirically. Future research should also investigate if a characterizing terminology for every IS really does exist. Additionally, criteria characterizing good IS and measures for this goodness are required. Furthermore, there should be research concerning conditions positively influencing the development of language communities, for instance, to better understand what is really happening in IS development processes.

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