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Selecting Interorganizational Standards – A Management Cybernetics Perspective

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ABSTRACT

Interorganizational Standards (IOS) are a key-lever to digitizing business relationships within value creating networks. They provide assistance in bridging organizational borders by providing standard processes and semantics. Various IOS have been developed for supporting complex, partly domain dependent communication scenarios. Only little academic work analyzes the process of selecting a specific standard (set) out of several sufficient and therefore "rival" candidates in situations of specifying a technological infrastructure for exchange. We argue that selecting a specific standard is a profound decision problem. This research contributes to this decision problem. First, by reflecting the academic field of Management Cybernetics we illustrate how this theoretical lens helps us to understand the nature of business relationships. Based on our findings we elaborate propositions that inform the standard selection. Second, this work may inspire researchers by the way propositions are utilized in design-oriented IS research by both guiding the actual design process and serving as profound reference in artifact evaluation.

Keywords

Interorganizational Standards, Management Cybernetics, Viable System Model, Model of Systemic Control, Standard Selection, Business Relationship Digitization

INTRODUCTION

Boundaries of nowadays organizations shift from structures and processes of single companies to value creating networks, which are not designed and implemented by a central instance but emerge cooperatively in negotiation processes. These networks are self-organizing systems which rely on IT to coordinate cooperation through communication. Different type of exchanges and the management of this exchange has been in focus of marketing and management studies for decades (Webster 1992).

Having increasing numbers of digital and electronic commerce tools at hands, mangers have witnessed new ways to manage such business relationships (Salo 2006). For digitizing business relationships Interorganizational IT Standards (IOS) are a distinctive lever. They provide a corpus for converting data into an agreed syntax (i.e. a grammar) (Philip and Petersen 1997). Upon this corpus exchange processes aim at (1) directing data to and gathering data from different application programs, (2) converting data from proprietary formats (as used by application programs) to standard formats (as transmitted by the communication network) and reversing the process at the other hand and (3) the actual transmission of data between business partners over a communication network.

These grammars are intended to realize information flows between business partners (and their depending activities). An accurate specification of these information flows is indispensible to assure business interoperability (Green et al. 2007). This

specification is not only restricted to a technical message transportation layer, but accounts also for the semantics of business objects and business processes on a conceptual level.

While much academic literature is present analyzing the adoption and implementation of one specific standard (namely EDI), there is few work analyzing the process of selecting a specific standard (set) out of more sufficient and therefore "rival" candidates in situations of designing a technological infrastructure for exchange. We argue that selecting a specific standard is a profound decision problem and claim for guidance to practitioners facing this decision problem. To the authors best knowledge so far there exists no consideration of how to do such evaluation based on a deep conceptualization of "goodness" of standard within a specific setting. Instead approaches are limited to ontological "completeness" analysis.

Though, scholars from various disciplines contributed valuable insights to the body of knowledge on the nature of business relationships that might inform the described decision problem. Our work integrates several of these approaches. In this paper we strive to focus on one and present how the academic field of Management Cybernetics helps us to better understand and guide the IOS selection process. We formulate our findings in the form of theory-grounded propositions to the future construction of a method assisting practitioners in selecting IOS.

This research is therefore intended to inform researchers and practitioners. Research might acknowledge the reflection on Management Cybernetics to understand the nature of IOS in digitalizing business relationships and the application of theoretical lenses to formulate theory-grounded propositions to a design process of a standard selection process. Practitioners might benefit from exploring new perspectives on selecting specific standard (sets) according to the nature of specific integration scenarios and will get initial findings, which influencing factors to consider in their decisions.

This paper remains as follows: Sec. 2 discusses the duality nature of propositions in design science approach to IS, i.e. (1) guiding the artifact design and implementation resp. (2) the artifact evaluation. Sec. 3 then introduces the decision problem of selecting IOS amongst several "rival" standards. Management Cybernetics serves as a theoretical lens (in Sec. 4) to reflect on this decision problem and to formulate propositions to a standard selection method. This paper concludes (Sec. 5) with and outlook and some limitations of the presented work.

THE DUALITY OF PROPOSITIONS IN DESIGN SCIENCE

Findings presented in this paper are intended to guide the development process of a method for selecting IOS amongst several standard candidates in integration scenarios within value creation networks. The application of the subsequently formulated proposition within the design cycle of the method is twofold: First, it informs the development process of the artifact – that is in this case the selection method – and then, second, it builds the basis for theorizing on the design process and on how properties of the artifact relate to the sufficiency of the method. This is a source for contributing to the body of knowledge as embedded by the kernel theories, i. e. in case our theoretical lens Management Cybernetics (Walls 1992, Walls 2004). We herby follow advices from scholars in IS research for design-oriented research settings. Here we refer to the design of a product, i.e. design as a noun (cf. Walls et. Al., 1992, 2004), that is the result of a sequence of expert activities that produce an innovative product (Hevner et al. 2004), namely the selection method.

When it comes to evaluation the question occurs "against" what to evaluate. We therefore formulate propositions to our future selection method. These propositions then in turn will serve as evaluation criteria for this future method and its application in real-world application scenarios.

We follow an approach that is inter alia inspired by a work of Hardless et al. (2007). In this work the authors apply kernel theory grounded on theories of learning and distributed cognition to build and then cyclic evaluate approaches to a technology-mediated learning system for project work. Several prototypical implementations are executed in a testing environment and evaluated against proposition formulated by the help of their kernel theories.

A second source of inspiration is the utilization of "principles" in theorizing on design processes in Markus et al. (2002). There she formulates principles for systems that support Emergent Knowledge Processes. The author credits these principles being "subject to empirical, as well as practical, validation" and thereby sets an agenda for subsequent academic research. Here, we are more concerned with the role of the principles to justify the evaluation process, but resort technically to her procedure of applying the principles within the research process.

Thus, the later formulated propositions contribute to upcoming research by fostering (i) understanding the problem and (ii) guiding the development and testing (of alternative solutions). This is as understanding solely leaves undone the task of developing successful strategies in design-oriented IS research. Thus, next to description-driven research programs also prescription-driven research is required in order to develop research products which can be used in designing solutions for management problems. This refers to the development of scientific knowledge to solve a class of managerial problems (here

selecting IOS standards), i.e. the development of abstract knowledge (van Aken 2004). With this work we strive to present guidance to the IOS selection problem.

DECISION PROBLEM OF SELECTING STANDARDS

This analysis is concerned with Interorganizational IT Standards (IOS) that are adopted by organization to facilitate cooperation with other organizations through business relationship digitization. We specifically aim at the analyses of process and semantic standards to support cooperation in value creation network. Our working definition on IOS draws from the work of Löwer (2006): "Interorganizational standards are broadly adopted specifications that formally define or support business-related semantics and processes, which are made accessible to other organizations' information systems."

The challenge of selecting IOS amongst several potential candidates is embedded within a process of business relationship digitization. For this work business relationship digitization shall be understood as "the process of making information, business activities, and offerings related to exchanges between two organizations digital." (Salo 2006)

We argue, that selecting a specific IOS standard (set) intended to support business relationship digitization is a profound decision problem. It is embodied within step 3 of Salo's phase model of business relationship digitization (again Salo 2006), i.e.:

1. Select appropriate business relationship.
2. Map transaction and information flows.
3. Form the required relationship-specific digital infrastructure.
4. Initiate digital activities.
5. Follow up, reorganize, and digitize more activities, if needed.

The digital infrastructure intended to realize digital business realization then must allow for (Philip and Petersen 1997):

1. directing data to and gathering data from different application programs,
2. converting data from proprietary source formats (as used by application programs) to standard formats (as transmitted by the communication network) and reversing the process at the other hand, and
3. the actual transmission of data between trading partners over a communication network

for a selected business relationship. Amongst the various architectural choices in this design process, this work is concerned with the selection of an (appropriate) IOS standard for the transmission of business information. We acknowledge that in practice the strategic choices in specifying the digital infrastructure will be often up to network initiators exclusively, and network followers will be limited in their freedom of deciding (Son, Narasimhan, Riggins and Kim 2008).

There is much related literature available that is concerned with EDI adoption and implementation. And also theoretical analyses for antecedents and perceived benefits of such projects have been done for some time. Elgarah et. (2005) depicted in a review on 68 articles published on EDI in the academic fields of (Management) Information Systems, Logistics / Transportation / Marketing, Production / Operations Management / Management Science and Management / General Management the various theoretical lenses that had been applied to EDI adoption decisions. Thus, the decision if either implementing EDI or rather waiting for business partners to take the initiative, resp. to avoid implementation until it becomes a business necessity (cf. Peffers, Dos Santos, Thurner 1998), is rather well studied in literature. This previous work led to some classification of relevant attributes influencing this decision problem. Certain of these criteria might be applied in the IOS selection, as well. Narayanan, Marucheck and Handfield (2009) recently presented a rather mature conceptual model structuring EDI adoption decisions and integrating much of the last decades' findings on these influencing attributes. As stressed, this framework explores factors that explain *why and when* firms adopt EDI, rather than which standard to choose.

In contrast the problem of selecting IOS standards, when having several appropriate ones on hands, is not yet considered in the literature. And so is the question of what is a *good* standard for architects finding themselves in the decision. We postpone a two-step approach to this challenge that is subject to a subsequent refinement within the IOS selection method: (i) the ontological expressiveness of an IOS serves as a sine qua non-condition (ii) several theoretical lenses inform a quality condition check of several IOS candidates by broadening the understanding of "good" standards with regard to a specific selection situation.

(i) Sine qua non-condition

Basend on either transaction sets and the application systems interfacing with the information exchange (Mukhopadhyay, Kekre and Kalathur 1995) or sufficient domain ontologies for a given business context a meta-physical analysis of the ontological expressiveness shall be conducted. We here build upon previous work in the field of technical grammar evaluation, esp. the work of Green et al., who made an initial step to an ontology-based analysis of IOS standards (Green et al. 2005, Green et al. 2007).

(ii) Quality condition

We argued that the "goodness" of a standard can't be solely estimated by an analysis of the IOS's internal structure. Instead, such decision must be in-line with (amongst others) strategic goals and plans of the enterprises and expectation e.g. on market development (cp. the strategy-structure-performance paradigm and its application to supply chains (Speier, Mollekopf and Stank 2008)).

The quality condition also considers the dynamics of the decision problems, i. e. changes over time in the surrounding business setting. In practice, digital business relationships are often built up gradually from one time-limited contact between organizations to often very close, far-reaching exchange relationships. These relationships are in a constant state of flux (Salo 2006), with changing requirements through stages or cycles. Accordingly, the standard selection process requires addressing expectations on future business development as well as acknowledging increased flexibility provided by IOS (sets) regarding a future business development.

The adoption phase itself then follows a cyclic process that has been introduced by scholars investigating the standardization process itself, the so called D-S-N framework (cp. Fomin et al. 2003, Purao et al. 2008). First, the design (D) phase considers functional and non-functional requirements demanded from the artifact. Then, sense-making (S) attaches frames of references to the technology, e.g. new forms of value creations that are enabled by more flexible acting in value creation networks. Finally, negotiation (N) is concerned with recognizing and reconciling diverging interest amongst actors in the enterprises environment.

We formulated propositions to the design of the selection method by applying various theoretical lenses that are: Transaction Costs, Coordination Theory, i.e. the management of depending activities in collaborative processes, Speech-Act Theory and Management Cybernetics. This work focuses on an exploration of the insights gathered by a Management Cybernetic perspective to the criterion "good".

MANAGEMENT CYBERNETICS: VIABILITY AND DEVELOPMENT OF ORGANIZATIONS

According to Schwaninger, organizations shall strive for viability in the sense of development as a permanent process of self-renewal. He conceives the implementation of the principle of "continuity through discontinuity" in four basic faculties of the so-called intelligent organization: (1) adaption as change in respond to external stimuli, (2) ability to influence and shape their environment, (3) to find a new milieu or reconfigure themselves with their environment and (4) to contribute to the development of the larger wholes they are embedded into. Schwaninger's Framework of Intelligent Organizations (FIO) structures organizations within five dimensions that have to be impacted simultaneously to assure its viability and development. The first three dimensions –activities, structure and behavior– are taken from the St. Gallen Management concept and are complemented by the dimension of the essential parameters ethos, identity and vision and the dimension of time. In the remainder of this paper we focus on the dimensions activities and structure. The primer describes intended operations or actions taken by an organization while the structure dimension is about the arrangement of relatively stable mutual relationships between the elements or components of an organization. We reflect on these dimensions in the context of IOS in order to formulate propositions to the selection method. The underpinning theoretical lenses of the dimensions are the activity-oriented Model of Systemic Control (MSC) (Schwaninger 1989, Schwaininger 2001) and the structure-oriented Viable Systems Model (VSM) (Beer 1995, Schwaninger 2001). In the context of the VSM we identify which structural communication channels existent in the organizational structure have to be supported by IOS. In the context of MSC we analyze how IOS impact and are impacted by aspects of the various scopes of management.

Reciprocal impacts of IOS and aspects of various management scopes

Management Cybernetics considers management as the task of coping with complexity. The approach of the MSC to deal with this complexity is to govern one and the same system by means of control variables that belong to different logical levels of management: the operative, strategic and normative level (Schwaninger 1989). As indicated by Figure 1, higher levels of management relate to lower levels in that they define pre-conditions. Schwaninger uses the term pre-control of variables to describe this relation.

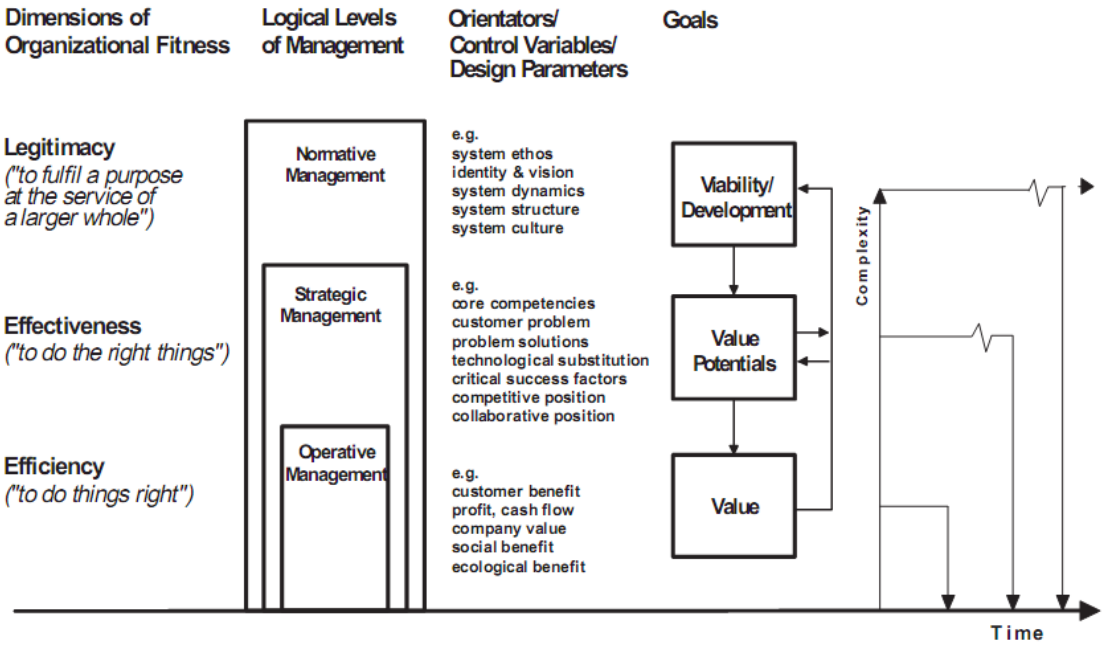

Figure 1. A model of systemic control (Schwaninger 2001)

On the operative level the overall goal is to create value, e.g. customer benefit, cash flow and social benefit. The directive is to operate efficiently for realizing goals. Basically, Interorganizational Information Systems (IIS) in B2X scenarios contribute remarkably to realize efficient coordination in value networks. As a premise, the interoperability of different organizations' IS has to be assured. This is the case for formerly defined semantics and processes. More specifically, from the perspective of operative management, the *strategic potential* of IOS for value creation has to be identified. One direct impact can be the contribution of B2C technologies to customer benefit via standardized purchase scenarios including product catalogue and payment standards. Another aspect can be the indirect value creation through cost reduction in B2B communication scenarios as order processing or shipping standards.

A company's decision for an IOS is more than the selection of a technology for the purpose of interorganizational communication and the achievement of short term revenues (or losses). We want to illustrate this effect by explicating two scenarios that have direct impacts on the organization's competitive and collaborative position (cf. Figure 1). First, the introduction of a domain specific standard is a strategic choice which integrates the company into a specific network of suppliers and consumers and at the same time excludes it from other networks. The same holds for domain independent standards that will facilitate communication with a network using the same standard and in turn will hamper –if not impede– the communication with other networks. Second, the context of cooperation bears a huge potential for the enrichment of an organizations capabilities. It can strengthen its market position being an Obligatory Passage Point. This term resides from the Actor Network Theory (ANT) and refers to the competitive position of an actor within a network as a gate keeper in that it claims control of crucial resources and responsibility for the success of an emerging actor-network (Martin 2000). Both scenarios accent the strategic impact of the choice of IOS and position the preceding decision at the strategic level of management. Here the criterion for organizational fitness is effectiveness, both in competitive and cooperative sense (Schwaninger 1989). At this stage value potentials are defined as a pre-requisite for the realization of values on the operative level.

The normative level of management is concerned with the overall goal of guaranteeing viability of an organization. Schwaninger (2000) takes a distinctive view on this capability: "Intelligent organizations conceive their viability in a broader way in the sense of pure survival at any price, or of autopoiesis, i.e. self-reproduction. Ultimately, they adhere the goal of development."

Development after Ackoff (1994) is defined as a systems's growing ability and desire to fulfill its own and other's needs. The normative management level is engaged in the organization's aspects of identity, ethos and vision. In the context of the FIO they are considered as the fundamental parameters that impact all the other dimensions: activity, structure and behavior

(Schwaninger 2001). Identity is what makes an organization unique and distinguishable from its environment. The ethos consists of the salient ethical principles or the characteristic spirit of an organization. A vision can be understood as a highly imaginative anticipation of the possible future of an organization (Schwaninger 2001). Organizations often define their identity through the uniqueness of their products and services, i. e. for instance an unique selling proposition (USP) (cf. Reeves 1961). The contribution of IOS to identity can be of collateral nature. A retail company may have unique relations to suppliers and hereby be able to provide goods to its customers that are not available from any other retailer. The same may account for the time of delivery for special goods. Obviously IOS may play a crucial role in these supplier relationships. An organization's ethos has a direct impact on the adoption of IOS. If within the ethical principle of the aforementioned retailer is its willingness to cooperate with vertical and horizontal supply chain partners accordant IIS and IOS will be adopted rapidly. The same is the case for a vision that positions the organizations among top sellers in a market segment served by only few other retailers.

The discussion of the indicated distinctive scopes of organizational planning that shall be facilitated by IOS is subsumed in the following proposition.

Proposition 1: The goodness of specific IOS is to be considered from an operative, strategic and normative level of management in order to fulfill predefined organizational goals on each level.

Requirements derived from structural normatives to viable systems

The VSM is a normative model that predefines an organization's structure that is necessary and sufficient for viability (Beer 1995). The structure consists of five sub-systems. Each of them performs a specific task in the overall organization and has predefined communication channels to distinctive other systems that define a hierarchical structure. The VSM is related to the MSC insofar as the different logical levels of management can be mapped to each other. Systems 1-3 (and autonomous divisions) constitute the operational level, system 4 in interaction with system 3 constitutes the strategic level and finally system 5 constitutes the normative level of management (Schwaninger 2001). One way to cope with the complexity of real-world scenarios is that the VSM is organized in a recursive way. Divisions and their respective system 1 are internally structured the same way as the macro organization, i.e. it encompasses system 1 to 5. In this way it fulfills the Law of Requisite Variety which claims for variety, being the measure of complexity, can only be coped with variety (Ashby 1956). In the context of value networks we assume that the different divisions controlled by System 1 to 5 or even systems themselves are partly or completely distributed and logically or geographically distributed in different organizations, such as sub-departments or independent business entities.

Each division is controlled by an own system 1 in the manner of a *closed-loop control*, more specifically a servo mechanism. In this constellation control is effectuated by means of a model of the division. One important property of these models are indices that are eligible to measure the status of the division. In terms of these indices target values for the divisions are defined, activities to achieve them are triggered and results und environmental influences are perceived by sensors (Schwaninger 2001). In case of deviations, i.e. differences in target and perceived values, adjusting activities have to be triggered. This servo mechanism is implemented in controlling departments in most medium and large enterprises. Reporting plans and triggering events are subject to standardization.

System 2 has the function to prevent *uncontrolled oscillations* of the various divisions. It therefore has communication channels to all regulatory centers of the divisions and has to coordinate their activities with the help of provided information. An example for the named oscillation is the Bullwhip effect that occurs in supply chains of producing companies (Lee et al. 1997). Here, the lack of information about customer effects leads to oscillations in order quantities that build up to the upstream supplier side. Moreover, system 2 assures coordinated activities among all divisions. However it cannot assure that an overall optimum of the operations, thus synergy between the scattered divisions is achieved. This is the function of system 3. Its task is to define an overall plan for *resource allocation* considering all information provided by system 4 and 5. Moreover the allocated resources have to be controlled in their purposeful application.

Function of system 4 is the perception, processing and forwarding of information from the *systems environment*. By this, it has to contribute to the balancing of the internal and external systems' equilibrium (Malik 1992). The internal perspective arises from system 3 whilst system 5 defines the decisive strategic goal setting. In this context IOS play a crucial role in defining the communication channels of system 4 as intermediate system to system 5 and 3. Moreover the perception of external market information has to be supported in an efficient way. Representative examples are standardizes reporting interfaces provided by market research institutes to access and extract data automatically and integrate it within an proprietary information portal.

System 5 defines and communicates of aforementioned perspective of normative management: identity, ethos and vision. As discussed before these dimensions predominantly impact the choice of an IOS but not vice-versa.

Subsuming, the VSM perspective on organization identifies systems with distinct organizational functions and predefined communication channels amongst them. The overall goal of this normative structure is to guarantee the viability of the organization. Hence, we derive the following proposition:

Proposition: The goodness of specific IOS is to be considered by evaluating the extent it is capable to serve the discussed VSM (sub) system and the standards ability to facilitate communication channels amongst these systems.

CONCLUSION, OUTLOOK AND LIMITATIONS

This work explained that and in how far selecting a specific IOS from several "rival" ones is a profound decision problem. Utilizing Management Cybernetics as theoretical lens we formulated propositions that inform this decision and guides subsequently the design and implementation of an according selection method. We deduced that the decision has to regard different strategic levels defined by the MSC. IOS shall be in accordance with organizational structures defined by the VSM in order to assure viability of the overall network-embedded organization.

These propositions provide a predictive approach to evaluating the impact of standard selection decisions in value-creation networks. The propositions mark an initial step to providing guidance for creating effective decision support in specifying information exchange infrastructures that suits the value networks strategic goals and relational strategies they are meant to support. The research as presented here is limited, as it illustrates only one of the various depicted theoretical lenses that we use to inform the method development process. In future and accompanying research complementing theoretical lenses will be taken to depict the decision problem and foster our understanding of it.

Based on the elaborated preposition we strive to develop a method that guides the choice of appropriate IOS in a specific business context. An according research project elaborating such support in the domain of Brazilian-German business cooperation has been initiated. This paper lays the basis for standards' evaluation from a theoretical perspective. In the research project we subsequently aim to validate and extend these requirements with empirical qualitative studies conducted in cooperating Brazilian and German companies from various industries. After categorization and extensible analyses of existing IOS we then will integrate insights into a decision support methodology. Afterwards this methodology will be implemented in a software tool to ease its practical application. Tool and method will then in turn be evaluated both with expert revisions of IOS recommendations made in specific application scenario settings and by a standard implementation within a real-world cooperation scenario.

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