# Towards a Socio-Institutional Ontology for Conceptual Modelling of Information Systems

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**Abstract.** Most work on ontologies for conceptual modelling is based on the assumption that conceptual models represent a pre-existing reality, which they should faithfully reflect. This paper suggests an ontology for conceptual modelling of institutional domains taking into account also the prescriptive role of conceptual models, thereby supporting the design of information systems. The paper draws on the current ontological discourse in information systems engineering; descriptive vs prescriptive conceptual modelling; socio-materiality in terms of clarifying the relationships between physical and social domains; and ontological differences between (physical) properties and rights. The results of the paper can be used to support conceptual modelling in business analysis, in particular requirements elicitation of regulative aspects.

## 1 Introduction

A fundamental question in conceptual modelling and business analysis is the one stated by Wand and Weber (2002), "How can we model the world to better facilitate our developing, implementing, using, and maintaining more valuable information systems?" This question has been addressed in the research literature using a variety of approaches and research methods. The idea behind the use of ontology as a foundation for conceptual modelling has been that ontology can help us better model the real-world that is under consideration [Wand and Weber 2002; Wand et al. 1999; Gruber 1995]. The most widespread ontology in Management Information Systems conceptual modelling research, the Bunge-Wand-Weber (BWW) ontology (Wand et al. 1999, p. 497), states that "the world is made of things that possess properties". Although "things" refer to substantial (physical) individuals (e.g., a Human being called John), constructions such as "bank account" is also a considered to be a thing because it is a concrete thing in someone's mind. However, as pointed out by March and Allen (2014), work on ontology for conceptual modelling has so far only provided limited guidance, including requirements elicitation.


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Most work on ontologies for conceptual modelling is based on the assumption that conceptual models represent pre-existing or potential state of affairs i.e. the general status of things in reality, which they should faithfully reflect. This assumption entails that conceptual modelling is primarily a descriptive activity, in which modellers investigate some reality in order to understand it so well, that they can form an accurate model of it. This assumption is often valid when modelling material worlds, but it easily breaks down for the modelling of social worlds. In the latter case, a conceptual model typically does not only represent state of affairs. Instead, it can also work prescriptively as a blueprint that people can use to construct the social world, including their social relationships. The conceptual model provides a language and rules, which are normative and constitutive, and not just descriptive that people can apply to create and regulate their relationships.

The purpose of this paper is to propose an ontology for institutional domains. The ontology is intended to be used for supporting conceptual modeling in business analysis. In particular, it can help to elicit and structure requirements related to rules and regulations in a business used for creating institutional facts, and by that also supports the identification and constitution of entities in a business domain.

The proposed ontology is an extension of Bergholtz et al. 2013, which uses a socio-material perspective (Orlikowski 2008) as starting point. A key notion in socio-materiality is that of performativity, which has its roots in Searle's and Habermas's work, (Searle 1969, Habermas 1976), on performative utterances (speech acts), where social relationships are created in discourses, thereby constituting and regulating the social world.

The paper is organized as follows. Section 2 presents the research settings and introduces a case study to illustrate the ontology. Section 3 presents the ontology. Section 4 illustrates conceptual problems that we have found in the case study. Section 5 shows how the conceptual problems found in the case could be resolved, thereby outlining how the ontology could be used for conceptual modelling as well as comparing the solutions to other ontological approaches.

## 2 Research Setting

### 2.1 Research Approach

The socio-institutional ontology is based on primary data from a rich dataset of longitudinal case studies that we have been performed from 1997 until now. Examples include a sell support system used by car dealers at Volvo (Ågerfalk and Eriksson 2004); an e-infrastructure used at the Swedish National Road Administration in Sweden for providing the RDS-TMC service, a student registry used at all the universities in Sweden (Eriksson and Ågerfalk 2010). The secondary data set we have used is typical modelling patterns and problems depicted in the mainstream metamodelling and modelling literature (e.g. Wand et al. 1999; Guizzardi 2005; Henderson-Sellers and Gonzalez-Perez 2010).

### 2.2 Case Study

One of the case studies that we use to exemplify the ontology has been a longitudinal action design project in the social welfare sector. An elaborate description of the study can be found in Eriksson and Goldkuhl (2013).

A municipality of Sweden is obliged to provide income support if a person cannot support himself and his family by own means. A person could apply for income support to the social welfare department in a municipality. What claims could be made in the application and what duties the applicants must follow is regulated and prescribed in Chapter 4 of the Social Service Act (SoL14), the National Standard for expenditure (NSoE) and the prescriptions made by Socialstyrelsen (the national governing body). The first step made by a social welfare officer is to open or re-open a case that already exists, and register the application in the case handling system. The second step is to create or identify an already existing household, because this is the entity that could be granted income support. The third step is to investigate the social situation of the household, i.e. to scrutinize the information about employment situation, income, costs and assets that have been described in the application. To check this, the social welfare officer has to interact with a number of state agencies, e.g. The Board for Study Support (BSS), The Public Employment Service (PES), The Federation of Unemployment Insurance Funds (FUIF) and The Pensions Agency (PA). The fourth step is to deduce the costs of the household from the income and assets of the household and to decide whether the household could be granted income support, as well as the amount granted. The information exchange between the municipalities and state agencies is prescribed by statute (SFS 2008:975). However, the interaction with the state agencies is difficult due to conceptual problems in the case handling systems. We will elaborate on these problems in more detail in Sect. 4.

## 3 The Socio-Institutional Ontology

### 3.1 Institutions

Humans regularly interact and, thereby, become socially related with each other. Thus, social interaction forms communities that may become more or less stable over time. For complex communities, the relationships among their participants are governed by rights and rules that express what people are allowed, or obliged, to do. Such rights are always relational, in the sense that they express that someone has a right in relationship to someone else. For example, a municipality (juridical person) of Sweden is obliged by the Social Services Act to provide income support if a client (person) cannot support himself and his family (the household). This also implies that a person could make a claim for such a support from the municipality. In order to describe the interactions, the notion of institution is helpful. An institution consists of a language and a set of rules expressed in that language, which are upheld through collective intentionality. Institutions are able to work thanks to the collective intentionality of a community, i.e. the intentionality shared by its members, including their shared beliefs and emotions (Searle 2011), in particular this means that “Language does not just describe a pre-existing institutional reality but is partly constitutive of that reality.” (ibid.).

### 3.2 Institutional Entities and Rights

In order to capture the idea that some objects e.g. (a person, juridical person, money) are related to rights, the notion of institutional entity is introduced. An *institutional entity* (see Fig. 1 central part) is an instance of a general institutional concept constituted by the use of language within some institution, which has rights or can bestow rights on other institutional entities.

The notion of right can be clarified using the work of W. N. Hohfeld, (Hohfeld 1978). Hohfeld suggested a classification, in which four kinds of rights (deontic powers) are distinguished. An institutional entity has a *claim* on another institutional entity if the second entity is required to act in a certain way for the benefit of the first one, typically by carrying out some action. An institutional entity has a *duty* to another institutional entity if the second entity has a claim on the first one. An institutional entity has a *privilege* on an action if she is free to carry out that action in accordance with the rules of an institution. A *power* is the ability of an institutional entity to create or modify claims, duties, privileges or powers.

As there exists a large variety of institutional entities, it is helpful to identify and structure various kinds of institutional entities into a taxonomy. We distinguish between physical and institutional grounding. Sometimes institutional entities have to correspond to one physical human being, e.g. in the case of a client to come into existence. This is called *physical grounding*. However sometimes there is no such need e.g. a juridical person does not have to have such a correspondence relationship. Thus it could come into existence without there being a physical thing or human being which becomes the juridical person (Searle 2005, p. 16). The only requirement is that there is a media trace of it. *Institutional grounding* means that an institutional entity must be associated to another institutional entity in order to come into existence. For example a client could come to existence because there already exists an instance of a Swedish citizen that the client could be associated to. For all types of rights, a distinction can be drawn between legal and non-legal rights. A *legal right* is a right that is acknowledged by a state and could be a basis for official sanctions from the state. A *non-legal right* is a right that is acknowledged by a state or some other institution but could not be a basis for official sanctions from a state. At a top level (see Fig. 1, middle part), three kinds of institutional entities can be identified: ***institutional subject, institutional thing***, and ***institutional contract***.

An *institutional subject* is an institutional entity that can have duties, and there are four types institutional subjects: person, social group, social subject and juridical person: A *person* is an institutional subject, physically grounded in a single human being or socially grounded in another person. A person can have legal and non-legal rights. A *social group* is an institutional subject physically grounded in one or more human beings or socially grounded in one or more persons. In contrast to a person, a social group can only have non-legal rights. A *juridical person* is an institutional subject that, in contrast to a person and social group, is not physically grounded in a human being and who can only have legal rights. A *social subject* is an institutional subject which, like a juridical person, is not physically grounded in a human being and can only have non-legal rights.

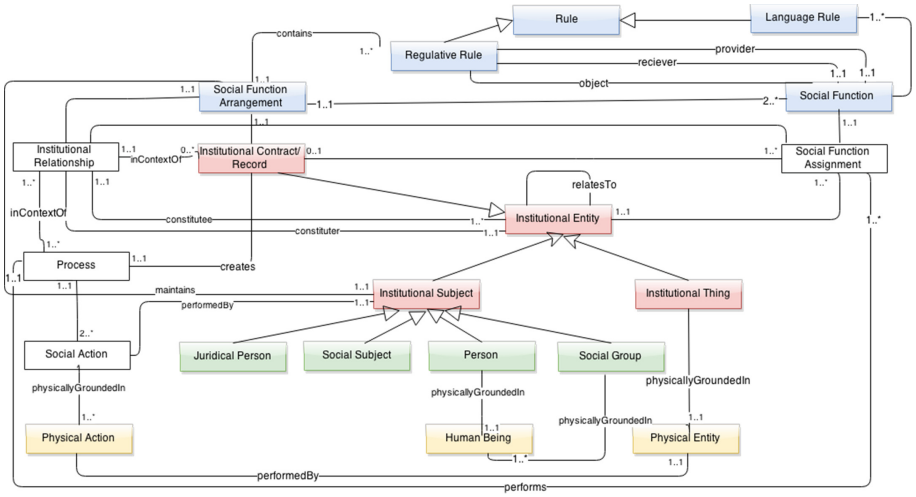


**Fig. 1.** The Socio-Institutional ontology (due to space restrictions all associations will not be discussed in the text, association-role cardinality assumed 0..* if not otherwise stated)

An *institutional thing* is an institutional entity that cannot have duties, and is physically grounded in a physical entity or socially grounded in another institutional thing.

An *institutional contrac*t is an institutional entity that cannot have rights but only bestow (mediate) rights between institutional subjects and things (we will explain this in more detail in Sect. 3.4).

This could be exemplified in the social service case like this. Institutional subjects: a client is a *person* which has both legal and non-legal rights and is physically grounded in a human being; a household is a *social group*, which has non-legal rights and is socially grounded in one or several *clients*; a social service office is a *social subject*, which has the power to grant income support to a household, however, not legally responsible for the decisions made; a municipality is a *juridical person* that is legally responsible for the decisions made. Institutional thing; a realisable asset e.g. a vehicle that could be sold in order to provide an income to the household. Institutional contract: a granted income support is a contract between the social service office, the household and the clients who are the members of the household.

### 3.3 Rules and Social Functions

Institutions precede institutional entities, in the sense that institutional entities can only be created and regulated if there exist institutions with a language and rules so that they can create, maintain, relate and refer to institutional entities. These rules fall into two main categories, *regulative rules* that express what rights that can hold between institutional entities and *language rules* (see Fig. 1 top right part).

A *regulative rule* expresses a right that can hold between institutional entities. It can be expressed as a formula, which includes a kind of right, an action type and two or more open variables. An example is the regulative rule of the Social Service Act Chapter 4 § 1 could be formulated like this. "*Municipalities* have the duty to provide *Income support* to *Households"*, which includes the variables *Municipality, Income Support, and Household*. Rules do not refer to specific institutional entities, but to general terms (concepts), which we call social functions. The variables can be substituted with terms referring to such entities. For example, after substitutions, the rule above could result in the expression "The Municipality identified by organization number 212-0829 has the duty to provide the granted income support prescribed in the contract with the id 16661 to the Household identified with householdId 9882".

The assignments of rights are also governed by language rules because in order to assign rights, it is necessary to be able to instantiate and identify the entities to which the rights apply. There are three kinds of language rules: *application rules*, *instantiation rules* and, and *identification rules*.

An *application rule* specifies under which circumstances a definition applies to an institutional entity. An example of an application rule is a definition of a household: "A household is a unity for the sustainment of a number of household members which could be adults and children that live together and try to make a living together." Additionally the household member must be understood as clients of the social service, and this applies only to persons who could be identified as Swedish, EU- or EES citizens. Thus only persons that fulfil this definition could count as household members. Hence, a *social function* is a concept that specifies a number of regulative and application rules that could be applied to some institutional entity.

An *instantiation rule* defines how institutional entities are created and assigned social functions. An example is that something becomes a household when it has been registered as such and acknowledged as such by a social welfare officer in the case handling process at the social service department. Thus, the social welfare officer must also know the application rule, i.e. the definition of the household type and its role in this context in order to be able to correctly instantiate an entity of such a type.

An *identification rule* specifies how an institutional entity is to be identified. For example, typing in the household identifier in the case handling system at the social service department, and checking other credentials that is important for the identification of the household. In order to identify an object it must exist, i.e. it must first be instantiated (see above).

Social functions do not appear in isolation but always in groups, or arrangements, of two or more social functions. To represent these arrangements, the notion of *social function arrangement* is introduced. A *social function arrangement* is a set of social functions that are related to each other through a number of rules.

### 3.4 Social Function Assignment

There are two ways to assign social functions: (1) through the creation of a new institutional relationship or (2) through the creation of an institutional contract.

(1) An *institutional relationship* is created between a number of institutional entities, two of which are institutional subjects, and at least one of which does not exist prior to the creation of the relationship. The new institutional entity is said to be *constituted* by the institutional relationship. When the relationship is created a number of rights are assigned. For example, when a household-ship is created, the household and its members have been recognized as institutional entities, it is also acknowledged that they have the right to claim income support from the municipality.

(2) Social functions could also be assigned through institutional contracts. An example of an institutional contract in the household case is the granted income support.

## 4 Conceptual Problems Found in the Case Study

In the social allowance welfare case from Sect. 2.2, the interaction between social welfare officers and the state agencies were analysed in the light of statute (SFS 2008:975), which prescribes how the interaction must be performed. When we investigated two of the most used case handling systems used in more than half of the municipalities, a number of conceptual ambiguities were disclosed.

Firstly, the case handling systems used the same identifier for the case, the household and one of the members of the household which was called "the leader of the registry". It was often the PID-number of the adult man that was used, and this caused a number of problems: (a) Decisions made by the social welfare officer using the case handling systems were only sent to the adult man and not to the adult woman of the household. (b) If the woman wanted information about the case she had to provide the PID-number of the man. (c) It was difficult to get the right statistics from the case handling systems because the clients were not distinctly identified within the household as its identity was mixed up with the identity of the adult man.

Secondly, the notion of an open case was ambiguous, and the municipalities had different opinions of what it meant. A new case was created only if the household had not been granted income support within three months before the application date. If the household earlier on had been granted income support within this period, the old case was just re-opened. However, when the law that regulates the case handling process (Förvaltningslag 1986:223) was scrutinized, we found out that there was no such case status (i.e. reopened case) defined in the law. So the notion of reopened case and how it was implemented in the case handling systems were not in line with the law.

## 5 Discussion

Below two models that solve the conceptual problems outlined above, as well as a number of ontological questions and modelling problems, are presented.

### 5.1 Identity Is Socio-Institutional, not Material, to Its Character

The model of Fig. 2 makes a clear distinction between a household, its clients (the household members), and the case. These concepts were not clearly separated in the case handling systems, because the same identifier was used for referring to the entities of all three classes. The model above shows that these are different classes and each class should provide its own principle of identity. This implies that the problems described above which were caused by the first conceptual ambiguity could be resolved. This also means that the identity of a household is not to be found by describing physical human beings or their properties it is something assigned by the municipality.

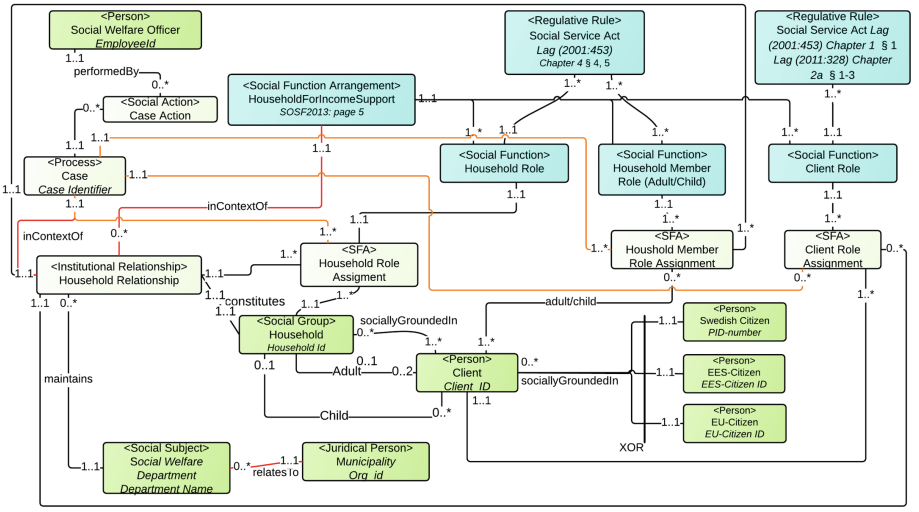


**Fig. 2.** A conceptual model that prescribe how the household relationship is constituted

Furthermore, the PID-number had also wrongly been chosen to identify the case. The Swedish law prescribes that every case should have a unique number, (which should not be mixed-up with a PID-number). The case is a process, which is composed of a number of social acts which have to be recorded according to the law. Thus, the case process should have its own principle of identity (see also Ågerfalk and Eriksson 2004). This indicates that the principle of identity in institutional reality is a matter of language rules rather than a rigid substantial property. This is an alternative view compared to the one that has been suggested e.g. in the UFO-ontology. According to UFO a process is a perdurant, which should be represented as an abstract class because it cannot provide a principle of identity since none of its temporal parts retain their identity through time (Guizzardi 2005, p. 211).

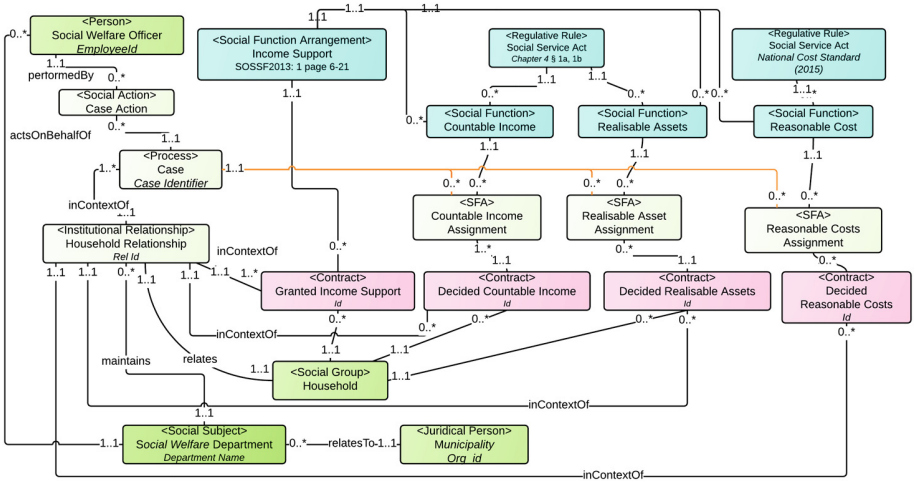


**Fig. 3.** A conceptual model prescribing how welfare contracts are constituted.

## 5.2 Institutional Relationships Should Be Modelled as Classes

The next model solves the second conceptual ambiguity problem because the model clearly distinguishes between the household institutional relationship and the case. The model in Fig. 3 shows that there could be several cases within the same household relationship. This draws from the fact that in the SMO institutional relationships are modelled as concrete classes with entities of its own. However, this is e.g. proscribed in the BWW-ontology where relationships should be modelled as mutual properties (Wand et al. 1999, p. 510). Based on this case and other case findings this should not always be prohibited, rather encouraged. This result is in line with e.g. (Guizzardi 2005, p. 267–268), which also warrants modelling mutual properties as (relator) classes.

## 5.3 Rights and Properties Are Ontologically Different

Another feature of the SMO is that rights are not modelled as properties of classes, but are relational, i.e. they do not appear in isolation but always in the context of institutional relationships that hold between classes, see Fig. 3. An example is the granted income support contract that exists within the relationship between the social service department and the household. This contract primarily consists of a duty for the municipality to cover household costs for the next month. In return, the household has a duty to inform about any changes which could affect the decided income, assets etc. of the household, which also are contracts within this institutional relationship.

## 5.4 Language as a Constituter of the Socio-Institutional World

The ontological difference between the material and socio-institutional is not yet well understood in conceptual modelling. It is important to make a distinction between brute

and institutional facts (Searle 1995). Brute facts exist independently of human institutions and concern physical (brute) things and their properties. Institutional facts, i.e. institutional entities and rights, on the other hand, require special human institutions for their very existence. Brute facts are described using language, but institutional facts are prescribed (and later obviously also described) and assigned using language. The solutions to the conceptual problems described above were not to be found by observing the existing world of physical things and their properties and to describe it more truthfully. The solution to the problems had to be sought in the constituencies of the socio-institutional world and how language is used to prescribe and constitute that world.

## References

Ågerfalk, P.J., Eriksson, O.: Action-oriented conceptual modelling. Euro. J. Inf. Syst. **13**(1), 80–92 (2004)

Bergholtz, M., Eriksson, O., Johannesson, P.: Towards a sociomaterial ontology. In: Franch, X., Soffer, P. (eds.) CAiSE Workshops 2013. LNBIP, vol. 148, pp. 341–348. Springer, Heidelberg (2013)

Eriksson, O., Goldkuhl, G.: Preconditions for public sector e-infrastructure development. Inf. Organ. **23**(3), 149–176 (2013)

Eriksson, O., Ågerfalk, P.: Rethinking the meaning of identifiers in information infrastructures. J. Assoc. Inf. Syst. **11**(8), 433–454 (2010)

http://www.notisum.se/rnp/sls/lag/19860223.htm

Gruber, T.R.: Toward principles for the design of ontologies used for knowledge sharing? Int. J. Hum. Comput. Stud. **43**(5), 907–928 (1995)

Guizzardi, G.: Ontological Foundations for Structural Conceptual Models, CTIT Ph.D. thesis Series, No. 05-74, Telematica Instituut Fundamental Research Series, No. 015 (TI/FRS/015) (2005)

Habermas, J.: What is Universal Pragmatics? In: Cooke, M., Habermas, J. (eds.) On the Pragmatics of Communication 1976, 1 edn. Massachusetts Institute of Technology, Cambridge (1984)

Henderson-Sellers, B., Gonzalez-Perez, C.: Granularity in conceptual modelling: application to metamodels. In: Parsons, J., Saeki, M., Shoval, P., Woo, C., Wand, Y. (eds.) ER 2010. LNCS, vol. 6412, pp. 219–232. Springer, Heidelberg (2010)

Hohfeld, W.N., Corbin, A. (eds.): Fundamental Legal Conceptions. Greenwood Press, Westport (1978)

March, S.T., Allen, G.N.: Toward a social ontology for conceptual modeling. Commun. Assoc. Inf. Syst. 34, Article 70 (2014)

National Standard of Expenditure, Riksnormen för försörjningsstöd. http://www.socialstyrelsen.se/ekonomisktbistand/riksnormen

Orlikowski, W., Scott, S.: Sociomateriality: challenging the separation of technology work and organization. Acad. Manag. Ann. **2**(1), 433–474 (2008)

Searle, J.: Speech Acts: An Essay in the Philosophy of Language. Cambridge University Press, Cambridge (1969)

Searle, J.: The Construction of Social Reality. Free Press, New York (1997)

Searle, J.: Making the Social World: The Structure of Human Civilization. Oxford University Press, Oxford (2010)

https://www.riksdagen.se/sv/Dokument-Lagar/Lagar/Svenskforfattningssam-ling/Socialtjanstlag-2001453_sfs-2001-453/

SFS (2008:975) In Swedish. Förordning om uppgiftsskyldighet i vissa fall enligt socialtjänstlagen. https://lagen.nu/2008:975

Wand, Y., Storey, V.C., Weber, R.: An ontological analysis of the relationship construct in conceptual modeling. ACM Trans. Database Syst. **24**(4), 494–528 (1999)

Wand, Y., Weber, Y.: Research commentary: information systems and conceptual modeling—a research agenda. Inf. Syst. Res. **13**(4), 363–376 (2002)