Multi-Grounded Development of Enterprise Modeling Methods: The Case of SIMM

Peter Rittgen

University College of Borås, 501 90 Borås, Sweden, Email: peter.rittgen@hb.se

Abstract. *Multi-Grounded Theory (MGT) extends Grounded Theory by further grounding processes, most notably theoretical grounding. As an example for applying MGT we use the enterprise modeling method SIMM, which is empirically grounded, and show that this method can profit from grounding it also in an external theory. We outline a procedure called communicative and material functions analysis that can be used for this purpose and apply it to Business Action Theory. With the help of the extended method we analyze a business situation in order to follow up the commitments that are made in the course of a business process with the ultimate aim of detecting flaws in that process.*

1 Introduction

Grounded Theory (GT; Glaser, Strauss 1967; Glaser 1992; Glaser 1998; Strauss, Corbin 1998) was introduced to provide a systematic procedure for deriving categories and theoretical constructs from empirical data. GT is, strictly speaking, not a theory but rather a method for theory development. Its characteristics are the relatively short iteration cycles and a process of continual improvement. Starting with a small set of empirical data we develop an initial understanding of the problem field, which then can be used to gather further empirical data in a more controlled fashion, leading to an improved understanding and so on until we reach theoretical saturation.

GT started out in sociology but has since been applied in a variety of fields including informatics. In the latter it has also been used to develop modeling methods, typically based on action research. An example of such a method is SIMM (Situation-adaptable work and Information systems Modeling Method; Goldkuhl 1996). SIMM has been empirically grounded in action research projects some of which are documented in (Lind, Goldkuhl 1997; Melin, Goldkuhl 1999; Axelsson et al. 2000; Goldkuhl, Melin 2001; Axelsson, Segerkvist 2001; Lind et al. 2003; Melin, Axelsson 2004; Johansson, Axelsson 2004; Johansson, Axelsson 2005; Haraldsson, Lind 2005). SIMM provides both a method for enterprise modeling and a meta-method for evaluating modeling methods.

Empirical grounding proceeds as follows: SIMM Enterprise Modeling is applied in an action research project. The experiences gained from the use of the method are evaluated with the SIMM Meta Method and corresponding changes to SIMM Enterprise Modeling are made. In a further round of action research these changes are consolidated and further improvements are made (see fig. 1).

GT has been criticized for being restricted to a purely inductive approach. It is argued that we cannot ignore the knowledge that established theories might contribute. Consequently, (Goldkuhl, Cronholm 2003) suggest that further grounding processes are required in addtion to the existing empirical grounding process, most of all a theoretical grounding process. They call this new approach Multi-Grounded Theory (MGT).

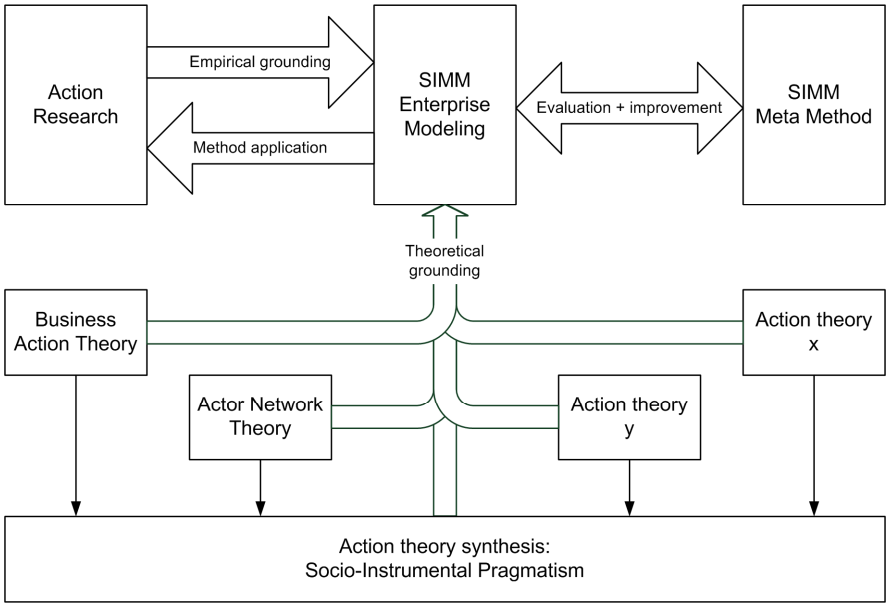

Fig. 1: Multi-grounded development of an enterprise modeling method

If we want to apply MGT in the context of enterprise modeling we must identify a suitable theory that can function as external theory for theoretical grounding. For the purpose of this paper we have chosen Business Action Theory (BAT; Goldkuhl 1996; Goldkuhl 1998; Goldkuhl, Lind 2004) because some preliminary work has already been done in that area. E.g. (Goldkuhl 1996) has extended SIMM to cover communicative actions, which are essential in BAT. Many other important concepts such as layers and phases have been disregarded, though. It is the purpose of this paper to complete the theoretical grounding of SIMM in BAT.

This can be considered as a first step, as a grouding in other action theories might also be considered. But as the choice of external theory is contingent there are strong arguments to synthesize the relevant theories as Goldkuhl (2005) pointed out. The result, Socio-Instrumental Pragmatism (SIP; Goldkuhl 2002; Goldkuhl 2005), is a general ontology of social action. So far it is not sufficiently developed to provide a basis for theoretical grounding. We therefore restrict our approach to BAT for the purpose of this paper.

The remaining sections are structured as follows: We first introduce BAT and the generic layered patterns for business modeling. This framework is then refined by combining phases and layers. We proceed by applying communicative and material functions analysis to it, followed by a classification of the resulting functions, and finally leading to the extension of SIMM in terms of BAT concepts. We conclude by presenting an application of the extended method for the purpose of commitment analysis.

2 Business Action Theory

The elementary unit of behavior in BAT is a business act. It comprises both a language act and a material act. A language act is an elementary communicative activity in spoken or written form directed from one actor to another with the aim of changing the mental state of the latter. A material act is an elementary physical activity directed from an actor to the material world with the aim of changing its state.

Strictly speaking, and as observed by Goldkuhl (1996), language and material acts are not so much distinct and separate acts but rather functions (or aspects) of one and the same business act. For example, the business act of delivering goods is, perhaps in the first place, a material act. i.e. transporting "stuff" from one place to another. But at the same time it has a communicative function, i.e. it implies the language act "We have fulfilled the commitment we entered by accepting the respective order."

This means that a deeper understanding of business action must be grounded in an analysis of these functions. We call this analysis 'communicative and material functions analysis' and use it as a basis for deriving concepts for modeling business actions. The objectives of such an analysis are

1. to find the communicative and material functions that are inherent in a generic or specific business act,

2. to classify the identified functions, and

3. to derive suitable concepts for business action modeling.

We apply the procedure to BAT itself to derive concepts for enterprise modeling that refine and extend an existing method: SIMM. A business process in BAT is divided into 6 phases:

1. Business prerequisites phase

2. Exposure and contact search phase

3. Contact establishment and proposal phase

4. Contractual or commitment phase

5. Fulfilment phase

6. Completion or assessment phase

BAT was introduced by Goldkuhl (1996) and was enhanced in (Goldkuhl 1998) and (Goldkuhl, Lind 2004). It is ontologically rooted in Socio-Instrumental Pragmatism (SIP; Goldkuhl 2002), which combines communicative (social) and material (instrumental) aspects of actions. The roots of BAT are Speech Act Theory (Austin 1962; Searle 1969) and the Theory of Communicative Action (Habermas 1984).

In BAT business interaction involves two principal players, supplier and customer (see fig. 2). The phases are constituted by generic business actions on each side of the transaction (see table 1).

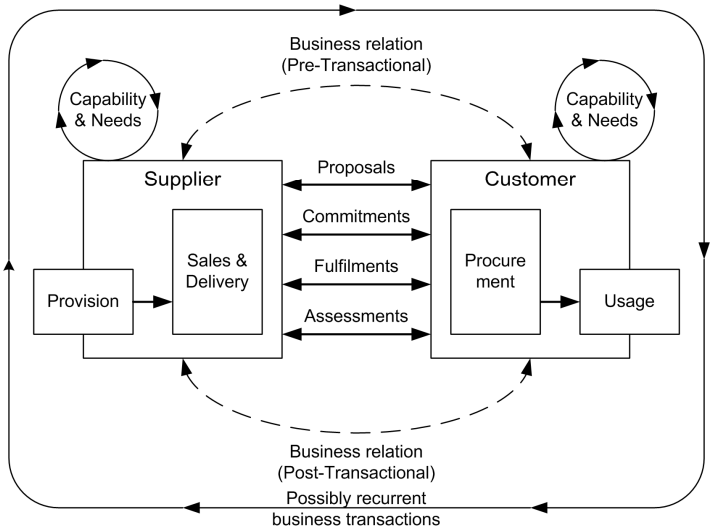

Fig. 2: A business transaction in BAT (Lind, Goldkuhl 2005)

Table 1: Generic business actions

Phase	**Supplier**	**Customer**
Prerequisites phase	Product/offer development	Identification of problems/needs
Exposure & contact search phase	Offer exposure	Contact search
Proposal phase	Offer	Inquiry
Commitment phase	Order confirmation	Order
Fulfilment phase	Delivery, Invoice, Receipt of payment	Receipt of delivery, Payment
Assessment phase	Acceptance, Claim	Acceptance, Claim

The business actions follow a certain execution logic but the whole transaction is by no means linear. In the proposal phase, for example, the supplier can make any number of offers where each one will typically meet the customer's needs better than the preceding one. Likewise the customer can make a series of inquiries that usually become more and more "realistic". These loops terminate when offer and inquiry are sufficiently close to each other to reach an agreement whereupon we enter the contractual phase. In an ideal scenario this consists of the customer placing an order and the supplier confirming it. Both actions together constitute a contract the fulfilment of which is subject of the next phase. Here the supplier, again ideally, delivers the products/services and sends a corresponding invoice. The customer receives the delivery and makes the payment, which the supplier finally receives. In the completion phase each party decides whether they accept the delivery/money or make a claim, i.e. request the fulfilment of that part of the contract they consider unfulfilled.

Orthogonal to the phases (Lind, Goldkuhl 2001) introduced another dimension: layers. They extend and modify the layers originally suggested by Weigand and van den Heuvel (1998). Layers refer to the granularity of an action and they are, from fine grain to coarse grain: business act, action pair, exchange, business transaction and transaction group.

3 Refining the Framework

A theoretical grounding in BAT has to take into account both dimensions, phases and layers. Strictly speaking, the phases are only a refinement of a particular layer, namely the transaction layer. To derive BAT concepts for SIMM we also need a refinement of the other layers. Such a refinement is suggested in figure 3.

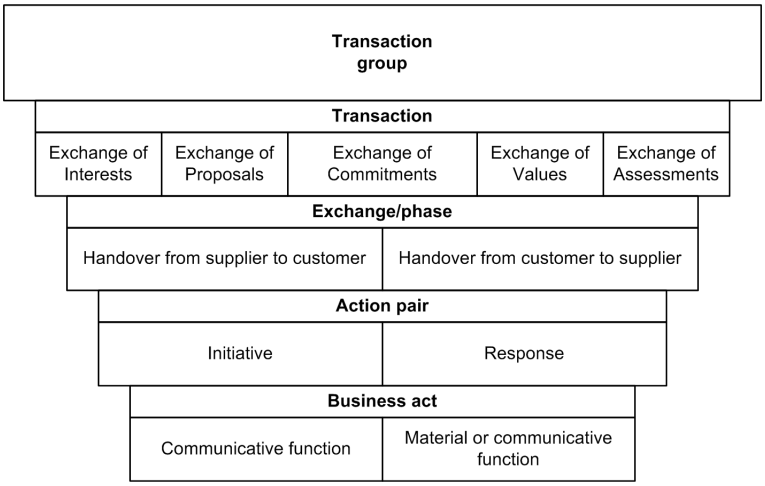

Fig. 3: Structure of the layers

On the fifth and final layer the same customer and supplier engage in a number of transactions over a longer period of time thus forming a stable business relation (Axelsson et al. 2000; Goldkuhl, Melin 2001). The transaction layer is divided into exchanges (they correspond to the phases). An exchange consists of two handover actions: One directed from supplier to customer and the other vice versa. These handovers usually happen one after the other where the second happens in return for the first but the order is not predefined, i.e. in some cases the supplier hands over first and in others the customer. An action pair is a pair of actions where the first one is a trigger (initiative) and the second a response. Actions can have a dual function so the response of one action pair can be the initiative of another. A business act is elementary and has a primary function which is always communicative but can also have a secondary function (communicative or material).

4 Communicative and Material Functions Analysis

A business act consists of one or more functions. Goldkuhl (1996) gives the example of a (commercial) offer, which can be a single business act that has two communicative functions,

1. that of requesting the potential customer to buy (i.e. to place an order),
2. that of committing the potential supplier to sell (i.e. to deliver) under certain conditions.

If we apply that kind of analysis, which we call communicative and material functions analysis, to the remaining generic business actions we get the results shown in table 2.

Table 2: Communicative & material functions of the generic business actions

Business Action	Communicative/material function	Business Action
Offer exposure	*State* general offer	Offer exposure
Contact search	*Express* interest	Contact search
Inquiry	*Request* commercial offer + *Express* interest	Inquiry
Commercial offer	*Offer* delivery + *Request* order	Commercial offer
Order	*Request* delivery + *Offer* payment	Order
Order confirmation	*Promise* delivery	Order confirmation
Delivery	*Transfer* merchandise/*Perform* service + *State* delivery	Delivery
Invoice	*Request* payment + *State* contract fulfilment [supplier]	Invoice
Receipt of delivery	*Accept* delivery + (*Accept* contract fulfilment [supplier])	Receipt of delivery
Payment	*Transfer* money + *State* contract fulfilment [customer]	Payment
Receipt of payment	*Accept* payment + (*Accept* contract fulfilment [customer])	Receipt of payment
Acceptance	*Accept* contract fulfilment [supplier or customer]	Acceptance
Claim	*Request* contract fulfilment [supplier or customer]	Claim

These results show that a business act typically has one or two functions. The communicative function is always present (even in the case of material acts) but there might be another function of either type. This is reflected in the model of figure 3.1. The generic business action "receipt of delivery or payment" can in some cases imply the acceptance of the contract fulfilment. In other cases the acceptance is stated explicitly (i.e. separately in the assessment phase) or a claim is made.

We are aware of the fact that such a list of generic actions and their functions can only serve as a recommendation that covers some typical or common situations. It is not meant to be a prescriptive template for all business interactions. Using that analysis in a different context might yield different actions and even different functions concerning the same actions. But the results can nevertheless be useful to find a set of recurring material and communicative functions that can be used as a pattern for a modeling language.

5 Extending SIMM

The results from the communicative and material functions analysis are now used to enrich the SIMM method. This extension is part of theoretical grounding with the external theory being BAT. The techniques for such an extension are offered by (situational) method engineering (Ralyté et al. 2003). The idea behind method engineering is to design methods in such a way that they fit the specific modeling situation. This can be done in different ways. One way is to extend an existing method. Using this approach, we enrich and refine the language of SIMM with the concepts from the analysis.

SIMM provides three basic categories: actors, actions and (action) objects. The latter are divided in information and material objects. Examples of them are shown in fig. 6.1 but SIMM offers many additional types. For non-elementary actions the circumference is drawn as a double line and an inscribed symbol identifies the layer (see fig. 4). If a material function is involved we may use an octagon. The box is labelled with the business act or the respective function(s) where the function header is italicized.

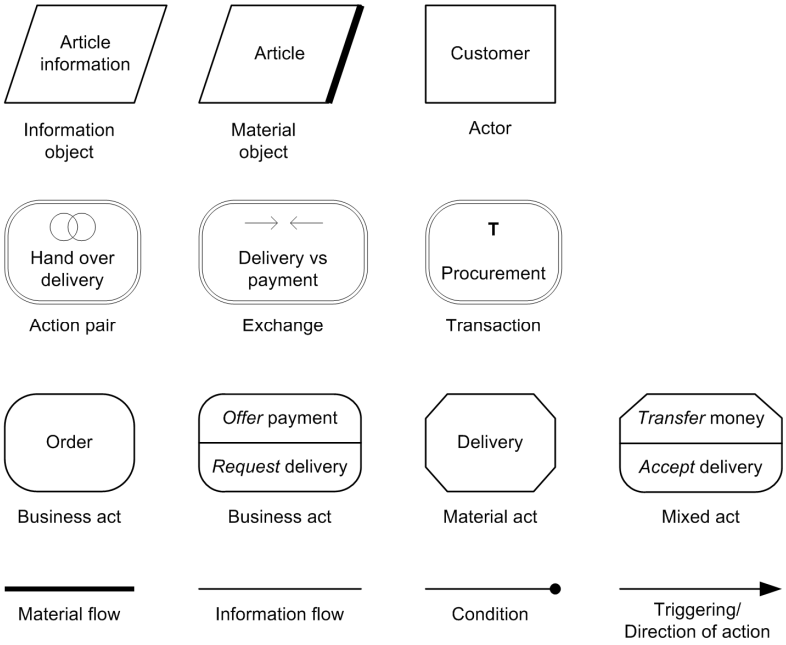

Fig. 4: Concepts for business action modeling and their notation

Among the notational elements there are also four types of arcs. The condition arc allows us to show that one action is a condition for another action with the black dot being attached to the latter. The arrow serves two purposes. If it points from one action to another, the former triggers the latter. If it points from one actor to another, it represents an action that is directed from the first actor to the second. In this case the name of the action is written along the arrow. It can be accompanied by a symbol denoting the layer. For communicative or material functions we can also use a circle or a diamond, respectively. As an alternative to the arrow form of the action the boxed form of the action can be interlaced with the arrow.

6 Applying the Extended Method: A Case Study

Commitment analysis in terms of language action was introduced by Auramäki et al. (1988). We performed it in a project with two companies that have a very close business relationship. One of them is the headquarters of a retail chain, the other a third-party logistics provider (LogPro). Our goal was to detect and solve major problems in their relationship. For this we analyzed order processing and delivery. We intended to use SIMM Interaction Diagrams but required additional information on the type and level of an action so we enriched the diagram with the features introduced above. The result is shown in fig. 5.

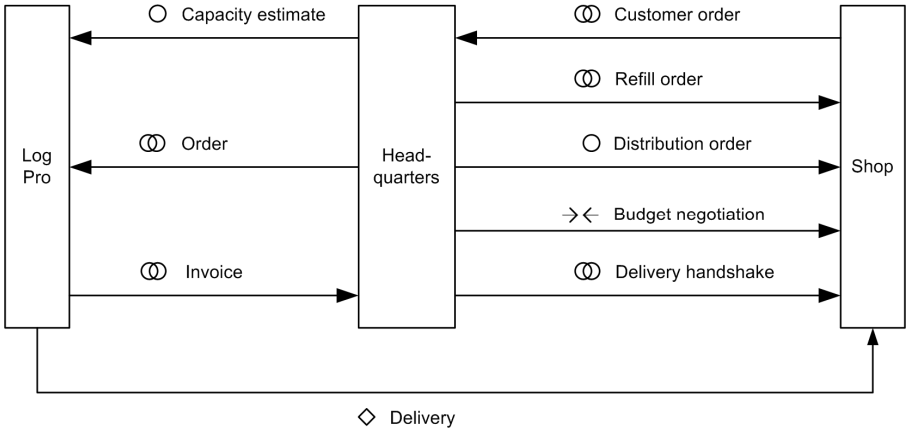

Fig. 5: Enriched Interaction Diagram

The process starts when Headquarters send an estimate regarding the required capacity for future orders. There are three types of orders. A customer order is initiated by the Shop on behalf of a customer who wishes to buy an article that is not currently available. The refill order is triggered by Headquarters when the stock is running low. Both are on the action-pair level because they require confirmation from the partner. The third type is called distribution order. It is based on a negotiated budget and the Shop is obliged to accept it. This order is therefore only a single speech act with an informative character. The budget negotiation, however, is bilateral. It consists of an exchange of budget proposals initiated by Headquarters.

All orders are combined into one and forwarded to LogPro. LogPro will perform delivery to the Shop. Headquarters inform the Shop about an upcoming delivery and receive a confirmation when it arrives (delivery handshake). In regular intervals LogPro bill their services to Headquarters.

In the next step we developed detailed Interaction Diagrams. The one for LogPro and Headquarters is shown in fig. 6 on the business-act level. It shows that Headquarters send a capacity estimate first. On the day of delivery a pick file is transferred to LogPro that contains the order data. This is used to pick the articles from the shelves and to pack them. As soon as they are on their way, LogPro reports delivery to Headquarters. At the next billing occasion LogPro send an invoice and Headquarters make the respective payment.

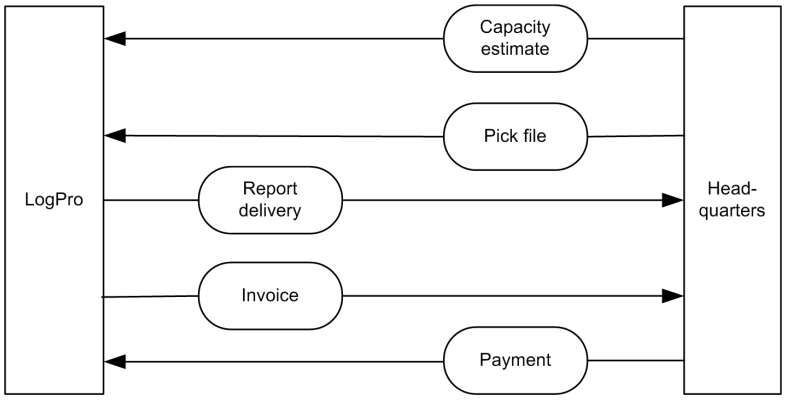

Fig. 6: Detailed Interaction Diagram

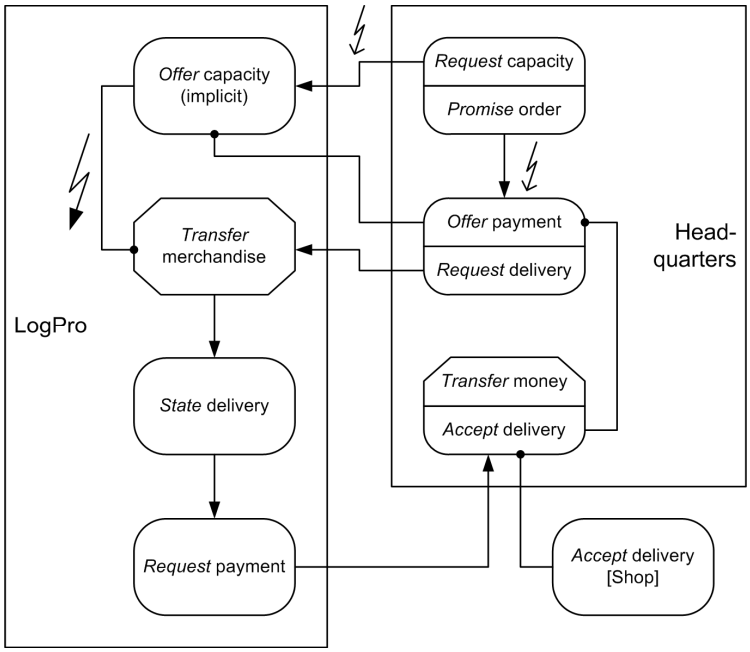

Fig. 7: Business Act Diagram

For commitment analysis we need more information about how actions are related to each other. This implies exhibiting their communicative and material functions that lead to the establishment or fulfilment of commitments and the conditional and causal relations between them. This helps us to uncover broken commitments. For this purpose we employ a Business Act Diagram (see fig. 7).

The capacity estimate implies a request to provide this capacity and a promise to place a respective order. LogPro offers to provide the capacity subject to the order and the implied offer of payment. The capacity offer is implicit (i.e. not communicated) because LogPro is required to provide it by virtue of the frame contract. The provision of capacity is a condition for performing the delivery that is triggered by the respective request from Headquarters (a function of the order). The other function, offer payment, is subject to an accepted delivery. The delivery triggers a respective report (state delivery) which in turn initiates the invoice (request payment). The latter triggers the payment (transfer money) but only if the Shop has confirmed the arrival of the delivery. Headquarters confirm acceptance of the delivery towards LogPro implicitly by paying the invoice. Therefore “Transfer money” and “Accept delivery” are functions of the same business act.

The Business Act Diagram has shown us that commitments are broken in three different places (see the flash symbols in fig. 7):

1. Headquarters promise that the order will require the requested capacity but in reality orders often deviate substantially from the estimates.

2. The request for capacity is not in a suitable format for LogPro so that capacity planning does not work but Headquarters rely on it.

3. Due to 1 and 2 the prerequisites for delivery are often not given leading to higher costs and occasional failures to meet delivery deadlines.

We have used this approach for other parts of the business process where we also succeeded in identifying bad commitment management.

7 Conclusion

According to MGT a modeling method can be informed by grounding it in some theory or theories. We have chosen Business Action Theory to inform the existing enterprise modeling method of SIMM. Grounding is performed via a procedure called communicative and material functions analysis. The result is an extended method that reflects the properties of the theory. We have shown the usefulness of this approach in the context of a case study involving the analysis of commitments in an interorganizational business process. Future research might investigate the theoretical grounding of enterprise modeling in a more general theory or ontology.

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