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Coordinating Interorganizational Business Processes via Trading Partner Agreements

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Abstract

A trading partner agreement can be used to regulate the cooperation of organizations. It is typically written in natural language which gives rise to misunderstandings when partners interpret it differently. In addition it is often compiled in an unsystematic way so that we might easily overlook a situation the contract should have covered. It is therefore desirable to have a method that can support the design of such an agreement in a controlled and structured fashion. We suggest an approach to this problem that is based on the Language-Action Perspective on organizations.

Keywords: Trading Partner Agreement, Collaboration Model, Business Rules, Interaction Model, simulation

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1 Introduction

Today we can witness two seemingly opposed trends in the cooperation between businesses: On the one hand companies are forced to concentrate on their core competencies and to outsource all activities that lie outside the core. On the other hand customers demand that a supplier covers an increasing range of products and services. They want to buy a complete solution from only one supplier instead of buying bits and pieces from many. This latter point seems to suggest an increased amount of "insourcing". The solution to both is that companies have to engage in closer cooperations, each concentrating on its area of expertise, but jointly offering a complete suite of related products and services that are well matched (one face to the customer). But this scenario represents an enormous challenge both in terms of organization and regarding the information system support.

Companies that want to engage in a closer cooperation, e.g. a business network, a virtual enterprise or the like, bring into this cooperation not only their different organizational cultures but also different, often incompatible, information systems. A successful cooperation therefore requires the alignment or integration of both the business processes and the information systems to a certain degree. In some industries, such as the automotive industry, this can go as far as the customer forcing the suppliers to introduce the ERP system of the customer's choice (e.g. SAP). But on the whole it is more common that the organizations involved will strive for some kind of mutual adaptation of their business processes and information systems. In a very simple case this could be the introduction of a file transfer accompanied by suitable import and export functionalities and some organizational measures for providing and handling the new data. In more advanced cases it will imply substantial reorganization of business processes and changes to existing information systems and/or introduction of new ones.

In a business network organizations strive for the provision of complex products and services by coodinating their activities in an "intelligent" way. This implies that the coordination effort is much higher than in a conventional supply chain. In the latter an individual company can focus on managing the relation to a few immediate major suppliers for creating a product or service. In a business network this is not enough but coordination is also required among the suppliers. Theoretically we move from a tree structure to a graph topology which implies that we have to hit a new balance between market and hierarchical coordination. The general problem behind this is quite old and several theories have been advanced to explain the use of a particular form of coordination, most notably Agency Theory (Alchian & Demsetz, 1972; Jensen & Meckling, 1976; Ross, 1973; Wilson, 1968) and Transaction Cost Economics (Coase, 1937; Klein, Crawford, & Alchian, 1978; Williamson, 1975, 1981, 1985). Based on these theories the internal and external coordination costs can be determined (Gurbaxani & Whang, 1991). High external costs favour centralization, high internal costs promote decentralization. It is typically assumed that organizations in a supply chain choose their organizational structure and network of trading partners in such a way that the sum of both costs is minimized. There has also been some debate on the impact of information technology (IT). Early work by Malone et al. (Malone, Yates, & Benjamin, 1987) suggested that IT will lower transaction costs and therefore, ceteris paribus, lead to an increase in market coordination. Later work posited that organizations will "move to the middle", i.e. to "more outsourcing, but from a reduced set of stable partnerships" (Clemons, Reddi, & Row, 1993) if non-contractible issues (e.g. quality and trust) play an important role. Empirical evidence (Holland & Lockett, 1997) shows that companies often operate in a "mixed mode" blending aspects from both markets and hierarchies.

But the majority of these studies was performed in the context of conventional supply chains. In the face of a network topology the balance between hierarchical and market coordination needs to be readjusted: In the absence of a central coordination unit we typically use the contract as an instrument for coordination. Agency Theory suggests two principal forms of contracts, behavior-based contracts and outcome-based contracts. Between an employer and an employee, for example, a contract with a fixed annual salary would be behavior-based as such a contract demands that the agent performs to the best of his capabilities. An outcome-based contract would specify a remuneration that depends on the results that the agent has achieved (e.g. a commission). If the costs for monitoring agent behavior are high, an outcome-based contract is often superior. This is because an unobserved agent is assumed to shirk (i.e. underperform) knowing that he has no consequences to fear. This problem is called moral hazard. An outcome-based contract can be seen as a special case of a behavior-based contract where delivering the outcome is considered to be the only observable behavior of the agent. In addition to that, the costs for monitoring agent behavior have become marginal in many cases due to the omnipresence of information technology. These arguments apply also to the context of business networks. We will therefore focus our investigation on behavior-based contracts.

A behavior-based approach requires a detailed analysis of the interactions between (and within) organizations. This suggest the use of a particular perspective, namely the language-action perspective, for modeling interactions. For this purpose we select a suitable language called DEMO (Dynamic Essential Modeling of Organization) that represents this perspective. One of the models in DEMO is the Interaction Model. It describes how organizations or organizational units interact with each other. This can form the basis for the development of more detailed models of collaboration. But in addition to this, it can also support the design of a contract regulating the cooperation. The design process is structured and systematic which makes it less likely that (potentially important) details are overlooked. The resulting contract will cover all situations that can possibly occur according to the Interaction and Transaction Models. As the contract (also called trading partner agreement, TPA) is in part formulated in a rigorous language, the enforcement of the agreement is also facilitated. This implies a reduction of the costs for writing and enforcing contracts. Together they form the so-called contractual costs which represent a substantial part of the overall transaction costs (Gurbaxani and Whang, 1991). Hence the design of a trading partner agreement supported by an Interaction Model can reduce transaction costs.

The remaining sections of the paper are structured as follows. First we give an overview of the Language-Action Perspective on Organizations. We motivate the use of that specific perspective for modeling business processes and we show why interorganizational modeling in particular can profit from it. The focus is on interactions between organizational units or organizations. For this purpose we introduce the Interaction Model of a methodology called DEMO. Based on this model we develop Transaction Models which represent a more detailed account of the interaction.

In the section "Trading Partner Agreements" we proceed by giving an outline of the structure of such agreements. We take a closer look at three of their components, General Terms & Conditions, Business Rules and Collaboration Model, and show how they can be derived from the detailed description of the interorganizational interaction. Figure 1 depicts the overall process.

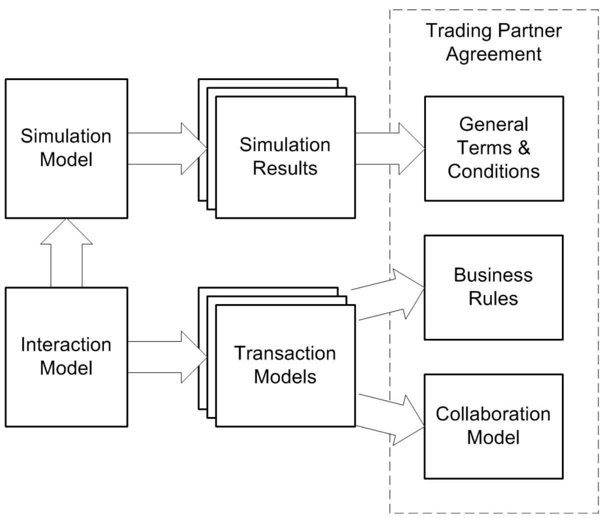

Figure 1: The design of a Trading Partner Agreement based on an Interaction Model.

All examples and figures used in this paper are excerpts from the real models we designed in the course of a consulting project where we tested the feasibility of our approach. The section "A Case Study" gives further details on this project. Last but not least we conclude this paper by summarizing the main arguments and specifying directions for further work.

2 A Language-Action Perspective on Organizations

At the core of the Language-Action Perspective is the Speech-Act Theory by Austin and Searle (Austin, 1962; Searle, 1969). The central premise of this theory claims that language is not only, and not even primarily, a medium for exchanging information. Instead it is a means of action. Uttering something is actually doing something. We can instruct, direct, request, make commitments, promise, apologize, declare marriage and the like, all by just saying a few words. Each language action consists of an illocution describing the kind of action and a propositional content referring to the object of the action. Habermas (1984) embedded this theory of speech acts into a social context whereby language action becomes social action. In his Theory of Communicative Action he argued that each action is determined by the roles that the actors play and the (power) relation they have towards each other. For this purpose he introduced validity claims implying that an actor makes such a claim, implicitly or explicitly, when performing a language action. An order, for example, makes a claim to authority. If the actor issuing the order has no authority over the addressee, the latter is under no obligation to obey and hence the order itself becomes meaningless. The adressee will at best consider it as a joke, at worst he might be seriously offended.

In an organizational setting communication is often aimed at the performance of a specific action ("getting a job done") to achieve some objective. Templates for such goal-driven conversations are the Conversation-for-Action schema (Winograd and Flores, 1986) and the Action-Workflow Loop (Medina-Mora et al., 1992; Denning and Medina-Mora, 1995). They provide a stable framework for the analysis of organizations in general and business processes in particular. More sophisticated examples of such frameworks are: Dynamic Essential Modelling of Organizations (DEMO; Dietz and Habing, 2004; Liu et al., 2003; Dietz, 1999), Action-Based Modeling (Lehtinen and Lyytinen, 1986), Business Action Theory and SIMM (Goldkuhl and Lind, 2004; Goldkuhl and Röstlinger, 1993; Goldkuhl, 1996).

The research addressed in the preceding papragraphs shows that organizational behavior is deeply rooted in language action. All coordination is essentially communicative. With the help of language we build and maintain organizations. It is used to delegate, report, inform, negotiate, sanction, hire, show the ropes, and so on. The importance of communication is even more obvious in an interorganizational context where we cannot rely on a common structure when coordinating activities that cross the boundaries between organizations. This raises a demand for additional communication, particularly in two areas. Firstly a contract has to be negotiated that regulates the relation between the cooperating parties, and secondly there is also an increased need for communication between members of different organizations in the daily routine work. This is due to the fact that a member of organization A typically has a limited knowledge about organization B and also little access to internal information of B. This can partly be compensated by introducing Inter-Organizational Systems (IOS), which formalize to a certain extent the otherwise more spontaneous, ad-hoc communication. The Trading Partner Agreement specifies the environment in which such an IOS operates.

2.1 DEMO

The Language-Action Perspective offers many approaches some of which we have already mentioned. We have have chosen DEMO because it offers transactional patterns not only in the metalanguage but also as concepts in the modeling language itself. This allows us to distinguish between transactions (as complex communicative actions) and speech-acts (as elementary actions) which is essential for our approach (see section "Transaction Models").

In DEMO the structure of an organization is understood as a network of commitments. As these commitments are the result of communication, it follows that a model of the organization is essentially a model based on purposeful, communicative acts. In DEMO, all acts that serve the same purpose are collected in a *transaction* in which two roles are engaged: the *initiator* and the *executor*. The definition of a transaction in DEMO is similar to that of a workflow loop (Medina-Mora et al., 1992; Denning and Medina-Mora, 1995) but it also includes a non-communicative action, namely the agreed action that the executor performs in the object world. Hence each transaction is assumed to follow a certain pattern which is divided into 3 sequential phases and 3 layers. The phases are: *order* (O), *execute* (E) and *result* (R). The layers are: success, discussion and discourse. On the success layer the phases are structured as follows. In the order phase the contract is negotiated. This involves typically a *request* being made by the initiator and a *promise* by the executor to carry out the request. In the next phase the contract is executed which involves factual changes in the object world (as opposed to the intersubject world of communication). Finally, in the result phase the executor *states* that the agreed result has been achieved and the initiator *accepts* this *fact*. If anything goes wrong on the success layer, the participants can decide to move to the discussion or discourse layer. For details on these layers see (Reijswoud, 1996).

The following section describes one of DEMO's models, the Interaction Model, which will serve as a basis for deriving the Transaction Models, which in turn lead us to the Business Rules and the Collaboration Model.

2.2 DEMO's Interaction Model

The Interaction Model shows actors and transactions. The actors are roles that are enacted by a person, an organizational unit or a whole organization. Figure 2 shows the Interaction Model of our case. The main actors are the Logistics Provider, the Headquarters of the retailer and the Shop. The latter two maintain a very close, franchise-like relationship but are nevertheless organizations in their own right.

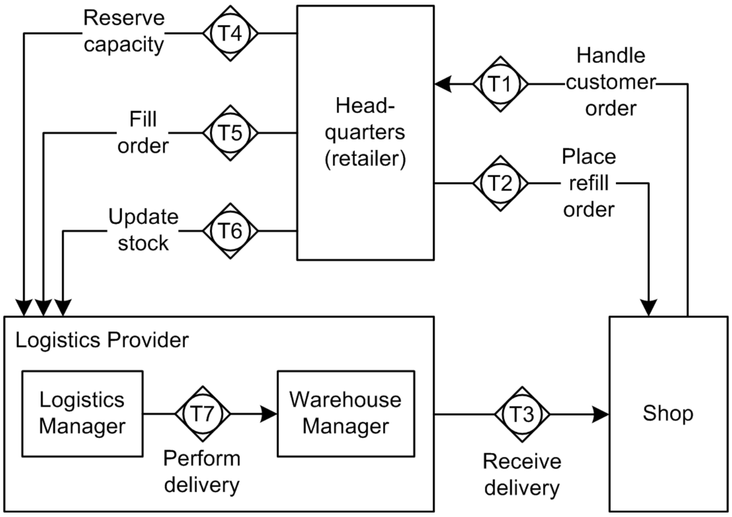

Figure 2: Interaction Model.

A transaction is represented by a diamond with an enscribed circle that contains the number of the transaction. An undirected arc connects it with the initiator, an arrow points from it to the executor. In Figure 2 we have added the name of the transaction, which coincides with that of the objective action, to enhance readability. This is not a feature of the original DEMO language. Figure 2 describes the process of capacity reservation and order handling among these organizations. It starts when Headquarters reserve capacity for handling a certain amount of ordered items 6 months, 2 months and 2 weeks in advance of the actual order (T4). These reservations represent forecasts with increasing accuracy the closer they are to the date of delivery. The Logisitics Provider (LogPro) allocates staff and space so that the reserved capacity can be provided at the time the respective order arrives. But the capacity required by the order might actually be higher or lower than the one that was reserved.

The product assortment consists of basic-range products and seasonal products. The latter are distributed according to turnover quota and are not part of the order process. Orders for basic-range products can be initiated either by Headquarters or by the Shop. The former happens when the Shop is running low on certain products. Headquarters will in such a case suggest to to the Shop to place a refill order (T2). For this purpose they send an order proposal containing the products in question which, after possible changes and/or additions is returned. If customers ask for specific products, the Shop can also place a so-called customer order (T1). Headquarters will forward both types of orders to LogPro (T5). The delivery to the Shop will then be performed by LogPro (internal transaction T7) which includes picking items, packing them and handing them over to the carrier. The actual delivery is largely non-communicative and material and it is therefore not explicit in the Interaction Model. We only represent the coordinative part of it, namely the Shop receiving the delivery (T3). This consists of the arrival of the goods and a confirmation. The arrival of the goods is a material action which also has a communicative function: Through it LogPro states that they have performed the delivery and thereby fulfilled their obligation. The confirmation can be accompanied by a complaint if items are missing or wrong ones have been sent.

Periodically Headquarters will also ask for an update of the stock (T6). This is necessary because they run their own "virtual" warehouse management system which is not integrated with the "physical" warehouse management system of LogPro. The next section describes how the Transaction Models can be derived from the Interaction Model. This is an intermediate step towards the two dynamic parts that make up the Trading Partner Agreement (TPA), i.e. the Business Rules and the Collaboration Model.

2.3 Transaction Models

Much of the detailed behavior that constitutes a business process is hidden inside each transaction. For the specification of the TPA this has to be brought to light because it constitutes the content of the Business Rules and the Collaboration Model. A transaction in DEMO is made up of a number of speech acts and an objective action which follow a certain pattern. This pattern is not a rigid template that claims to fit every transaction. It is rather a guideline that describes a common conversational structure that can help us in analyzing a particular situation. In some cases it will describe the situation fairly accurately, in others we might have to revise it or even to develop a new one that is specific to that particular situation.

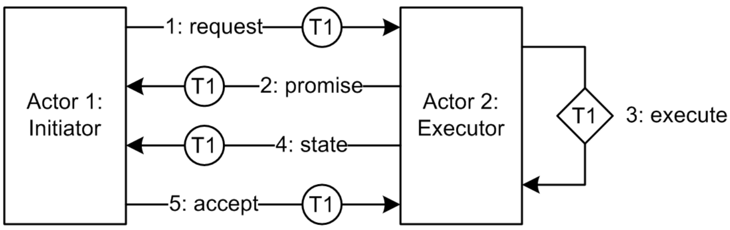

Figure 3: Speech-Act Model of a transaction (Transaction Model of T1).

The pattern consists of the phases mentioned above: order, execute and result. The actagenic conversation (O phase) has at least two elements: a *request* and a *promise* (see Figure 3) but longer negotiations (including a failure) are possible. If an agreement was reached in the order phase, the objective action (E phase) is executed and the factagenic conversation (R phase) is entered. As a minimum this can consist of the speech acts *state* and *accept*. Figure 3 summarizes these steps which are performed in the order that is indicated by the leading numbers. For the actors we use the same notation as in the Interaction Model. A speech act is represented by a circle containing the number of the respective transaction. An arrow goes from the performer via the circle to the addressee. The performer is the one who makes the utterance, the addressee is the "listener". The arrow is annotated by the name of the speech act which can be preceded by a sequence number. An objective action is represented by a diamond containing the number of the respective transition. The arrow starts and ends at the executor. A model that contains only actors, speech acts and objective actions is called a Speech-Act Model. A Speech-Act Model that contains only actions and actors belonging to one transaction is called a Transaction Model.

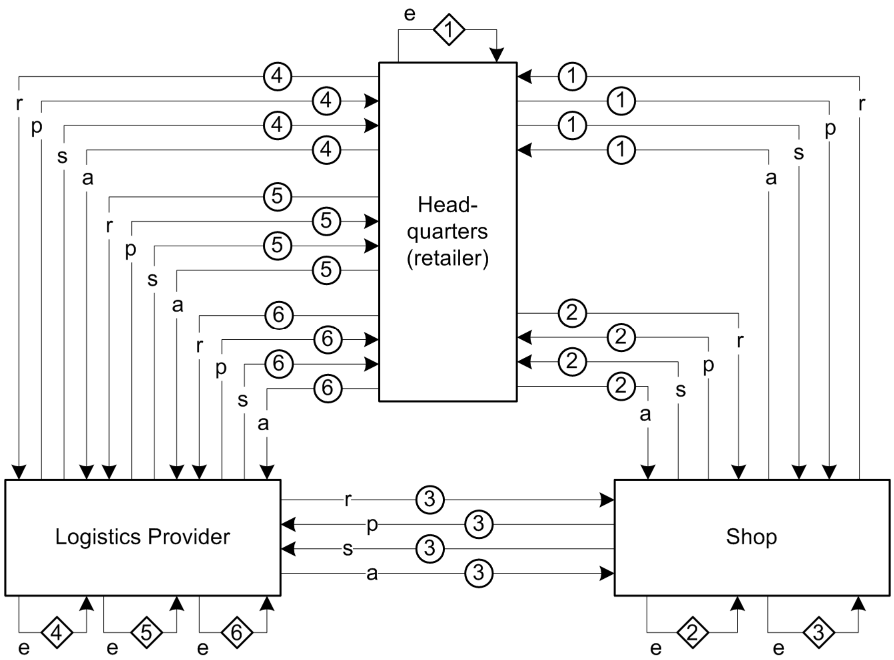

Figure 4: Complete Speech-Act Model of the interactions.

Figure 4 shows the complete, minimum Speech-Act Model of the Interaction Model in Figure 2. As Speech-Act Models can be very complex for realistic cases we will usually refer to a set of Transaction Models instead. The following section shows how these can support the development of Trading Partner Agreements in general and the Business Rules and Collaboration Models in particular. But first we describe the development of the simulation model and its role in designing the static part of the TPA, the general terms & conditions.

3 Simulation Model and Results

A TPA has to specify general terms and conditions that can be seen as static parameters that control the interaction between the trading partners. Examples for such parameters are pricing, terms of delivery, terms of payment and so on. Determining reasonable values for these parameters is difficult because they depend heavily on characteristics of the interorganizational process. This is particularly true when companies engage in a cooperation for the first time and therefore lack prior experience. Let us consider, for example, the pricing of a logistics service, e.g. the handling of one unit of the customer's product. How much we charge for that depends, among other things, on how much it costs us to deliver this service, which in turn depends on the time it takes, the number of workers that are involved, resources that are used etc. One way of assessing the complex interaction of these factors is to simulate the respective business process. The usefulness of business process simulation has been studied thoroughly (Giaglis, Paul and Hlupic, 1999; Hlupic and Robinson, 1998; Paul, Giaglis and Hlupic, 1999; Paul and Serrano, 2003, 2004; Weyland. and Engiles, 2003), particularly in an interorganizational context (Chandra, Smirnov and Chilov, 2000; Giaglis, Doukidis and Paul, 1996; Giaglis, Paul and Doukidis, 1997).

A simulation model is an abstracted, formal description of some real or imagined system. A simulation is an enactment of such a model that allows us

- to observe the potential behaviour of a system that does not (yet) exist, or
- to observe the (potential) behaviour of an existing system at a much faster pace and at lower costs than that of the real system and without disturbing it.

If an appropriate abstraction is chosen the results of the simulation will represent a fair approximation of the behaviour of the real system (or the imagined system if it were built). With its help we can determine the performance characteristics of the business process. This data can then be used to support the design of the terms and conditions of the trading partner agreement. For the development of the simulation model we use the approach described in (Rittgen, 2005). It is based on a language-action model of the business process and proceeds in three steps:

1. Designing the business process view,
2. Designing the resource view,
3. Designing the simulation model.

The first step involves the design of a flow-like view on the process that excludes the actors in favour of a more precise description of the execution logic. In the second step we develop a view that tells us which resources are required by each action and the final step results in the simulation model which is written in SimPy (Simulation in Python). To give the reader an idea of how this works, steps 1 and 2 are shown in detail in the following sections. As an example we use the pricing of product handling. This issue was given highest priority by both corporate partners in our project. We assumed that the costs of handling a product unit will play an important role in determining the price. We therefore took a closer look at transaction T7, Perform delivery, and the associated transactions T4, Reserve capacity, and T5, Fill order (see Figure 2).

When decomposing the transactions into speech acts and productive actions we get the process view as shown in Figure 5. The business process starts with a request speech act for a certain capacity which is then used to schedule the warehouse staff accordingly (target action). Note that the promise part of the actagenic conversation is omitted because the business rules force the logistics provider to accept each request (see next section). After that the availability of the capacity is confirmed (speech act: state). Due to the business rules in the TPA (see next section) we can omit the speech acts “promise” and “accept” in this and later transactions. The next step in the process is the order that is sent by the customer. Observe that this action is not caused by the confirmation of the capacity because the customer might decide not to make use of the capacity and not send an order. Hence there is no causal relation. But on the other hand, the order cannot be sent without prior reservation of capacity which makes the relation conditional (dashed arrow).

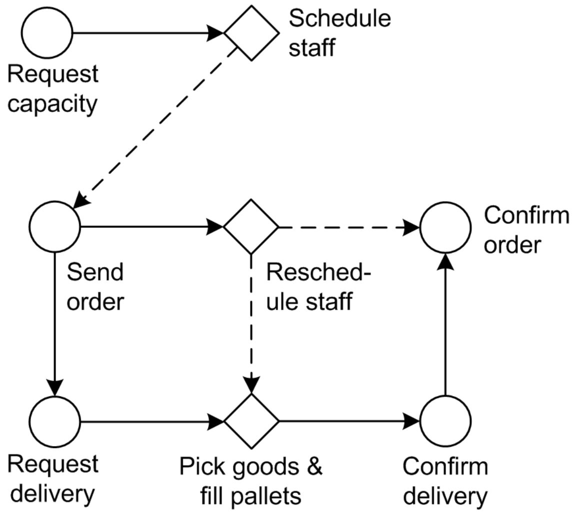

Figure 5: The Process View of the Interaction Model.

The information in the order is then used to reschedule the staff depending on the actual package load. This might involve that the outbound staff is required to do extra hours or that inbound staff is reassigned. At the same time the delivery is requested but this cannot be done before the staff for this task is rescheduled, so that sufficient staff is available. The goods are then picked from the respective shelves and each pallet is filled with the goods destined for that particular shop. When this has been done the pallets are picked up by the forwarder and the delivery is confirmed. This allows us to also confirm the completion of the whole order.

The work described so far was part of the initial business analysis where we also identified problems and goals. One of the most pressing problems (from the point of view of the logistics provider) was related to the discrepancies between planned and actual capacities so we suggested to do a simulation of the relevant parts of the overall process to determine how these deviations affect transaction costs. To do so we have to complement the business process view with a resource view (step 2) to get a clearer picture of the use of resources by the actions in the process. The result is shown in Figure 6. It contains information than can be derived directly from the other views but also some information that is new.

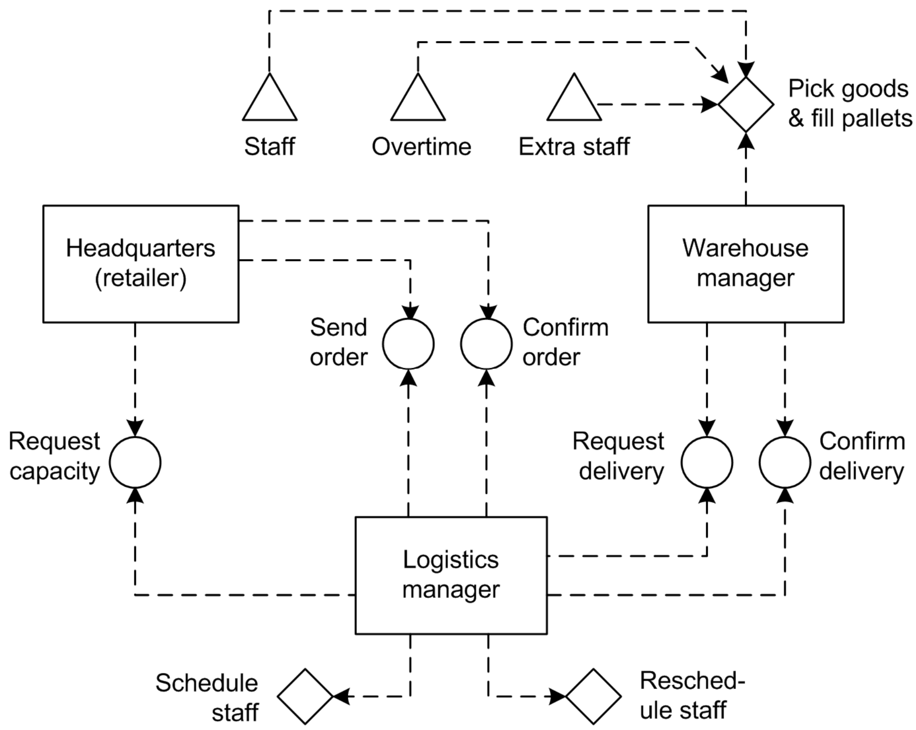

Figure 6: The Resource View of the Interaction Model.

The resource view shows the actors and objects that are involved in each action. We assume that an actor who is engaged in an action cannot perform another action at the same time. Most of the information contained in Figure 6 can be derived from the action and process views (figs. 2 and 5, respectively) in the following way: For each action in the process view find the corresponding transaction in the action view and from there the actors involved (initiator and executor). These are the resources of the respective speech act. The initiator becomes the performer of the request and accept acts and the addressee of the promise and state acts. Likewise the executor will be the performer of the promise and state acts and the addressee of the request and accept acts. If the action is productive we drop the initiator and record only the executor as a resource.

In the example of Figure 6 this procedure yields an almost complete diagram with only three resources missing. These concern the action "Pick goods & fill pallets" that requires additional resources: the scheduled staff, extra staff that might be called in and overtime of the scheduled staff. The use of these resources is associated with certain costs. The time for filling the pallets depends on the actual number of packing units to be handled, the number of available staff (incl. extra staff), the overtime and the time required for handling a unit. The latter is assumed to be normally distributed with given μ and σ. Packing units that cannot be handled during the week in question have to be treated in the following week which leads to delays and further overtime. The time for (re)scheduling is also normally distributed with given μ and σ. All other actions are assumed to require a negligible time.

A run of the resulting simulation model yielded results for a full year (52 weeks), the first 6 of which are shown in Table 1.

Table 1: Excerpt from the simulation results.

Reserved capacity	Actual units	Deviation %	Staff	Extra staff	Over-time	Handled units	Total costs	Costs per unit
4841	7366	52%	10	4	29,28	7366	11.385,60 €	1,55 €
5099	4494	-12%	10	0	-40,48	4494	6.000,00 €	1,34 €
4684	4957	6%	9	0	36,56	4957	6.131,20 €	1,24 €
2203	1179	-46%	4	0	-65,68	1179	2.400,00 €	2,04 €
5374	7817	45%	11	3	65,36	7817	11.507,20 €	1,47 €
2525	3564	41%	5	1	45,12	3564	5.102,40 €	1,43 €

The results of this simulation can now be used to make the constant pricing model of the old frame contract variable. This implies that the price for handling a unit is no longer fixed but depends on the accuracy of the capacity forecasts, i.e. the difference between reserved and actual capacity. The advantages of a variable pricing model are twofold. On the one hand it encourages Headquarters to improve the quality of their estimates as inaccurate capacity forecasts will invariably lead to higher logistics costs. This in turn improves the planning situation for LogPro. On the other hand, if deviations do occur, LogPro will get compensation for their increased costs due to insufficient or unused capacity.

For example, to determine a reasonable price for each handled unit we can refer to the unit costs in table 1 and use these figures as the basis for the cost calculation. One approach might be to take the average unit costs as an input for simple cost-plus pricing. Others might be to consider sesaonal variations or to make the price depend on the difference between actual and reserved capacity. In our case we applied the latter approach. Using the simulation results mentioned above we get a cost base of 1.34 € plus 3 cents for positive deviations in steps of 10 %, and 1.07 € plus 26 cents for negative deviations in steps of -10 % based on a linear regression on the full results.

4 Trading Partner Agreements

A Trading Partner Agreement is a formal, contractual representation of the cooperation between a number of organizations. It consists of a static and a dynamic part. In the static part we can find product or service specifications, prices, terms of delivery and general conditions. It can be set up with the help of the results from the simulation as demonstrated in the previous section for the pricing of the service in our case.
The dynamic part defines the roles that each party to the contract plays and the activities they perform in the context of the cooperation. In principle we could claim that the Speech-Act Model already contains most of the information necessary for the dynamic part but this approach is not sufficient for at least two reasons. Firstly this model is typically very complex for realistic cases as the example of Figure 4 (which contains only a small part of the overall model) indicates. It is therefore unsuitable for communicating knowledge about the obligations implied by this process structure to

the respective parties. But one of the most important requirements of a good contract is that the parties signing it should be fully aware of its implications.

Secondly the Speech-Act Model is hard to implement. It does not give us any directions as to which of its activities are supported by information systems integration and which not. Both issues can be addressed by dividing the behavioral model into two components: *Business Rules* and *Collaboration Model*. The latter is a detailed, workflow-like model of the cooperation. It is structurally very similar to the Speech-Act Model but it contains only a fraction of the actions. It shows only standard, routine behavior that can be performed or largely supported by information systems integration. This facilitates the enforcement of the contract.

The Business Rules then cover exceptional or non-routine behaviour. This kind of behavior does not occur often enough to economically justify an integration of the involved information systems. Such behaviour would also crowd the Collaboration Model. It can be better represented in form of a table. The next section describes the development and the use of the Collaboration Model and the Business Rules in detail.

4.1 Collaboration Model and Business Rules

When developing the Trading Partner Agreement we look at each transaction in turn. We first create a Speech-Act Model of the respective transaction as described in the section "Transaction Models". The result is a very detailed model with all the steps that have to be performed in the course of the transaction. Figure 7 shows as an example the Speech-Act Model that corresponds to transaction T5.

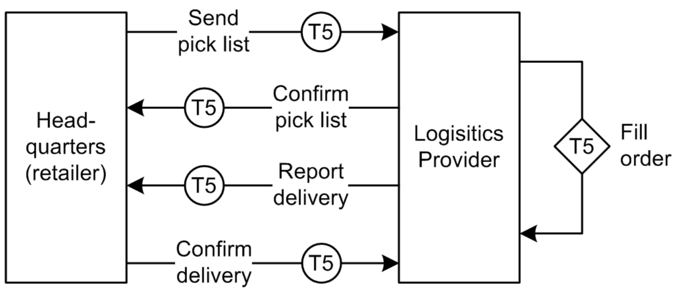

Figure 7: Speech-Act Model of transaction T5.

The aim of that transaction is to fill the order, i.e. to deliver the items contained in the order. It starts when Headquarters send a so-called pick list to LogPro. This list names the products to be picked (and delivered) and their quantities. The associated activity is a routine activity and the information is important for controling the process of filling the order. It will therefore be entered into the Collaboration Model (see Figure 8). The information systems of Headquarters and LogPro are integrated in such a way that the list is sent electronically as a "pick file".

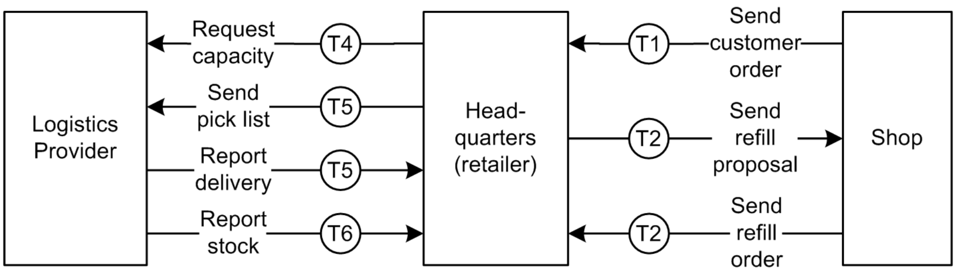

Figure 8: Collaboration Model.

The next step in transaction T5 is that LogPro confirms the receipt of the pick list. As the warehouse management system of Headquarters mirrors that of LogPro an out-of-stock situation cannot occur. LogPro only has to confirm that enough resources are available (staff, shelf space) to handle the order. As the reserved capacity (T4) is usually sufficient an explicit confirmation is not required but is per default assumed. The respective speech act does therefore not appear in the Collaboration Model. Instead we create a Business Rule that is activated in the case of an exception, i.e. if the required capacity does exceed the reserved one by more than the specified percentage value (see Table 2, T5, promise). As a special arrangement has to be made for solving this problem in each specific case this activity cannot be supported by information systems integration. The logistics managers at both companies have to negotiate this solution.

Table 2: Business Rules.

Transaction	Phase	Business Rule
T1	promise	A request to deliver items is per default granted and hence not confirmed. In case of out-of-stock a respective notification is sent.
	state, accept	covered by transition T3
T2	state, accept	covered by transition T3
T3	request, promise	covered by transition T1 or T2
	accept	If 'confirm receipt' was O.K. no further message is sent. Otherwise the claim is processed (return/resend).
T4	promise	A request for a capacity (forecast of required capacity) is always accepted and hence not confirmed.
	state, accept	The provision of the requested capacity is guaranteed. Hence no confirmation is required.
T5	promise	The pick list is accepted per default, no confirmation is sent. If the amount of items to be picked exceeds the limit specified in the general terms and conditions of this agreement (in relation to the reserved capacity), a special arrangement is made (rescheduling of warehouse staff / higher unit price).

	accept	This is implied by the receipt of the delivery. If items are missing or wrong ones have been sent a respective complaint is sent to LogPro and wrong items are returned to LogPro.
T6	request, promise	The updating of the retailer's warehouse system is done via an automatic, daily file transmission containing a stock report. Request and promise are therefore obsolete.
	accept	The receipt of the stock report is assumed. If transmission fails, manual troubleshooting will be invoked.

The objective action "Fill order" is not considered in the TPA because it concerns only internal behavior of LogPro. The next step in transaction T5 is that LogPro reports the delivery. This is a routine activity and Headquarters needs this information for billing purposes. It is therefore a part of the Collaboration Model. The final step, confirm delivery, is implied by the receipt of the delivery (T3). The exceptional case of a wrong delivery is handled by the Business Rule T5, accept (see Table 2).

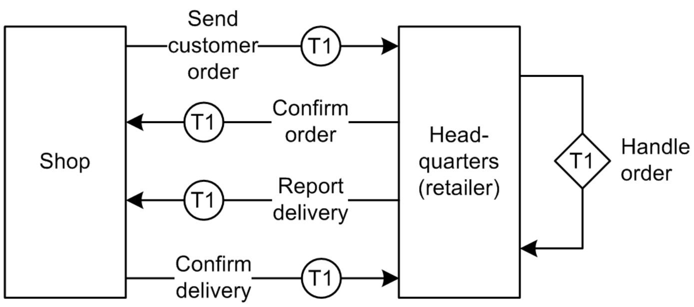

Figure 9: Speech-Act Model of transaction T1.

As another example let us consider the transaction T1, "Handle customer order", as shown in Figure 9. In it the Shop sends a customer order to Headquarters. Such a customer order concerns products that customers wanted to buy but which were not available, i.e., a kind of back order. As this activity triggers the whole process it becomes part of the Collaboration Model. The confirmation of this order is omitted and hence it is not entered into the Collaboration Model. Instead we establish a Business Rule (table 2, T1, promise) that demands a notification in the case of an out-of-stock situation. The whole factagenic conversation (state, accept) can also be omitted because it is covered by transition T3, "Receive delivery". This particular situation arises because Headquarters delegates the execution of the delivery (as part of order handling) to LogPro so that T3 is a subtransition of T1 covering the execution and result phases of the latter. This is recorded in table 2, T1, state, accept.

The same is done for the remaining transactions T2 – T4 and T6. This leads to the complete Collaboration model in Figure 8 and the complete list of Business Rules in Table 2.

5 A Case Study

The approach we have described so far was tested in a project that we carried out with representatives from both the Logistics Provider and their customer, a retail chain.

One of the aims of that project was to improve the existing Trading Partner Agreement. Our approach helped us to develop a proposal for a new contract based on a thorough analysis of the interorganizational business process. The old contract was vague which led to a series of problems:

1. Indistinct communication structures: It was often unclear who communicates with whom regarding which issue.
2. Lack of trust: Different interpretations of the contract by the parties led to expectations that were not fulfilled.
3. Lack of information: LogPro was not provided with the information they need for a reliable capacity planning, This had not been specified clearly in the old TPA.
4. Excessive communication: A considerable amount of personal interorganizational communication was spent on handling everyday work. This was only necessary because of insufficient specification of routine procedures in the TPA.
5. High transaction costs: Ad-hoc solutions to exceptional problems increased transaction costs.

Using the approach introduced in the previous sections we developed a proposal for a new TPA that addressed the issues 1, 2, 4 and 5. Excerpts from all parts of this TPA have already been presented in the course of this paper. We do therefore not provide further details here but rather discuss the implications of the changes.

The new contract specified more precisely the obligations of each party concerning the behavior at the interface between the organizations. This reduces the room for interpreation of the TPA which leads to more realistic expectations and ultimately to increased trust (issue 2). The Collaboration Model clearly states who interacts with whom regarding which issue. This clarifies the communication structures (issue 1) and reduces the amount of “unnecessary” communication (issue 4). Business Rules specify the behavior in exceptional situations eliminating the need for developing ad-hoc solutions. This reduces transaction costs (issue 5).

6 Conclusions

A language-action model of the interactions between organizations can contribute towards the design of Trading Partner Agreements. In particular the Interaction Model of DEMO allows us to develop the static and dynamic parts of the TPA. The former can be derived from the results of simulation runs. The design of the models required for this can be based on an Interaction Model of intra- and interorganizational parts of the business process. The Interaction Model is also at the root of the Transaction Models, detailed Speech-Act Models of each transaction, which ultimately support the development of the dynamic constituents of the contract: Collaboration Model and Business Rules. The former represents routine behavior that is typically supported or performed by an integration of the respective information systems and it is formally a reduced version of the complete Speech-Act Model that provides the same level of precision. The latter complements the former and describes the exceptional and/or situational behavior in a less formal, textual manner in form of a table.

A TPA that is developed in this way is less ambiguous which facilitates the implementation of the procedures and the enforcement of the rules and conditions. This can reduce transaction costs, the need for extraneous communication and the reliability of commitments. Ultimately this leads to an increased level of service quality and improves the mutual trust among the participants in the cooperation.

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