Supporting Interorganizational Processes with Interaction Flows and Business Rules

Peter Rittgen, University College Borås, Allégatan 1, 501 90 Borås, Sweden; E-mail: peter.rittgen@hb.se

ABSTRACT

Framework contracts are the main instrument to regulate the cooperation of organizations but they are rarely sufficiently elaborated to actually support the daily routine of interaction. In order to provide this support we suggest the development of interaction flows, interorganizational workflows that describe routine behaviour on a detailed level (sunny-day scenario). They are complemented by business rules which cover exceptional behaviour.

1. INTRODUCTION

The principal mechanisms to coordinate economic activities are hierarchies (internal coordination) and markets (external coordination). Two major theories have been put forward to explain why a particular mechanism is preferred in a given situation: agency theory (Wilson, 1968) and transaction cost economics (Williamson, 1975). Based on these theories it is typically assumed that companies choose their organizational structure and network of trading partners in such a way that the sum of both costs is minimized. Regarding the impact information technology on governance structures, (Malone, Yates, & Benjamin, 1987) suggested that it will lower transaction costs and therefore, ceteris paribus, lead to an increase in market coordination. Empirical evidence (Holland & Lockett, 1997) shows that companies often operate in a "mixed mode" blending aspects from both markets and hierarchies.

In this situation organizations have to rely on contracts to regulate their cooperation. Such framework contracts should provide for sufficiently detailed rules to facilitate process design and IT support. But in reality we often find that the contract only covers few issues (prices, terms of delivery) and leaves it to the responsible managers on each side to work out the details between them. As a consequence the process organization is often ad-hoc and inefficient. Such a situation can be avoided if the framework contract also provided for a description of the necessary interorganizational workflows. The following chapters elaborate this idea.

We base our approach on Business Action Theory (Goldkuhl & Lind, 2004). It divides a process along two dimensions into phases and layers. The phases are: proposals, commitments, fulfilments and assessments, complemented by pre- and post-transactional activities. The layers are transaction group, business transaction, exchange, action pair and business act. We extend this classification scheme by a third dimension: regularity, which consists of regular and exceptional behaviour. This extension is driven by the need to balance complexity and level of detail in the process model. We therefore suggest to split it into regular and exceptional behaviour, where the former is covered by an interaction flow model and the latter by business rules. We show how we applied this approach to a case.

2. BUSINESS ACTION THEORY

Business Action Theory (BAT) is a framework for business interaction. Its origins are in Speech Act Theory (Searle, 1969) and the Theory of Communicative Action (Habermas, 1984) but considers also material (i.e. physical) aspects. According to BAT a business transaction is divided into four main phases: proposals, commitments, fulfilments and assessments. They are complemented by pre- and post-transactional activities. In addition to this BAT also defines layers of actions that represent levels of granularity (Lind & Goldkuhl, 2001). The layer dimension is orthogonal to that of the phases and on each layer a process is composed of elements of the next lower level.

The basic layer contains business acts which can be communicative and/or material. Communicative acts are speech acts in the sense of Speech Act Theory. They are performed in the social (or intersubjective) world. An example of a communicatice act is placing an order. Material acts are performed in the physical (or objective) world. An example of that is the delivery of a pallet. There is no strict demarcation between the two types of acts because business acts are often multi-functional. Delivery of a pallet constitutes, for example, both the material act of moving the physical object and the communicative act of fulfilling the commitment to deliver.

On the second layer business acts are arranged in pairs of action and reaction (or trigger and response). Some authors claim that only such combinations of speech acts should be considered as action pairs that lead to a deontic change, i.e. a commitment or accomplishment in the social world (Weigand & van den Heuvel, 1998; Weigand, van den Heuvel & Dignum, 1998; both papers use the term transaction instead of action pair). This claim is challenged by (Lind & Goldkuhl, 2001) who argue that there are relevant business action pairs that do not lead to deontic changes. When, for example, a customer places an order and the supplier refuses it, no commitment has been made nor has anything been accomplished. But this sequence still constitutes admissible and relevant business behaviour. The refusal might for example trigger the placement of a respective order with a different supplier.

On the third level one or more action pairs form an exchange. This is meant in the most general sense of something that is given in return for something else (e.g. a product in return for money). With respect to a particular exchange the things exchanged belong to the same category. The categories are: interests, proposals, commitments, values (products, services, money) and assessments. They are closely related to the phases so that a business transaction can also be defined as a sequence of exchanges (fourth level). The fifth layer, transaction group, groups consecutive transactions between the same partners.

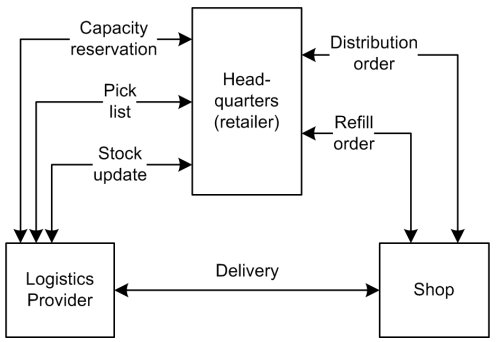
3. MODELING INTERACTIONS BETWEEN ORGANIZATIONS

Some business modeling methodologies provide their own modeling languages, e.g. Dynamic Essential Modeling of Organization (Dietz, 1999). In contrast to this BAT does not come with its own language. Instead its proponents suggest to use the language of SIMM (Situation adaptable work and Information systems Modelling Method) (Goldkuhl, 1996). The loose coupling between method and language might be seen as a disadvantage but (Lind & Goldkuhl, 1997) defend this approach. SIMM contains among other things a number of different diagram types for describing collaboration, interaction, process, action, problem, strength and goal. In our case the Interaction Diagram provided a suitable view. It describes interaction between actors within and between organizations. Its primary elements are actors (in roles) and actions. Actions can be initiated by some actor and directed towards another (single-headed arrows) or they can be mutual (double-headed arrows). Fig. 1 shows the interaction between the three organizations involved in our project.

The main actors are the Logistics Provider, the Headquarters of the retailer and the Shop. The figure shows the exchanges that are performed during order handling. It starts when Headquarters reserve capacity for handling a certain amount of ordered items in advance of the actual order. 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 of the retailer consists of basic-range products and seasonal products. The latter are distributed to the Shop according to turnover quota (distribution order). This is triggered by Headquarters. Orders for basic-range

Figure 1. The interaction diagram of the case (exchange level)



products are initiated by the Shop. This happens when the Shop is running low on certain products (refill order). Headquarters will forward both types of orders to LogPro in form of a pick list. The delivery to the Shop will then be performed by LogPro which includes picking items, packing them and handing them over to the carrier. The delivery consists of a material act (moving the goods to the Shop) complemented by a communicative act (confirmation of delivery). The material act also has a communicative function of its own: Through it LogPro states that they have performed the delivery and thereby fulfilled their obligation.

Periodically Headquarters will also ask for an update of the stock. This is necessary because they run their own warehouse management system which is not integrated with that of LogPro. The process described so far was part of the business analysis we performed in the project mentioned above. As a result we found out that the existing framework contract was vague which led to a series of problems including:

1. Broken patterns: One important characteristic of a business transaction is that each business act is related to another in a pattern of initiative and response. This means that the sequence of business acts needs to be followed in the sense that the pattern should not be broken. Going back to the empirical setting it can be identified that Headquarters supply estimates (as an initiative) without getting a response. There is thus a pattern of interaction when establishing the framework contract and another one when realizing the business transaction. The interaction pattern that glues framework contract and business process is thus broken. This has the effect that Headquarters cannot be sure of the capacity that will be available at the time of order and LogPro does not reserve the required capacity. The estimates made by Headquarters are therefore neither informative nor directive and hence do not imply mutual commitments. As a consequence, the contract should be specified in such a way that encourages the parties to keep the patterns intact.
2. Business rules: There are no rules that guide the interplay between the overall framework contract and the embedded business transactions. Such rules are necessary to regulate the details of interaction and to provide infrastructural support such as IT systems.
3. Indistinct communication structures: It is often unclear who communicates with whom regarding which issue.
4. Lack of trust: Different interpretations of the contract by the parties led to expectations that were not fulfilled. This led in turn to a lack of trust in succeeding transactions.
5. 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 framework contract.
6. High transaction costs: Ad-hoc solutions to exceptional problems increased transaction costs.

In this situation it soon became clear that the solutions to these problems require a relatively detailed specification of the coordination process down to the level of business acts. Moreover, according to issues 1 and 2 this detailed process description has to be part of the framework contract itself to ensure that the internal workflows in each party to the contract are aligned with the overall interorganizational process. This poses a substantial problem because the resulting interaction model would be too large and complex to be included in a contract. As a consequence it would be difficult to achieve understanding on all sides of such a contract and the chances of reaching an agreement would be even smaller. The following section pursues a possible solution to this problem.

4. INTERACTION FLOW AND BUSINESS RULES

As mentioned in the previous section, an improved support for interorganizational processes requires the specification of the interaction on the level of business acts. Fig. 2 shows, as an example, the result of decomposing the pick list exchange of fig. 1 into its business acts assuming that the exchange requires only the minimum of two conversations (actagenic and factagenic) with one action pair each. These consecutive conversations aim at reaching an agreement about 1) the execution of an action, and 2) the result of that execution, respectively.

This scenario does not provide for exceptional behaviour. Headquarters send a pick list to LogPro which is confirmed. LogPro then picks the ordered items from the shelves and packs them onto pallets (which are subsequently picked up by a carrier). Thereafter the delivery is reported by LogPro and confirmed by Headquarters (after having received the corresponding confirmation from the Shop). If we make the same assumptions for the remaining exchanges of fig. 1 we arrive at the Interaction Diagram in fig. 3.

This diagram already exhibits a substantial complexity but it does still not cover cases where something goes wrong. We therefore decided to take a closer look at the process with respect to the frequency of each act. In the course of this analysis we discovered:

- Some business acts are rarely performed in reality. Putting them into the diagram would crowd it without improving understanding of the process. Such exceptional behaviour can better be treated separately in form of business rules. Business rules are listed in a table in the form of a textual description.

Figure 2. The interaction diagram of the pick list exchange (business-act level)

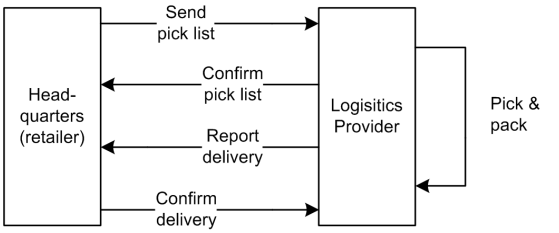
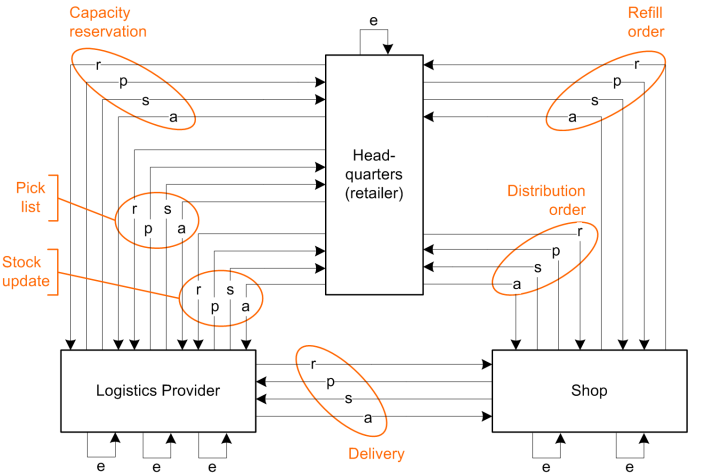


Figure 3. The interaction diagram of the case (business-act level): r = request, p = promise, s= state, a = accept, e = execute



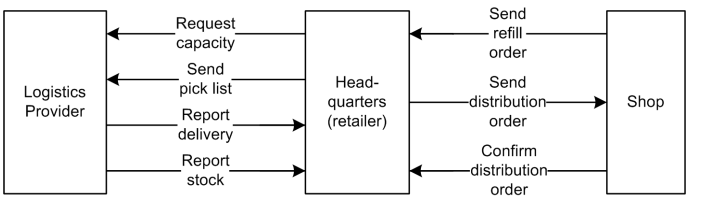
- Some business acts are often performed repeatedly with the same result or their result is usually not required. In such a situation it can be more appropriate to drop this act from the diagram (in the positive, regular case) and replace it with a business rule that covers the negative case instead (i.e. the exception). An example for this is the act "Confirm pick list". This confirmation is usually not needed because the act of sending the pick list is automated and hence quite reliable. So instead of having the confirmation act in the interaction diagram we will assume that the pick list was sent and specify a rule that provides for the case of a failure.

This means that we introduce a third dimension into Business Action Theory: regularity. It refers to the frequency with which a certain action is performed in relation to the overall business process. A regular action is one that is performed in (almost) every instance of the business process. An exceptional action is performed only in a fraction of the instances. Along this dimension the business action can be divided into a number of classes that depends on the application scenario. Each class is associated with a (possibly different) modeling language that fits this type of business action. In our case we found it useful to define two classes: regular and exceptional. The regular class is associated with the Interaction Diagram, the exceptional class with business rules. The borderline between the classes is usually not sharp and critical cases have to be assessed individually.

An Interaction Diagram on the business-act level that represents regular behaviour is called an Interaction Flow because its level of detail is such that it corresponds to a workflow of the interaction. Consequently it can be used not only for the framework contract but also as a basis for setting up the internal workflows in each participating organization. The latter could then be supported by workflow management systems.

Fig. 4 shows the Interaction Flow for our case. The flow starts when Headquarters send a request for capacity. Such a request is always granted provided that the limits specified in the framework contract are not exceeded. Hence no further interaction is triggered. At some later point in time Headquarters send a distribution order for seasonal products to the Shop. This distribution order has to be confirmed by the Shop because they often have to make corrections (i.e. this is a regular act). Independent of that the Shop can also send a refill order when the stock is running

Figure 4. The interaction flow of the case



low on certain products of the basic range. Such an order is, as a rule, not confirmed by Headquarters because a sufficient stock is assumed for these prodcuts. Only in the exceptional case of an out-of-stock situation they would send a respective notification. This is covered by a business rule (see table 1). Any kind of order is forwarded to LogPro in the form of a pick list. It contains detailed information on type and amount of products to be delivered to each Shop and it triggers a number of internal activities by LogPro such as picking the products from the shelves, packing them into boxes and stacking the boxes on pallets to be picked up by a carrier. Upon completion of this work LogPro will report the delivery. Again there is no confirmation and exceptions are handled by a business rule, such as complaints about missing items and returns of wrong items (see table 1). A daily stock report is sent automatically via file transfer without it being requested.

Regular and exceptional actions can be seen as complements of each other. A regular action is one that is performed in the majority of instances of a business process, i.e. it covers the "normal case" (so-called sunny-day scenario). The remaining instances represent "unusual cases" which are dealt with by a set of exceptional actions (rainy-day scenarios). Regular and exceptional actions together should cover all possible cases. It should be noted that there can be situations where all cases occur only occasionally and a regular case is hard to identify. In such a situation the decision regarding the regularity of the action should be guided by the suitability of the respective method (i.e. in our case Interaction Flow vs. business rule).

Table 1. The business rules of the case

Exchange	Business act	Performer	Adressee	Business Rule
Refill order	Accept order	Headquarters	Shop	A refill order is per default accepted and hence not confirmed. In case of out-of-stock a respective notification is sent.
	State/accept delivery	Covered by delivery		
Distribution order	State/accept delivery	Covered by delivery		
Delivery	Request/promise delivery	Covered by refill/distribution order		
	Accept delivery	Shop	LogPro	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.
Capacity reservation	Confirm reservation	LogPro	Head-quarters	A request for a capacity (forecast of required capacity) is always granted and hence not confirmed.
Pick list	Accept pick list	LogPro	Head-quarters	The pick list is accepted per default and no confirmation is sent. If the amount of items exceeds the limit specified in the general terms and conditions of the framework contract (in relation to the reserved capacity) a special arrangement is made (e.g. the warehouse staff is rescheduled, the unit price is raised).
	Confirm picking	Headquarters	LogPro	This is implied by the receipt of the delivery by the Shop and assumed by LogPro. The claims are handled directly between LogPro and Shop (return/resend).
Stock update	Request update	Headquarters	LogPro	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.
	Promise update	LogPro	Head-quarters	
	Accept update	Headquarters	LogPro	The receipt of the stock report is assumed. If transmission fails, manual trouble-shooting is invoked.

5. RELATED AND FUTURE RESEARCH

The research we have performed so far shows the feasibility of the approach with respect to the case. An issue that we have barely touched is that of workflow management support. We already pointed out that Interaction Flows provide sufficient detail for the development of a workflow model. But conventional workflow technology is limited to deployment within an organization. A possible solution lies in the integration of decentralized workflow management systems. This is the object of current research (Jang, Choi, & Zhao, 2004; Shen & Liu, 2001).

The rigorous description of the interorganizational process could extended to the static part. e.g. the general terms and conditions. Simulation can facilitate both reengineering of the process itself and the derivation of static contract parameters from the simulation results (e.g. period of delivery based on the simulated time from order to delivery).

In the areas of electronic commerce and virtual organizations there is a growing interest in more formalized contracts (Artyshchev & Weigand, 2005; Milosevic, Linington, Gibson, Kulkarni, & Cole, 2004; Weigand & Xu, 2003). The existing approaches are often technology-driven and there is a need to complement them with rigorous approaches that have a strong business orientation. Our research takes a step in this direction. But formalized contracts (e.g. eContracts) are not only beneficial in electronic commerce or automated transactions. They can also make a substantial contribution towards the support of interorganizational business processes and workflows.

6. CONCLUSION

Business Action Theory offers a stable framework for the analysis of interorganizational processes and the SIMM language provides a suitable diagram, the Interaction Diagram, to model them from an interaction perspective. But this approach is fraught with a trade-off: In order to translate the contract into a workflow specification the Interaction Diagram has to be on a detailed, i.e. business-act level. But in order to reach an agreement on it all parties have to understand it. We balance these needs by splitting the interaction model into two parts, one for regular behavior and one for exceptions, thus introducing a third dimension into BAT. In our application the first part is modeled as an Interaction Flow, a special case of the Interaction Diagram, to facilitate the design of workflows. For the second part we have chosen business rules, an informal language that employs textual information in form of a table.

A case study involving a logistics provider and a retail chain was performed to prove the feasibility of the approach. To ensure the authenticity of the models we used seminar-based modeling sessions that involved participants from both organizations. A seminar leader elicited information from them to design a preliminary version of a model. This was then discussed and the feedback was used to adapt, extend or detail the model. This process was repeated until the required scope and level of detail were reached and no further improvements could be achieved.

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