Argumentation semantics of communicative action

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Abstract

Communication is a process aimed at agreement on some situation definition. When the agreement is not immediate, a discussion is needed to resolve the points of disagreement using argumentation. Although such a discussion is recognized in the LAP approaches, no formal treatment of it has been given so far. In this paper, we introduce a formal model based on recent results from argumentation theory. It suggests some valuable norms and procedures for rational discussion that could be applied in business process support, IS design as well as in communication diagnosis. The model is further developed in confrontation with the well-known IBIS approach of Conklin. This results in a so-called 3-box model that is proposed as an extension of the Transaction Process Model of Van Reijswoud.

1 Introduction

In the Language/Action Perspective, as well as in other areas, such as agent communication languages, the semantics of conversations is usually described in terms of speech acts (as in the Conversation for Action protocol of Winograd & Flores, 1986) and the effects of these in terms of beliefs, intentions and obligations (e.g. Weigand et al, 1995; Chaib-Draa & Dignum, 2002). We want to extend this

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framework in several ways. First, we want to account better for the interplay of communicative action and common ground (cf. Clark, 1996; Weigand et al, 2003). The semantics of communicative actions is given in terms of claims, and these claims get their support from the shared background in the community. The effects of the communicative actions appeal to the common ground as well: once a claim is conceded, its content becomes mutually accepted.

The second extension is to account for the possibility of a rational discussion by linking to argumentation theory. A discussion layer is recognized in LAP (Reijswoud, 1996), but has not been formally worked out there yet. Argumentation can be viewed the process of building a bridge between what is agreed upon in the community (or relationship) in the form of common ground (shared norms, in the sense of Stamper, 2000) and the situation at hand („grounding“).

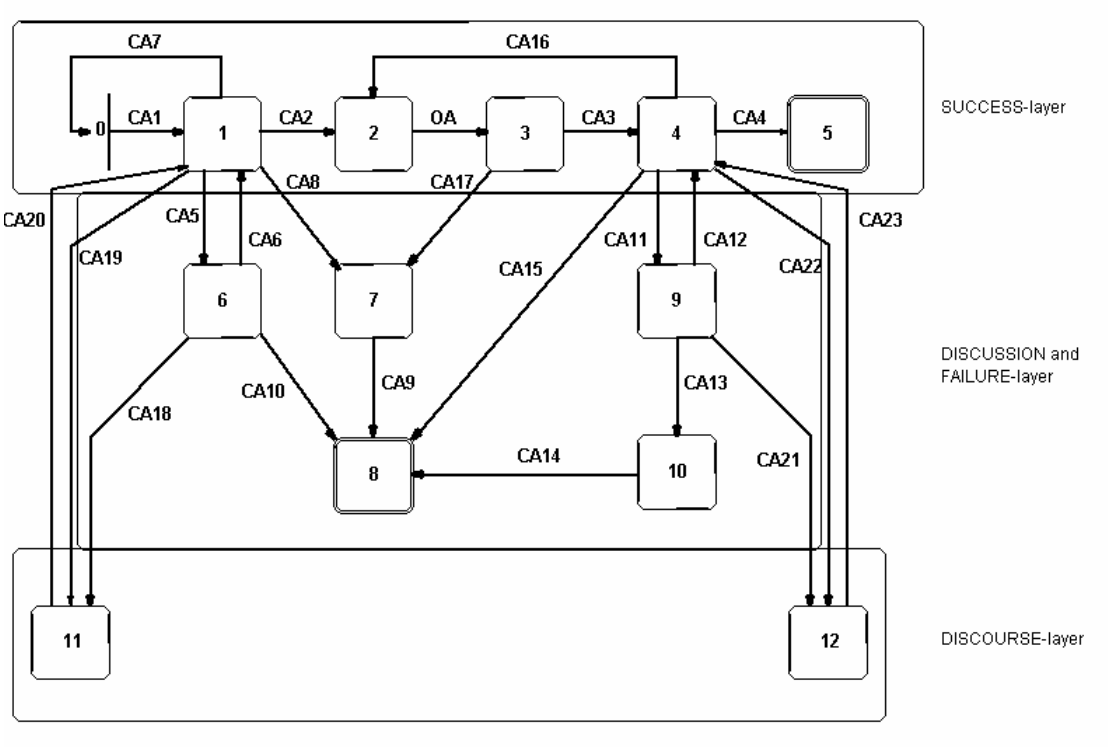

Fig. 1. Transaction Process Model (Reijswoud, 1996). The CA's are communicative actions. For example, CA1 is a request, and CA2 the acceptance of the request. The alternative to CA2 is CA5 (request justification), by means of which the Hearer moves into the Discussion and Failure layer.

The intended contribution of this paper is primarily theoretical: development of a formal communication model based on the Language/Action Perspective and

encompassing argumentation. This is done by the incremental development of a model in confrontation with existing formal models and methods grounded in practice. Although the primary result is theoretical, we believe that this model can be a useful reference for designers of all kinds of communication systems, such as Negotiation Support Systems, Workflow systems, and Group Support Systems.The structure of this paper is as follows. In section 2, we briefly recall related work in the field of LAP, in particular, the Transaction Process Model (TPM) of Van Reijswoud. In section 3, an argumentation semantics for communicative action is introduced in which validity claims are central. This framework can be easily extended to include discussions on the claims (section 4). In section 5, the framework is applied to and confronted with the existing discussion tool Questmap which is grounded in the Issue-Based Information Systems (IBIS) paradigm. On the one hand, we are interested in the question whether IBIS can profit from a formal underpinning by the argumentation framework, but on the other hand, we are also interested in the completeness and appropriateness of the argumentation framework when confronted with a class of systems that have a long history of practical experience. This results in section 6 with a proposal on the status and structure of the discussion layer: the 3-box model. We conclude with a summary of results and some directions for future research.

2 Related work

One of the first references in the LAP literature to argumentation is made in (Chang & Woo, 1994). This article describes a speech-act based negotiation protocol (SANP). Its design is based on Ballmer and Brennenstuhl's work on the classification of speech act verbs in German. This study revealed that many speech act verbs belong to the semantic center "Verbal Struggle" (for example, admit, defeat, give in, press, defend, retreat, claim). The article also draws on the classical argument model of Toulmin (Toulmin, 1969). One of the observations of the study was that the Struggle Model was more effective in situations where the participants had strong opinions beforehand, and less effective in more exploratory discussions.

The introduction already briefly mentioned the TPM model of Van Reijswoud (fig. 1). In contrast to the Conversation for Action as introduced by Winograd & Flores (1986), the TPM makes a clear separation between three communication layers: the success layer, the discussion and failure layer and the discourse layer. Whereas the former was based primarily on Searle's speech act theory, the latter is based on Habermas' theory of communicative action (Habermas, 1984). For Habermas, communicative action is oriented towards agreement. To arrive at agreement, participants make statements containing validity claims. Agreement is reached when the participants agree on the validity claims. When they do not agree, they are supposed to enter a rational discussion to resolve the issue.

Presumably, there are certain background norms and rules that enable this resolution. Sometimes, this background has to be revitalized or adapted; this is what the discourse layer is supposed to do.

In the Conversation for Action, the Hearer is allowed to counter a request, which again may be countered by the other party, until one of the two does not counter anymore (accepts, or cancels the conversation). If we look at the discussion layer of TPM, we find that the hearer/executor can "counter" by requesting justification of a claim. Apparently, he never makes counterclaims. The cycle of request justification/provide justification (CA5/CA6) stops when the Hearer/Executor accepts the claim (CA2) or the conversation is cancelled (CA8,CA9,CA10). The model also allows the Initiator to redefine his claim (CA7), or any party to enter the Discourse layer (CA18, CA19). One of the goals of this paper is to be more precise on the discussion cycle, as it seems to have not much semantic structure. This structure can help the parties in seeing more clearly what the disagreement is about, in avoiding "livelock" situations where arguments are exchanged without any progress, and thereby also in resolving the discussion more effectively and timely.

The model of Toulmin (in combination with Rhetorical Structure Theory) has also been used in (Dalianis & Johannesson, 1998) in the area of Requirements Engineering. A clear argument structure can help in generating explanations (for the purpose of validating the design against the user requirements). The focus in their paper is on the conceptual structure of arguments (claim, warrant, ground etc), however, it does not consider the logical aspects.

3 Argumentation semantics of communicative action – the basic model

Both the Conversation for Action protocol and the Transaction Process Model characterize conversations by means of a state diagram. The conversational state is characterized by which conversational acts are possible from there and whose turn it is. Unfortunately, this says very little about the illocutionary effect of the conversational act (what the speech act *does*). In (Weigand et al, 1995), a formal language called L_{ill} was described with which an integrated semantics for information and communication systems can be expressed. It is an extension of dynamic deontic logic and the semantics of speech acts is described using preconditions and postconditions. For example, the postcondition of an authorized request is that the Hearer is obliged to perform the requested action. Pre- and postconditions have been used also in agent communication languages such as KQML and FIPA-ACL (see Chaibdraa & Dignum, 2002 for references). For example, the precondition of KQML's *tell* message states that the sender believes what he tells and that he knows that the receiver wants to know that the sender believes it. The postcondition of sending the *tell* message is that the receiver can

conclude that the sender believes the content of the message. In a similar vein, FIPA-ACL uses feasibility preconditions and rational effects.

There have been many discussions about this approach (Chaibdraa & Dignum, 2002). One problem in many of these proposals is that the semantics refer to mental states such as beliefs, and it is not very clear what it means that an agent, being a kind of software, holds a certain belief. Another problem is that FIPA-ACL does specify the effects in the mental state of the sender, but offers no clue on how to infer the mental states of the receiver. For a semantics of communication, this is rather disappointing. With regards to the first problem, some have argued that the semantics should not be based on mental states, but on social commitments (Singh, 2000). Others have tried to ground the semantics in the notion of sign conventions (Jones & Parent, 2003). The latter approach takes its starting point in Searle's dictum that if the performance by agent *j* of a given linguistic act counts as an assertion of the truth of A, *j*'s performance counts as an undertaking to the effect that A is true. In other words, given the right functioning of the sign conventions within a community, A "ought to be" true when *j* asserts A. This leads then to the introduction of a modality "ought to be (according to the conventions)" for a first approximation of the meaning of a speech act, from which beliefs, obligations etc are derived in a second step, according to additional norms. In the following we will take an approach that has a similar formal structure, but we instead of "ought to be", we will use the modality "(ought to be) agreed": when *j* asserts A and I concurs, then this *counts as* agreement.

3.1 Communication by agreement

The semantics that we propose in this paper is based on Habermas' theory of communicative action. This theory is based on the notion of validity claim. Speakers make claims, and when these claims are conceded, they turn into common ground. In this way, coordination is enabled. The general scheme is as follows.

Definition

For all φ being a well-formed formula, I and J being communicative actors:

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[claim(I,φ); accept(J,φ)] agreed({I,J},φ)
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In words: when φ has been claimed by I and has been accepted by J, it is agreed upon by I and J. In a more refined account, a difference could be made between claiming and suggesting. Both are actions oriented towards agreement. However, in the case of a claim, the Speaker is willing to back up (provide justification), whereas in the case of a suggestion, the speaker only expresses that he is willing to accept the claim if the other party supports it too.

Although in our opinion this "communication by agreement" scheme is highly generic, one could ask the question whether this holds in all settings. In particular, what about communicative acts based on power? One viable approach is to accept the scheme as such, but to recognize that there are different contexts and different systems of norms that justify claims. For example, power (institutional, political, or otherwise) can be a legitimate justification for a directive in one case and not in another. We also recognize that in situations where the norms and authorizations are formalized (almost) completely, not much room is left for discussion, and so the acceptance as a separate act becomes (again, almost) redundant. That is why the acceptance is often left implicit for economic reasons, although this needs to be done with care (cf. Weigand & De Moor, 2003).

The meta-predicates *claim*, *accept*, and *agreed* adhere to some minimal logical properties, such as conjunction distribution,

$$agreed(X, \varphi \wedge \psi) \Leftrightarrow agreed(X, \varphi) \wedge agreed(X, \psi)$$

but they are not necessarily deductively closed, for instance, as this would ignore the bounded rationality of the actors.

The fact that φ has the status "agreed" does not say anything about its truth. In that respect, this modality is comparable to the "ought to be" modality of Jones and Parent. Depending on whether the hearer is convinced of the sincerity and trustworthiness of the speaker, she will infer from here (or not) that φ is believed by the speaker and whether φ is true. We distinguish three different ways of relating the common ground and truth:

1. Axioms are added to the effect that everything that is in the common ground is considered true and believed by all parties. This approach is a bit naive, but can work in certain situations.
2. Refraining from inferring truth or belief, we restrict ourselves to the "agreed". What usually counts for coordination purposes is what is agreed upon, so why bother about beliefs and truth?
3. To believe or not to believe is left to the actor. That is, "believe" is introduced as an action that turns a statement from the common ground into the belief set of the actor. Similarly, what counts as „true" is made dependent on certain certain procedures within the community.

Alternative (3) is the most general, but we posit that in the organizational practice, (2) is usually sufficient.

Claims and acceptances can refer to things already agreed upon, or to things that are to be agreed upon. The first category contains what is traditionally called the stock of presuppositions. For example, if a speaker claims that an obligation has been fulfilled, the presupposition is that there was an obligation. For the hearer, the following situations can be distinguished:

1. The hearer is already committed to the claim (the presupposition was justified), and so has no problem in accepting it.
2. The hearer is not committed to the claim (the presupposition was not justified), but is willing to assume it had already been agreed upon.
3. The hearer is not commited to the claim, and does not want to commit either, typically because it conflicts with some of her commitments.

3.2 The objects of agreement

Among the many kinds of claims that are made by a speaker when performing a conversational act, we distinguish the following essential categories for the success layer of the Conversation for Action.

1. **claims about the „agreed“** – such as presuppositions. The object of the claim can be manykind including the categories given below. To distinguish these claims from the new claims, we use the modality *agreed*
2. **claims about conversation roles** – the conversation roles that we distinguish are Initiator, Executor and Evaluator.
3. **authorization claims** - when performing a conversational act, the speaker claims that he is authorized to perform the act. Authorization claims should be distinguished from authorizing speech acts where some agent transfers an authorization (with the claim that the agent himself is authorized to authorize).
4. **claims about actions** - the things to be achieved. Actions can be in one of the following states: {*desired, intended, started, finished, approved, dismissed*}. These phases correspond roughly to the well-known action cycle of Norman (Norman, 1990). The difference between intended and desired is whether the action has been planned already or not yet.
5. **claims about actor obligations** - what an actor or set of actors should do. Obligations can be in one of the following states: {*created, cancelled, violated, fulfilled*}.

This categorization is not meant to be exhaustive, but it covers the most important cases in our context. For each of the *claim* types there is also a corresponding *accept* action. There is a certain hierarchy of the claims, in the sense that the authorizations and roles usually have to be established first before the Hearer will be eager to accept the content, and the status of the obligation depends on the action status. The presuppositions (what is claimed to be agreed already), precede all the other claims.

Example

The conversation act that starts the conversation (CA1) is the request of an action by the Initiator to the Executor. Let us indicate the action by *s*. When user *u* initiates CA1 towards Hearer *h*, he makes the following claims:

1) **agreed(desired(s)) -** the request presupposes that the action was already agreed to be desired
2) **Initiator(*u*)**, **Executor(*h*)**
3) **authorized(*u*,CA1**)- the speaker, *u*, is permitted to perform this request
4) **intended(*s*)** - the action state of the action *s* is "intended" ("to be done"). The aim of the communicative action is that the action is not only desired, but becomes planned.
5) **created(obligation(*h*,s))** - the Hearer (role) is obliged to perform the action

A request of an action is done after a breakdown has been observed or an opportunity has been recognized. At this point, the desirability of the action has been discussed already, so the Conversation for Action starts when *s* already has the status "desired". The Speaker (with the initiator role) claims that the action is to be performed now (intended), and claims/suggests that the Hearer (with Executor role) is obliged to perform it. Both claims can be challenged by the Hearer, but if they are accepted, they lead to an obligation for the Executor and a state change of the action itself. The obligation claims and action claims are closely related, because it would be odd when an action is considered as "intended", but no one is responsible for the execution, or vice versa. However, these odd situations can happen in complex settings. For example, when an Executor withdraws and his obligation is cancelled. Or when the request above (CA1) is made in a situation where no actor is Executor and the request is not directed at one single person (e.g. in a mailing list, or in a meeting), so that the claim "created(obligation(H,kd))" is void. By separating the two claims, we can also accommodate the situation that the Hearer accepts one claim but challenges the other, thus preparing the ground for a more focused discussion.

CA1, by attempting to create an obligation on the part of the Hearer, is a typical request. Whether it is a *legitimate* request, can only be determined against the background of the norms (De Moor & Jeusfeld, 2001), and it is also this normative background that determines the net effect.

Example (continued)

The intended response of CA1 is CA2. This action is performed by the Hearer (a turn taking takes place) assuming the Executor role and consists of a commitment to the action. The authorization claim of CA2 is:

authorized(*h*,CA2) - the Hearer is authorized to make a commitment.

Furthermore, this conversational act contains acceptances corresponding to the claims (suggestions) made in CA1 above. So CA1 and CA2 together have at least the effect that "created (obligation(*h,s*))" and "intended(*s*)" are "agreed".

If everything goes well, the obligation will move later to the status "fulfilled" and *s* will move to the status "executing" and then "finished" and "approved". If is does not go well, the obligation will move to the status "cancelled" or "violated" and the status of the action to "dismissed".

The intended response CA2 is not the only possible one. If the Hearer does not accept the claims, she can challenge them. The discussion needed to resolve this disagreement is worked out in the next section. The result can be that the Hearer does accept the claims, or that the Speaker modifies his claims, or a break-down of the conversation.

4 Extending the basic model to cover argumentation semantics of discussions

A conversation state is characterized by the various types of claims and whether they are accepted or not. A further refinement of this characterization is needed when we want to account for challenging validity claims, that is, for the possibility of the actors to enter the Discussion and Failure Layer. This discussion can be modelled as rational discourse based on argumentation.

In recent years, dialogue systems for argumentation have received interest in several fields of AI, particularly in AI and law (Prakken, 2000; Prakken, 2001) and agent communication languages (Amgoud, 2002; Bentahar et al, 2003). In argumentation theory, formal dialogue systems have been developed for so-called "persuasion" or "critical discussion (Mackenzie, 1979; Walton & Krabbe, 1995 – other types are information-seeking dialogues and inquiry dialogues). The dialogue system in this case regulates the use of speech acts for such things as making or challenging a claim, accepting, withdrawing or arguing. The proponent of a claim aims at making the opponent concede (accept) his claim; the opponent instead aims at making the proponent withdraw his claim. Such a dialogue ends when one of the players has fulfilled his aim.

Prakken defines a dialogue system (in particular, a protocol for persuasion by dispute, PPD for short) as a tuple consisting of many elements. We have slightly adapted and simplified his system in the following definition. Our reformulation

reflects the fact that in our view, communicative action is focused on resolving conflicts rather than winning arguments.

Definition

A *protocol for persuasion by dispute* (PPD) consists of the following elements *Players, Acts, Replies, Moves, Comms, Rules, Resolution* as defined below

Players, typically represented with the characters S and H

Acts, the set of discussion acts: `claim(φ), argue(φ, so ψ), why(φ), retract(φ), accept(φ)`, where φ is a wff and "ψ, so φ" is an argument. Note that the claim and accept have been defined already in the above – which indicates the discussion layer is quite a natural elaboration of the success layer of communication if the latter is modelled in a Habermasian way on the basis of validity claims.

Replies, a function that defines for each act what are the possible reply acts (see Table 1). They can be characterized as either agreeing or disagreeing.

ACTS	DISAGREEING REPLIES	AGREEING REPLIES
claim ϕ	why ϕ argue Φ so ¬ϕ	accept ϕ
why ϕ	argue Φ so ϕ	retract ϕ
accept ϕ		
retract ϕ		
argue A: Φ so ψ where A identifies this argument	argue B: ϕ′ so ψ′ where argument B challenges or undercuts A why ϕ_I where $\phi_I \in \Phi$	accept A retract C where C is an argument challenged by A accept ϕ_i

Table 1: Argumentation acts and replies (based on Prakken, 2001).

Moves, the set of all well-formed moves. An initial move is a pair <Player, Act>, a responding move is a triple <Player, Act, Move>, where the third component indicates the move to which the current move responds.

Comms is a function that assigns to each player at each stage of a dialogue a set of propositions to which the player is committed at that stage. At the start, these can be considered empty or equal to the *Agreed*.

Rules is a function that for any dialogue state specifies the allowed moves at that point, given the dialogue so far and the players' commitments.

Resolution, is a function that determines how the discussion result is established. One way of establishing the result is to determine who is the "winner", that is subsequently defined as the one whose argument cannot be defeated. In a multi-actor setting, a voting procedure could be used.

For example, consider CA5 (request justification of validity claim) and CA6 (provide justification of validity claim). These acts do not have an immediate effect on the *Agreed*. However, what does change is the *dialogical status* of a claim. CA5 corresponds to a `why(φ)` move, where φ is one of the validity claims made by the Initiator, and CA6 corresponds to an `argue(ψ, so φ)` move that tries to defend the original validity claim.[1]

The dialogical status of the move indicates its status in the discussion. A certain claim is "in" when it has been made and not challenged. If it has been challenged, it becomes "out", until the challenge itself is effectively replied to. Formally:

Dialogical status of moves

A move M of a dialogue D is either *in* or *out* in D. It is *in* in D iff
1. M is accepted in D, or else:
2. all attacking moves in D that reply to it are *out* in D

This notion makes it possible to determine, at each stage of the discussion, which moves are in and out. In particular, it can be determined what is the status of the validity claim that started the discussion. Note that when the claim is accepted immediately (success layer), the move is immediately in, and no discussion is necessary (or, to be more precise, no discussion is *relevant* as it would not change the dialogical status of the claim anymore).

The dialogical status of the moves is one element of the logical characterization of a state. The other important element is *Comms*, the commitments of the discussion partners at that state. These commitments are to be understood here in the context of the rational discussion; they represent what the player adheres to, even if it is only for the sake of the argument (they do not correspond with responsibilities for action). During a discussion, the partners can take on different

[1] Note that we do not say that during the argumentation process, the Agreed is never affected. On the contrary, in a thriving community, continuous refinement of common beliefs should take place. So claims and acceptances on sub-items, as well as retracts, should be allowed.

commitment, of which only a part is agreed. (so the commitments are always a superset of the *Agreed*).

The logical semantics of the possible discussion acts can be represented using *Comms*. For example, the effect of `argue(φ, so ψ)` is that φ and ψ are added to the commitments of the speaker. The preconditions of the discussion acts refer to the Commitments as well. One general condition is that *Comms* must be left consistent. More specific preconditions are given in the following table based on (Prakken, 2001); note that many variants of the discussion game can be distinguished

Move	Preconditions	Postcondition (effects on the speakers commitments)
`Claim` ϕ	*Comms* ∪ {ϕ} is consistent	*Comms* := *Comms* ∪ {ϕ}
`Argue` Φ `so` ψ		*Comms* := *Comms* ∪ {ψ} ∪ Φ
`retract` ϕ	ϕ ∈ *Comms* (explicitly added)	*Comms* := *Comms* / {ϕ}
`accept` ϕ	ϕ ∉ *Comms* *Comms* do not justify ¬ϕ	*Comms* := *Comms* ∪ {ϕ}
`why` ϕ	*Comms* do not justify ϕ	(no change)

Table 2: Pre- and postcondition rules. Note that the moves can only affect the commitments of the speaker of the act.

Each dialogue system specifies somehow what are the allowed moves at some point (the Rules component). Obviously, this function depends on many factors. In dialogue theory, the following norms have been proposed for inclusion in the rules of any rational discussion:

Non-repetition

If moves m_i and m_j are both reply to M, then their content should be different.

Relevance

A move is relevant iff it replies to a relevant target. A target is relevant iff any attacking reply to it changes the dialogical status of the initial move. Every move (except the initial move) should be relevant.

No self-contradiction

It is not allowed to concede to a proposition if the opposite is justified by the player's own commitments (it is allowed that the speaker has changed his mind, but then he should retract his earlier commitment).

These norms are useful for increasing the coherence of conversations. If we would only have the Process Model any repetition of CA5 and CA6 (request justification, provide justification) would be allowed, and this cycle could go on endlessly. By imposing the right dialogue system rules, we can exclude certain incoherent conversations and keep the *meaningful* conversations only. Another nice property of dialogue rules is that they can guarantee (under certain circumstances) that when φ is deducible from the shared background with classical inference, there is also a strategy for justifying φ in the argumentation game. In addition, it is possible to go beyond classical inference, for example, by adding rules to the PPD on the assignment of the "burden of proof". Or by allowing the participants to bring in new facts during the discussion. The discussion layer of communicative action naturally extends into the Discourse Layer in which new rules, meanings and facts can be discussed and added to the shared commitments. This discourse layer is important for two reasons: first, most situations are open-ended and dynamic and so the background knowledge is never fixed and finished. Therefore, going into discourse should always be possible. It is desirable to structure the discourse, and record its results; in this way, organizations (or communities) can *learn*.

5 Argumentation in IBIS

The Issue-Based Information System (IBIS) paradigm originated in the 70's to deal with the discussions on wicked problems (Kurz & Rittel, 1970). *Wicked problems* cannot be solved in traditional ways, as no perfect solution can be found. The understanding of the problem evolves as the solution is being worked on, but no clear agreement on what the "real problem" is can be found. IBIS is an environment of multiple parties facing different views about the problem, different values and beliefs, few hard data, and time pressure for resolution. The method supports dialogue among the stakeholders in the problem. Applications grounded in IBIS were developed in the '80s (and onwards) by Jeff Conklin and others (Conklin and Begemann, 1988). To reach convergence, Conklin et al (2003) propose to use a human facilitator. However, we argue that our argumentation semantics can also help to formalize the reaching of convergence, in order to have at least part of this improved IBIS process supported by automated systems.

The key elements of IBIS are: *issues* (questions), *positions* (ideas), and *arguments*. Translated into the argumentation framework that we presented in this paper, the issues are close to why-moves, the positions are claim-moves, and the arguments are argue-moves. The why-move puts a certain proposition into question. In the Conversation for Action, the why-move is usually preceded by a validity claim (a claim-move by some actor in some action context). It seems that IBIS does not take this context into account. This may be a pity, as the problem context can have a steering function on what otherwise could become an academic

exercise of dreaming up possible questions and positions. On the other hand, we should mention that the IBIS question is typically more than a why-move. The question can be a yes/no-question (then it is a why-move), but it can also be (and according to IBIS, preferably is) an *open* question. The open question is not included in the dialogue system above. We could say that it is a move that introduces an issue and whose possible replies are various claims about the issue. In IBIS, these claims (the positions) are not necessarily mutually exclusive, so it is not needed to justify one position against another: each one is evaluated on its own merits. The only rule is that the claim must be *about* the issue. It has been said that the power of IBIS is that it moves the asking of questions into a central role in the dialogue process. The open question invites the participants to consider possible alternatives, instead of locking them up in one solution direction.

Besides the focus on (open) questions, another alleged advantage of IBIS is the separation of positions and arguments. Participants are often tempted to pack them into one statement. By separating them, IBIS permits a more structured discussion, as it now becomes possible to either attack (or support) the argument, or attack (or support) the position. This feature of IBIS could improve the argumentation framework given above. It suggests that the `argue` Φ `so` ψ move is a complex one that is better split up in a set of connected moves: `claim` Φ, `claim` ϕ_I (for all components of Φ), and `argue` Φ `so` ψ (or `so` $\neg\psi$, in the case of a con argument). The complexity of the argue move can be seen already in Table1 and 2, as it is the only move that has multiple agreeing and disagreeing replies.

A complete formalization of IBIS in terms of the argumentation model (or some extension) is beyond the scope of this paper. We restrict ourselves to evaluating how IBIS copes with the three general rules for discussions:

The non-repetition rule
As arguments and positions are added to one map, repeating arguments is excluded. It is mentioned as a big practical advantage that the trick of "truth by repetition" is automatically disarmed in IBIS systems. This helps considerably in raising the quality of dialogues.

The relevance rule
The positions can be seen as claim-moves, and the arguments as argue-moves. The arguments can be supporting or objecting. The former ones argue for the position, and the latter against the position. IBIS does not have a relevance rule such as we defined above, but this could be added. This could avoid useless discussions on sub-issues whose resolution would not affect the main issue anyway (an example is adding yet another argument against a claim, when there is already an argument con that has been accepted). We suggest therefore that IBIS gives the possibility of keeping track of the dialogical status of positions and arguments.

The "no self-contradiction" rule
An ingredient of the argumentation model that seems to be missing in IBIS is the set of Commitments. When a discussion extends in time, the map may have become quite complex and may contain ideas and arguments from different participants. Then it may be unclear who is or was committed to what. A possible advantage is that the argumentation may be more of a collaborative exercise. Actor A may bring in a position, while B may bring in a supporting argument for it. The other side of this coin is that actors may get too much freedom, up to a level where their position (their proposal) becomes incoherent. Then the discussion may become senseless. This problem is not easily solved, as the positions and arguments are not given in a formal language and typically resist logical interpretation. However, IBIS does have a Decision Node type, which is used to capture the resolution of a question into a decision. In this way, some parts of the map can be fixed – they correspond to what is agreed upon (and therefore committed).

6 The 3-box model of communicative action

In the above, we have introduced an argumentation framework that allows for an Habermasian semantics of communicative action. The framework is based on existing logical theories and has been confronted with the more practical and empirically validated IBIS method. On the basis of that, we propose a modification of the TPM model tentatively called the 3-box model of communicative action (see fig. 2). The picture is to be read as follows: we distinguish three boxes that exist side by side, and that can be updated independently. So in contrast to TPM, that has a discussion part related to the initiating phase of the transaction (state 6,7,8) and a part related to the evaluating phase (state 9,10,8), we have only one discourse box that can be entered at any time. In the process box (corresponding to the success layer), claims and accepts can be made (to indicate the pending status of claims, we use dotted boxes for these conversation states). The common ground box is not modeled as a state transition diagram (as in Conversation for Action and TPM), but, just as in IBIS, as a diagram that represents the growing argumentation structure. The most important actions here are adding claims, and adding arguments pro or con. Note that the link between a claim and the argument is a spawned tree, as there may be several claims ϕ_I that together form the basis of the argument. Furthermore, it is possible to accept a claim (then we get an undotted box), and also to retract a claim (marked by a cross). When the Hearer challenges a claim in the success layer (the CA5 in TPM), this has the effect of putting that claim into the discussion box and establishing a link between the boxes. We also allow for IBIS questions in the discussion box (marked here by a circle). In explorative discussions, it is be better to broaden a challenge (typically a closed question) to an open question.

In the process box, in fact, any business process modeling formalism can be used, including for example, Petri Nets. The 3-box model only specifies that it should be possible to jump out of the process box when some claim is challenged.

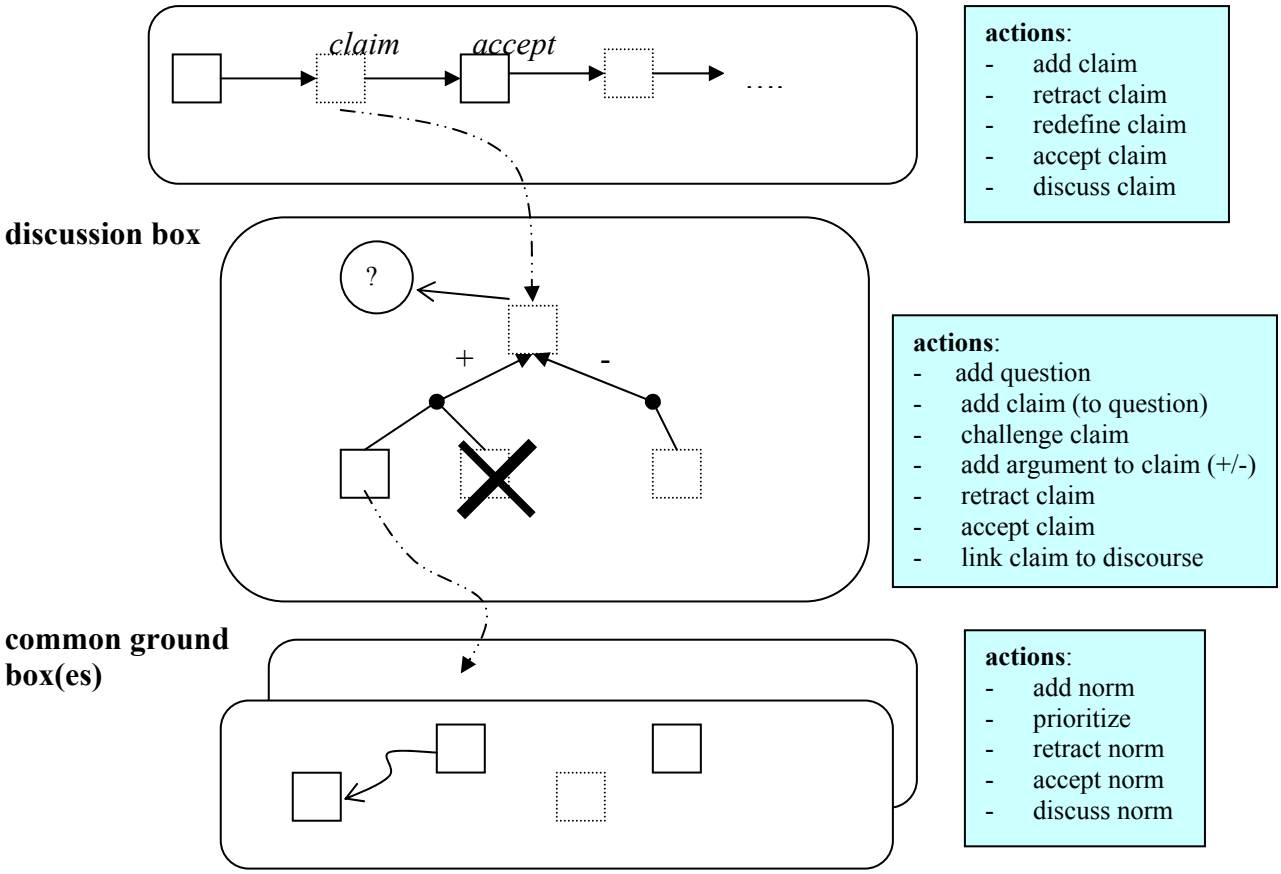

Fig. 2: The 3-box model of communicative action

The common ground box (corresponding to the discourse layer) is again independent from process box and discussion box. It is also a growing structure, which consists of facts, definitions, and rules (proposed, proposed and accepted, or retracted). In line with Stamper (2000), we group all these knowledge items together under the term „norm". In practice, there may be several of these boxes. Important here is the possibility of drawing priority links between the norms, which implies an overrule relationship. In practice, a norm system is seldom completely free of conflicts. Therefore an important goal of discourse is to solve norm conflicts by deciding on the relative weight. From the discussion box, it is

possible to link to the common ground box if the claim is directly warranted by a background norm. Conversely, it is also possible to go from the common ground box to the discussion box if a background norm is challenged (a community may have procedural rules that say when such a meta-discussion is allowed and how).

Example

A customer orders a product for a certain price. The seller does not accept the claim that the price is such and such, and starts a discussion. In the discussion, the customer grounds his argument on the rule that when a price is published somewhere, the seller is bound to it. In addition, he claims that this price has been published on the web page. The seller does not challenge the rule as such, but claims that it was explicitly stated on the bottom of the page that the prices are subject to changes and not guaranteed. In other words, he claims that the rule used by the customer is overruled by the rule that when the seller makes an explicit caveat, the price is not guaranteed. To convince the customer, the customer has to accept this norm, plus the claim that this caveat was made, and that this norm has priority over the other norm. Then the customer cannot defend his claim anymore, and may revise his order accordingly.

In the description so far, we have assumed one Speaker and one Hearer. However, the model can be easily extended to a multiparty situation. What needs to be specified then, in addition, is how a claim is accepted (e.g. a voting procedure). The participants per box may differ: the workflow can have just two participants, but when a discussion is started, more people can be involved, or even completely different people (e.g. management instead of operational people). The 3-box model is to be viewed as a „deep structure“ of communicative action, not as the design of an operational system like Questmap. Communicative action is highly situated, and settings differ not only in the common ground boxes, but also in the rules governing the possible actions, and the media and tools put to use.

7 Conclusion

In this paper, we have introduced an argumation framework that describes the semantics of communicative action, both at the success layer and at the discussion layer, in a unified way. The framework is based on logical Argumentation Theory. We have shown how conversational acts from the Transaction Process Model can be represented in this framework. The framework also extends the TPM by offering a more complete set of discussion acts, as well as rules and norms that can structure the discussion. We have confronted the logical framework with a system with a long history of practical experience, IBIS. This confontation resulted in some recommendations for IBIS, but also to some modifications in our framework.

Finally, we have come up with a reformulation of the 3-layered Transaction Process Model in the form of a 3-box model of communicative action. Evidently, this reformulation is still tentative and needs to be worked out in more detail. Validation is to be achieved by showing with examples or analytically, that any coherent conversation can be represented with this model.

Although this article has been written with the Conversation for Action in mind, the extended semantics described is in fact quite general, and we contend that it can be used in other contexts as well, for example, in the area of web-services and in agent societies. An important application domain is also Negotiation Support and Dispute Resolution. Negotiation is a complicated conversation type that typically includes discussions. The *N*egoist system described in (Schoop et al, 2003) supports the monitoring of obligations. It also allows for discussions in the form of offers and counter-offers. However, it might be useful to separate the claim (position) from its arguments, so that the arguments can be discussed separately. This is even more so the case when we generalize from the order negotiation process to business negotiation in general. Dispute resolution would not work on offers and counter-offers only. What is important there is to develop the right arguments given the common background (contract and relevant law).

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