Flexible Deadlines for Directed Obligations in Agent-based Business Contracts

(Extended Abstract)

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ABSTRACT
In B2B contract enactment, cooperation should be taken into account when modeling contractual commitments through obligations. We advocate a directed deadline obligation approach, taking inspiration on international legislation over trade procedures. Our proposal is based on authorizations granted in specific states of an obligation lifecycle model. Flexible deadlines provide an additional level of cooperation between contractual agents. Moreover, agents increase their decision-making options concerning obligations.

Categories and Subject Descriptors
I.2.11 [Distributed Artificial Intelligence]: Multiagent systems

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Norms, Normative Behavior, Contract, Deadline

1. INTRODUCTION
In cooperative Virtual Organizations, agents (enterprise delegates) share their competences in a regulated way, through commitments expressed as norms in contracts. The importance of pursuing a common goal demands for flexibility of operations: agents should facilitate compliance of their partners, because group success also benefits each agent’s private goals, which are not limited to the business in progress, but also concern future opportunities that may arise.

Many approaches to normative multi-agent systems are abstracted away from their potential application domain, and give deontic operators an universal semantics (e.g. deadline obligations are violated if the obliged fact does not happen before the deadline). We argue that in some domains – such as business contracts – this approach is not desirable. For instance, the UN Convention on Contracts for the International Sale of Goods (CISG) [4] establishes what parties may do in case of deadline violations. In some cases, obligations may be fulfilled after the deadline (Article 48), which may themselves be extended (Articles 47 and 63), denoting a flexible and even cooperative facet of trade contracts.

We propose a different approach to model obligations in MAS for the business contracts domain. Following a cooperative business performance posture, we argue that obligations should be directed, and that deadlines should be flexible. In our model, authorizations are granted on specific states of a lifecycle for time-framed directed obligations.

2. DIRECTED DEADLINE OBLIGATIONS
Deontic operators (such as obligations) can be modeled with different features. Our proposal for handling contractual obligations combines deadline [1] and directed [3] obligations. We also cope with the fact that anticipated fulfillments are not always welcome (in CISG’s Article 52, this is the case when storage costs are relevant). An obliged fact should therefore be obtained within a time window, delimited by a liveline and a deadline. A norm \( s \rightarrow O_{b,c}(f,l,d) \) indicates that if \( s \) then \( b \) (bearer) is obliged towards \( c \) (counterparty) to bring about \( f \) (fact) between \( l \) (liveline) and \( d \) (deadline). If \( b \) does not bring about \( f \) between \( l \) and \( d \), then \( c \) is authorized to react against \( b \) (see figure 1, where the shaded area indicates the period of time within which the achievement of \( f \) will certainly fulfill the obligation).

2.1 Temporal Violations
Figure 2 contains the state transition diagram for directed obligations with livelines and deadlines. The obligation is active \( (O_{b,c}(f,l,d)) \) when prescribed by a norm (whose situation \( s \) became true). When \( l \) arises, it becomes pending, unless an anticipated achievement of \( f \) occurs; in this case there is a liveline violation \( (LViol_{b,c}) \). If the deadline occurs before \( f \), there is a deadline violation \( (DViol_{b,c}) \). If \( f \) occurs while the obligation itself is not yet in a viola-
obtain certain facts, which benefit counterparties. A contract contains further norms dependent on the fulfillment or violation of previous obligations. In order to model the decision making process, we need to assess an agent’s valuations on the obligation states and facts he is able to bring about. Let $v_a(f)$ and $v_a(S)$ denote the valuation agent a makes of fact $f$ or state $S$, respectively (as in [2], where these are used to check correctness of contracts, while we focus on the course of contract execution). When valuating fulfillment or violation states, agents should take into account what further commitments those states trigger. Focusing on the counterparty, for an obligation $O_{b,c}(f,d)$ we have:
\[v_c(O_{b,c}(f,d)) > 0\] obl. is asset for counterparty
\[v_c(f) > v_c(O_{b,c}(f,d))\] c benefits from $f$
\[v_c(\text{Fulf}_{b,c}(f,d)) \leq 0\] c may acquire obligs. after
\[v_c(Viol_{b,c}(f,d)) > 0\] c may be compensated after

We may now say that $c$ should denounce (and thus obtain the violation) if $v_c(f) + v_c(\text{Fulf}_{b,c}(f,d)) < v_c(\text{Viol}_{b,c}(f,d))$. We consider that valuations may vary with time (it makes sense to think of $v_c(f)$ as possibly decreasing with time).

Even when the above condition does not hold, $c$ may still opt for tolerating the less preferred situation of failure for matters of conflicting goals. On the other hand, in environments enriched with social features agents can exploit, they can decide to behave cooperatively even when they have to bear a contained disadvantage – more than being altruistic, agents may try to enhance their trust awareness in the community, from which they will benefit in future interactions.

4. SUMMARY

Most implementations of norms in MAS ignore the need for having directed obligations from bearers to counterparties. This is because in those approaches obligations are seen as (implicitly) directed from an agent to the normative system itself. It is up to the system to detect violations and to enforce the norms which are embedded in the environment. On the contrary, contractual obligations are negotiated into contracts and directed to specific contractual partners.

We started from previous theoretical approaches to model authorizations, and developed a more concrete formalization by linking authorizations with a flexible model of deadlines. Obligation violations are now dependent on the counterparty will to claim them. Agent decision-making is enriched in our model, because both parties involved in directed obligations may have a say regarding their violation. When considering such obligations as interlinked through norms in a contract, agents should evaluate the consequences of fulfillment and violation states as stated in the contract. Furthermore, in “socially rich” environments, agents should explore the value of future relationships by enhancing their perceived trustworthiness and predisposition to facilitate compliance.

5. REFERENCES