Modular Argumentation for Modelling Legal Doctrines of Performance Relief

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ABSTRACT

Legal doctrines provide principles, guidelines and rules for dispute resolution in reasoning with cases. To apply legal doctrines, the context of a contract consisting of different knowledge bases about beliefs and expertise of contract parties as well as about common social, legal domains need to be established. Judges then decide legal outcomes by reasoning from factors drawn in contract contexts following legal doctrines. In this paper, we model this decision making by modular argumentation. We focus on legal doctrines in contract law, especially the doctrines of impossibility and frustration of purpose.

General Terms

Argumentation

Keywords

Legal doctrines, Impossibility, Frustration

1. INTRODUCTION

EXAMPLE 1. *Imagine that a health insurer contracted a software company to manage its database system about its customers. One day an earthquake hits the software company facility, destroying all database servers. The software company asks to rescind the contract on the grounds that its performance has been made impossible through no fault of either parties. How should the court rule? Would it be possible to arbitrate such disputes online?*

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The main task in reasoning with cases is to construct a theory from past cases that produce the desired legal outcomes and to persuade the judge of its validity [4, 17]. When a judge uses a past case as a model for deciding a current case, he should establish that both cases are instances of the same principle [8]. Legal doctrines can be viewed as representing such principles, guidelines, and rules for dispute resolution in reasoning with cases. In fact, the principle that cases that are instances of the same principle should be decided similarly is a doctrine governing much legal reasoning, the doctrine of precedent. As the vast and increasing number of cases lead to many conflicting decisions and an increased uncertainty in the law, Restatement (First and Second) of contracts have been proposed to "restate" clearly and precisely the principles and rules of common law[21]. Thus modeling legal doctrines offers an accountable method of constructing legal theories that produces legal outcomes less arbitrary and more persuasive to judges, who inherently accepts the doctrine of precedent, and a variety of doctrines in the dispute domain.

In this paper we are interested in legal doctrines in Restatement Second, especially the doctrine of impossibility and frustration of purpose. These doctrines provide the criteria for parties seeking relief of performance because unexpected events after the contract making made the performance of the contract literally impossible, or eliminated the principal goal of a party in entering into the contract. For illustration, we recall a famous court case below [10, 16].

EXAMPLE 2. *(Taylor v Caldwell, 1863) The plaintiff hired the defendant's hall for the purpose of given four grand concerts. The plaintiff were to pay £*100 *in the evening of each concert. After signing the contract but before the first concert a fire destroyed the hall. The plaintiff claimed damages (£*58*) in respect of the expenses which he had incurred in advertising and preparing for the concerts. The claim was dismissed for the reason that the fire, an unexpected event for both parties, destroyed the hall the non-existence of which renders the performance of contract impossible. Thus both parties are discharged. The plaintiff was not entitled to damages while the defendant was not entitled to the promised payment.*

To determine whether a party could rescind a contract, the court often relies on legal doctrines to construct hypothetical contracts also called intended contracts, to represent what parties would have agreed on had they foreseen the

unexpected situations. In particular, an intended contract supplements its actual contract with implied risk allocation clauses seen as unexpressed will of the parties. The ruling will then follow these clauses.

In [8, 9], we presented an argument-based formalism for contract dispute resolution as two-level reasoning process, where at object level factors of the case are established from the contract context and at meta-level legal doctrines combine these factors to determine the legal outcomes. The contract context consists of different knowledge bases depending on the requirement of the doctrine to be used. For instance the context in Taylor case should include the beliefs bases of both parties at contract making (for establishing that the fire is unexpected for both parties) and the general common knowledge base (for establishing that certainly the hall is destroyed by the fire, and the contract is impossible to perform without the hall). The assumption-based argumentation framework [7], a machinery capable of constructing arguments and determining their acceptability automatically from an underlying logic, is used to represent knowledge bases of contract contexts. Legal doctrines are represented by the modular argumentation framework [8], an extension of assumption-based argumentation to allow references to different semantics to the same knowledge base at the same time.

In this paper, we establish the appropriateness of modular argumentation for modelling legal doctrines by applying it for representing and reasoning with the doctrines of impossibility and frustration of purpose. These two doctrines, together with the doctrine of mutual mistake which in fact provides the motivation for the introduction of the modular argumentation in [8], represent an important advancement in their branch of contract law. We point out how building blocks of these doctrines can be captured by different facilities of the formalism. For instance, the risk attitudes of contract parties can be represented by their (skeptical or credulous) modes of reasoning while opinions open to challenge (e.g. contract party has to perform his part of the bargaining unless there are exceptions for him to rescind) can be represented by assumptions. Since these building blocks are themself the very basic rules and principles composing other complex ones, being able to model them naturally is a necessary step to establish the applicability of the formalism to other doctrines

Much work has been done to study computational models for different aspects of law and legal argument [1, 3, 4, 13, 14, 20, 19], and how formal argumentation developed in AI is applied for legal reasoning [1, 3, 4, 20]. In [2, 3], the view that the appeal of a legal argument is grounded in the values which acceptance of the argument would advance provides the motivation for extending the abstract argumentation framework in [6] to deal with social values. In [1, 3, 4] value-based argumentation was shown to provide a natural platform for case-based reasoning, in which judges are seen as constructors of legal theories advancing social values. A legal doctrine can be viewed as a control mechanism installed by its society to make this task of a judge less dependent on his own preference and personality. Since legal doctrines often have been thoroughly examined, the social values they bring about are more convincing and more socially accountable. For instance, as repeatedly described in many legal sources (e.g. [16]), the two doctrines modelled in this paper help to restore *fairness* in unexpected situations by allocating the loss fairly. To our best knowledge, there has not been sufficient work focusing on constructing legal theory for contract interpretation. Exceptions are the formalism of [22, 23] using meta-level rules in first order logic to infer contractual obligations and the rule-based system of [12] supporting decision makers, both for disputes in the offer-and-acceptance area of contract. It is not clear how to apply these formalisms for modelling legal doctrines since they are silent on important aspects, for example, how contexts are structured or how to represent risk attitudes of contract parties.

The paper is structured as follows. In section 2, modular argumentation and a contract representation are recalled. We model legal doctrines in section 3. Section 4 applies modular argumentation to model the legal doctrines. We conclude in section 5.

2. BACKGROUNDS

2.1 Modular Argumentation

An abstract argumentation framework [6] is a pair $(AR, attacks)$ where AR is a set of arguments and $attacks$ is a binary relation over AR representing the relation that an argument A attacks an argument B for $(A, B) \in attacks$. The semantics of abstract argumentation is determined by the acceptability of arguments and various associated notions of extensions. For the purpose of this paper, we introduce only one of them. A set S of arguments is said to be *admissible* if it counter-attacks each attack against it, i.e. for each argument A that attacks some argument B in S there is an argument C in S that attacks A. A maximal admissible set of arguments is called a *preferred extension*.

Abstract argumentation provides a natural platform for understanding many legal procedures [1, 3, 4, 13, 14, 20, 19]. But it does not provide an programming environment in which the arguments for such procedures could be constructed automatically. To address this issue, an instance of abstract argumentation called assumption-based argumentation where the arguments are deductive proofs based on assumptions [7] could be used. An assumption-based argumentation (ABA) framework is a triple $(\mathcal{R}, \mathcal{A}, \overline{\ })$ where $\mathcal{R}$ is set of inference rules of the form $l_0 \leftarrow l_1, \ldots l_n$ (for $n \geq 0$), and $\mathcal{A} \subseteq \mathcal{L}$ is a set of assumptions, and $\overline{\ }$ is a (total) mapping from $\mathcal{A}$ into $\mathcal{L}$, where $\overline{x}$ is referred to as the *contrary* of x. Assumptions in $\mathcal{A}$ do not appear in the heads of rules in $\mathcal{R}$. A *(backward) deduction* of a conclusion α based on (or supported by) a set of premises P is a sequence of sets $S_1, \ldots, S_m$, where $S_i \subseteq \mathcal{L}$, $S_1 = \{\alpha\}$, $S_m = P$, and for every i, where σ is the selected sentence in S_i: If σ is not in P then $S_{i+1} = S_i - \{\sigma\} \cup S$ for some inference rule of the form $\sigma \leftarrow S \in \mathcal{R}$. Otherwise $S_{i+1} = S_i$.

For a set of propositions X, and some sentence l, we write $X \models l$ if there exists a backward deduction for l from some $X' \subseteq X$. An *argument* for $x \in \mathcal{L}$ supported by a set of assumptions X is a (backward) deduction from x to X and denoted by (x, X). An argument (x, X) attacks an argument (y, Y) if x is the contrary of some assumption in Y. The abstract argumentation framework constructed from arguments of $\mathcal{F}$ is denoted by $AA_{\mathcal{F}}$.

Given an ABA framework $\mathcal{F}$, a proposition $\pi \in \mathcal{L}$ is said to be a *credulous consequence* of $\mathcal{F}$, denoted by $\mathcal{F} \vdash_{cr} \pi$ if it is supported by an argument in some preferred extension E of $AA_{\mathcal{F}}$, π is said to be a *skeptical consequence* of $\mathcal{F}$,

denoted by $\mathcal{F} \vdash_{sk} \pi$ if it is supported by some argument in each preferred extension E of $\mathcal{F}$.

For convenience, a preferred extension of $AA_{\mathcal{F}}$ is often referred to by the set of assumptions appearing in its arguments, also referred to as the preferred extension of $\mathcal{F}$ for short.

Representing and reasoning with legal doctrines requires references to different semantics in the same knowledge base at the same time, a feature that motivates the development of modular argumentation in [8]. A *modular assumption-based argumentation (MABA) framework* is structured into distinct modules where exactly one of them is considered as the main module while the others are called submodules. A module is basically an ABA framework with the exceptions that the premises in its rules are either sentences in $\mathcal{L}$ or a *module call* of the form $call(l, M, t)$ where l is a non-assumption sentence in $\mathcal{L}$, M is a module in which l occurs, $t \in \{cr, sk\}$ is the type of semantics of M according to which l is defined (i.e. $M \vdash_t l$). Note that in this paper, we restrict ourself to two types of semantics, notably the credulous and skeptical preferred semantics defined shortly before.

EXAMPLE 3. *Let $\mathcal{F}$ be a MABA framework consisting of two modules M_1, M_0 where*

M_1 consists of a single rule $h \leftarrow call(p, M_0, cr), call(q, M_0, cr)$ and

M_0 consists of two rules $p \leftarrow \neg q$ and $q \leftarrow \neg p$ and $\mathcal{A} = \{\neg p, \neg q\}$ and $\overline{\neg p} = p$ and $\overline{\neg q} = q$. M_0 has two preferred extensions $\{\neg p\}$ and $\{\neg q\}$. Hence, $M_0 \vdash_{cr} p$ and $M_0 \vdash_{cr} q$. Hence both module calls $call(p, M_0, cr), call(q, M_0, cr)$ are accepted. As result, M_1 has an unique extension in which h is concluded.

Note that $\mathcal{F}$ is distinct to the ABA framework consisting of three rules: $h \leftarrow p, q$ and $p \leftarrow \neg q$ and $q \leftarrow \neg p$ in which h is not concluded wrt any semantics.

In this paper, we restrict our consideration to stratified MABA frameworks where the modules names are ranked (by ordinals) such that all module calls in rules belonging to a module of rank k refer to modules of ranks lower than k. The rank of the main module is the highest rank. The MABA framework in example 3 is an example of stratified modular argumentation.

The semantics of stratified MABA framework is defined inductively by defining the semantics of the higher ranks modules based on the semantics of lower ranks modules. Suppose that the semantics (i.e. extensions) of all modules of ranks lower than the rank of a module M have been defined. A *(backward) deduction* of a conclusion α wrt module M based on (or supported by) a set of premises P is defined similarly as the backward deduction wrt ABA framework with the exception that when the selected element σ is a module call of the form $call(l, N, t)$ then $N \vdash_t l$ and $S_{i+1} = S_i - \{\sigma\}$.

The notions of arguments, extensions and consequences wrt a module M in MABA are defined similarly as in usual ABA frameworks. For a MABA framework $\mathcal{F}$, we write $\mathcal{F} \vdash_t p$ if $M \vdash_t p$ where M is the main module of $\mathcal{F}$ and $t \in \{cr, sk\}$. For $X \subseteq \mathcal{L}$, by $\mathcal{F} \cup X$, we mean the framework obtained from $\mathcal{F}$ by adding $\{x \leftarrow | \ x \in X\}$ to its set of inference rules.

EXAMPLE 4. *(Continue example 2) By modelling the general common domain knowledge base and the belief base of the defendant at contract making as ABAs CK_d and BO, the following arguments could be constructed automatically:*

- *the defendant did not believe that the fire may occur: $BO \not\vdash_{cr} Fire$,*
- *the fire destroyed the hall: $CK_d \cup \{Fire\} \vdash_{sk} \neg HallExist$,*
- *the non-existence of the hall renders the rent of hall impossible: $CK_d \cup \{\neg HallExist\} \vdash_{sk} \neg RentHall$,*

Thus a main module with CK_d, BO as submodules can construct argument: the fire, an unexpected event for the defendant, destroyed the hall, the non-existence of which renders the rent of hall impossible.

2.2 Contract

There is a huge research on formal represention of contracts (e.g. see [15, 11]). However, for our purpose, the following extension of the presentation in [8] suffices.

DEFINITION 1. *A contract between contractor CO and contractee CE is modelled as a five-tuple $\Gamma = \langle CO, CE, \tau, T, RA\rangle$ where*

1. *τ identifies the transaction or services that contractor promises to perform,*
2. *T is a contract specification written in some contract language.*
3. *RA allocates risks among the contract parties and consists of rules of the form $\varepsilon \rightarrow CX$ stating that if event ε occurs after the contract making, then the risk is allocated to $CX \in \{CO, CE\}$.*

In cases where the identities of contract parties are clear from the context, we denote a contract by $\langle \tau, T, RA\rangle$ or simply by $\langle \tau, T\rangle$ if RA is empty. Presenting a theory of contract languages is beyond the scope of this paper. For our purpose we assume that there is a consequence relation $T \vDash \alpha$ stating that α can be derived from T.

EXAMPLE 5. *(Continue example 2) The contract is represented by $\langle Taylor, Caldwell, RentHall, T, \emptyset\rangle$ stating that Taylor contracts Caldwell to rent a hall. No risk allocation is given. T specifies at least the contract price, for example $T = \{Price(\pi)\}$ stating that the price of T is π.*

3. LEGAL DOCTRINES FOR RELIEF OF PERFORMANCE

The doctrine that a failure to perform a considered promise constitutes a breach of contract states that under conditions specified in the contract, each contract party must perform his part unless there are exceptions for him to rescind. Legal doctrines for relief of performance provide classes of such exceptions.

If a mistake concerning an existing fact has been made by both parties at the contract making, then parties can seek relief on the grounds of the doctrine of mutual mistake. This doctrine is already modeled in [8]. Two other doctrines for relief of performance that are in focus of this paper concerns mistakes of contract parties with regard to events occurring after contract making. The Restatement Second states:

"Where, after a contract is made, **a party's performance is made impossible** or **a party's principal purpose is substantially frustrated** without his fault by the occurrence of an event the non-occurrence of which as a basic assumption on which the contract was made, his duty to render that performance is discharged, unless the language or the circumstances indicate the contrary".

DEFINITION 2. *The support for rescission on the grounds of* ***impossibility*** *or* ***frustration of purpose*** *consists of the following conditions*

1. *that an unexpected event occurred after contract making*
2. *that the non-occurrence of the event was a basic assumption on which the contract was made*
3. *that the event is not the fault of the party asking for rescission.*
4. *that the party asking for rescission does not bear the risk of that occurrence of the event either under the language of the contract or the surrounding circumstances.*

3.1 The Doctrine of Impossibility

Following definition 2, the defendant's rescission in Taylor case is granted because: 1) the fire is unexpected and occurred after the contract making; 2) the non-occurrence of fire is a basic assumption since fire destroyed the hall, an essential mean without which the contract is impossible to perform; 3) the fire is not caused by the defendant; and 4) no explicit clauses of the contract assigns risk of fire to him, and he could not do anything to guard against it.

It is important that in 2) the destroyed means must be specifically referred to in the contract, or at least understood by both parties to be the property that would be used. Thus the court decision would be different if the defendant has several halls none of which was referred to in the contract.

In the absence of explicit clauses in 4) the court often has to complete the contract with implied clauses representing what parties would have agreed on had they negotiated over the unexpected situations. Many modern courts and law school advocate that risk is allocated to a party who caused the situation or is able to foresee it but did not guard against it. Thus if Taylor case happened in our time the ruling could be in favor of the plaintiff for the reason that the risk of fire should be allocated to the defendant because he can easily prevent the fire, by installing sprinkler and alarm systems. We demonstrate this principle with another case[10].

EXAMPLE 6. *(Canadian Industrial Alcohol Co. v Dunbar Molasses Co.) P agrees to buy from D, a middleman, 1,500,000 gallons of molasses of National Sugar Refinery. At the time of contracting, D has no contract with the Refinery, because he reasonably expects the supply to be adequate. The Refinery cuts back its production unexpectedly, however, and is only willing to supply D with 344,000 gallons, which D delivers to P. P sues for damages for the remaining gallons.*

D should bear the risk of the event since he could have foreseen it but did not guard against it by contracting with the Refinery soon enough. Thus, the reason for his rescission on the grounds of impossibility is not justified, as it is not supported by condition 4.

Another way to reject D's rescission is to show that condition 1 fails by establishing that the cutback is not unexpected at all for P. To do so, P may show facts and evidences supporting the proposition that when signing contract, he believed that Refinery could cut back.

How should the court rule in example 1? The decision depends on many factors. If the software company is based in an earthquake-prone area such as California, then both parties can hardly be discharged by impossibility since an earthquake is always possible (condition 1 fails). An earthquake in an area without earthquake history, such as Berlin, will be unexpected. If only the main facilities are destroyed and the company would still manage the database system with other undestroyed facilities, then rescission is not allowed since the performance is not totally impossible (condition 2 fails). Further, rescission could also be rejected if the company could have distributed its resources over several locations not all of which are attacked by the earthquake (condition 4 fails). All in all, a Berlin-based small, start-up company may be excused. For the insurer, depending on its IT-capability, it is allocated the risk if it could, but did not back up its own data.

To represent and reason with legal doctrines, the context of a contract, which consists of a number of distinct knowledge bases about the beliefs and expertise of contract parties at the time of contract making, as well as about common social, legal, temporal domains, need to be established. A module representing legal doctrines should then combine these knowledge bases to construct arguments for supporting legal outcomes.

3.1.1 Contract contexts

Contexts are different for different doctrines. Under the doctrine of impossibility, contexts are defined as below.

DEFINITION 3. *A context under the doctrine of impossibility of a contract* $\Gamma = \langle \tau, T, RA \rangle$ *between contractor CO and contractee CE is defined as a 8-tuple* $\langle \varepsilon, CK_t, CK_d, KO, BO, KE, BE, Cost \rangle$ *where* ε *represents an unexpected event,* $CK_d, CK_t, KO, BO, KE, BE$ *are ABAs and*

1. CK_t *describes a body of temporal common knowledge established by the court whose purpose is to establish that event* ε *happened after the contract making.*
2. CK_d *describes a body of general common domain knowledge established by the court whose purpose is to establish:*
   (a) *whether* ε *destroys or make some means for performing* τ *unavailable.*
   (b) *whether the unavailability of such a means renders the performance of* τ *impossible*
3. KO, KE *describe respectively the general domain knowledge that contractor CO and contractee CE are expected to know at the time of making the contract,*
4. BO, BE *contain the evidences and facts about the relevant beliefs of contractor CO and contractee CE respectively at the time of making the contract,*
5. *Cost is a function specifying the cost of possible actions the contract parties could carry out to prevent* ε *from happening, or substantially mitigate its consequences.*

In cases where neither parties could do anything to prevent ε or mitigate its consequences, contexts are simply represented by $\langle \varepsilon, CK_t, CK_d, KO, KE, BO, BE\rangle$.

We assume a language $\mathcal{L}$ containing a special event E denoting the event of contract signing and a binary relation $\epsilon_0 \sqsubset \epsilon_1$ between events stating that ϵ_0 happens before ϵ_1. $\mathcal{L}$ also contains fluents and actions, and a finite set of integers and a partial order $p \succ q$ between the integers representing that p is greater than q by orders of magnitude.

EXAMPLE 7. *(Continue example 5) The context is represented by $\langle Fire, CK_t, CK_d, KO, BO, KE, BE\rangle$ where*

- *$CK_t = (\mathcal{R}_t, \mathcal{A}_t, \overline{\ })$ with $A_t = \emptyset$ and R_t consists of only $E \sqsubset Fire \leftarrow$ stating that the fire occurred after the contract making.*
- *$CK_d = (\mathcal{R}_d, \mathcal{A}_d, \overline{\ })$ with $A_d = \{HallExist\}, \overline{HallExist} = \neg HallExist$ and R_d consists of the following rule:*

  $\neg HallExist \leftarrow Fire$

  stating that the Fire destroys the hall.

  $\neg RentHall \leftarrow \neg HallExist$

  stating that it is impossible to rent the hall without its existence.

  The intuition of $A_d = \{HallExist\}$ is that the hall is commonly assumed to exist, unless there is explicit evidence to the contrary.
- *$KO = KE = CK_d$, i.e. both parties are not expected to know that the fire could happen.*
- *$BO = BE = CK_d$, i.e. neither believe that the fire could happen.* [1]

EXAMPLE 8. *(Continue example 6) The contract is represented by: $\langle Sell1500K, T, \emptyset\rangle$ for some contract specification T not given concretely. The context is represented by $\langle CutBack, CK_t, CK_d, KO, BO, KE, BE, Cost\rangle$, where*

- *$CK_t = (\mathcal{R}_t, \mathcal{A}_t, \overline{\ })$ with $A_t = \emptyset$ and $R_t = \{E \sqsubset CutBack \leftarrow\}$.*
- *$CK_d = (\mathcal{R}_d, \mathcal{A}_d, \overline{\ })$ with $A_d = \{CutBack, \neg CutBack\}$*[2]*, and R_d consists of rules:*

  $r_1 : \neg SupplyAdequate \leftarrow CutBack, \neg SubContract$

  stating that if cutback occurs and D did not contract Refinery, then he could not get an adequate supply.

  $r_2 : \neg Sell1500K \leftarrow \neg SupplyAdequate$

  stating that D can not sell 1500 K gallons of molasses if his supply is not adequate.

  $r_3 : SupplyAdequate \leftarrow \neg CutBack.$

  $r_4 : SupplyAdequate \leftarrow SubContract.$

  stating respectively that if there is no cutback or D contracts Refinery, then D has an adequate supply.

  $r_5 : \neg SubContract \leftarrow$

  stating that D had no contract with Refinery.
- *$KO = CK_d$, i.e. D is expected to know that CutBack could happen.*
- *$BO = (\mathcal{R}, \mathcal{A}, \overline{\ })$ with $A = \{\neg CutBack\}$ and $R = \{r_3\}$, i.e. CutBack is unexpected for D.*
- *KE, BE are unspecified.*
- *The cost of contracting Refinery $Cost(SubContract)$ is qualitatively much smaller than the value of the contract, thus is neglected.*

In the following, we define the notion of **impossibility** formalizing conditions 1 and 2 of definition 2 for justifying a party's rescission on the grounds of the impossibility doctrine.

DEFINITION 4. *Let $\Gamma_0 = \langle \tau, T, RA\rangle$ be a contract between contractor CO and contractee CE, and $CNT = \langle \varepsilon, CK_t, CK_d, KO, KE, BO, BE, Cost\rangle$ be a context of Γ_0*

1. *We say that the* **non-occurrence** *of ε is a* **basic impossibility-assumption** *on which the contract was made if there exists condition m, called an* **essential means** *for τ, such that the following conditions are satisfied:*
   (a) *$BO \not\vdash_{cr} \varepsilon$ and $BE \not\vdash_{cr} \varepsilon$, i.e. ε is unexpected for both parties.* [3]
   (b) *$CK_d \cup \{\varepsilon\} \vdash_{sk} \neg m$, i.e. ε* destroys *m.*
   (c) *$CK_d \cup T \cup \{\neg m\} \vdash_{sk} \neg \tau$, i.e. the unavailability of m rendered the performance of τ impossible.*
2. *We say that contract Γ is* **impossible** *wrt context CNT if*
   (a) *the non-occurrence of ε is a basic impossibility-assumption on which the contract was made, and*
   (b) *$CK_t \vdash_{sk} E \sqsubset \varepsilon$, i.e. event ε happened after the contract making*

EXAMPLE 9. *(Continue example 7) The contract is impossible wrt the context since:*

- *The fire is unexpected for both parties as no arguments supporting $Fire$ from both BO and BE.*
- *$Fire$ destroys $HallExist$ as $\neg HallExist$ is skeptical consequence of $CK_d \cup \{Fire\}$.*
- *$\neg HallExist$ results in $\neg RentHall$ as $\neg RentHall$ is a skeptical consequence of $CK_d \cup \{\neg HallExist\}$.*
- *$Fire$ happened after contract making as $CK_t \vdash_{sk} E \sqsubset Fire$.*

EXAMPLE 10. *(Continue 8) The following establishes that conditions 1.b, 1.c of definition 4 hold while condition 1.a can not verified.*

- *CutBack is unexpected for D since it does not appear in BO, i.e. $BO \not\vdash_{cr} CutBack$ (BO has a unique preferred extension containing $\neg CutBack$).*

[1] $Fire, \neg Fire$ could be assumptions in BO, BE if $Fire$ is not unexpected for the party.

[2] The production of a company depends on its market performance. Hence one should expect that it fluctuates, i.e. the company may or may not cut back its production.

[3] $BX \not\vdash_{cr} \varepsilon$ says that ε is either completely absent from BX, or supported by no acceptable arguments.

- *whether $CutBack$ is unexpected for P can not be verified since BE is unspecified.*
- *$CutBack$ destroys $SupplyAdequate$ as $\neg SupplyAdequate$ is a skeptical consequence of $CK_d \cup \{CutBack\}$.*
- *$\neg SupplyAdequate$ results in $\neg Sell1500K$ as $\neg Sell1500K$ is a skeptical consequence of $CK_d \cup \{\neg SupplyAdequate\}$.*
- *$CutBack$ happened after the contract making as $CK_t \vdash_{sk} E \sqsubset CutBack$.*

If P could establish that $BE \vdash_{cr} CutBack$, i.e. $CutBack$ is not unexpected for him, by for example showing that $BE = (\mathcal{R}_1, \mathcal{A}_1, \overline{\ })$ with $A_1 = \{CutBack, \neg CutBack\}$ and $R_1 = \{r_1, r_2, r_3\}$, then $\neg CutBack$ is not a basic impossibility assumption on which the contract was made. Hence, the contract is not impossible wrt the context.

3.1.2 Complete intended contracts

For rescission, it is not enough if the party seeking relief only shows that the contract is impossible wrt some context. He needs to show additionally that the event is not his fault and he does not bear the risk of its occurrence by any explicit as well as implied risk allocation clauses. We incorporate these conditions into the notion of complete intended contracts. Intuitively, a complete intended contract is a contract that parties would have entered into if they had bargained about the unexpected event. It supplements the actual contract with clauses, though not explicitly mentioned by the contract specification, but can be clearly seen from the contract context. For risk allocation, there are two principles widely accepted by modern courts for inferring such clauses. The first principle assigns the risk to a party if he caused the event. The second principle is based on efficiency stating that risks should be allocated to the party who could foresee the event but did not guard against it [18].

DEFINITION 5. *Let $\Gamma_0 = \langle \tau, T, RA \rangle$ be a contract between CO and CE that is impossible wrt context $CNT = \langle \varepsilon, CK_t, CK_d, KO, KE, BO, BE, Cost \rangle$. A contract $\Gamma_1 = \langle \tau, T, RB \rangle$ is called a* **complete intended contract** *of Γ_0 in the context CNT if RB is obtained by adding risk allocation clauses $\varepsilon \rightarrow CX$ to RA when CX* **caused** *ε or CX is an* **efficient risk bearer** *of ε, defined as follows.*

1. *We say CX* caused *ε if $CK_d \cup CK_t \vdash_{sk} Cause(CX, \varepsilon)$.*
2. *We say CX is an* efficient risk bearer *of ε if the following conditions hold*
   (a) *$KX \vdash_{cr} \varepsilon$, i.e. CX is expected to know that ε could happen.*
   (b) *CX could carry out a reasonable action α, such that one of the following conditions hold*
      i. *$KX \cup \{\alpha\} \vdash_{cr} \neg\varepsilon$, i.e. α can prevent ε from happening.*
      ii. *$KX \cup \{\varepsilon\} \cup \{\alpha\} \vdash_{cr} m$, i.e. α can substantially mitigate the consequences of ε.*

An action α is said to be reasonable if its cost is "negligible" wrt the contract price, i.e. $\pi \succ Cost(\alpha)$, where $T \models Price(\pi)$.

EXAMPLE 11. *(Continue example 5) One of the following reasons is enough to conclude that there are no efficient risk bearers:*

- *$KO \not\vdash_{cr} Fire$ and $KE \not\vdash_{cr} Fire$, i.e. neither parties are expected to foresee that fires could happen.*
- *Neither parties could do anything to prevent the fire or mitigate its consequence.*

EXAMPLE 12. *(Continue example 8) D is an efficient risk bearer of event $CutBack$ since:*

- *D is expected to know that $CutBack$ could occur because $KO \vdash_{cr} CutBack$.*
- *D can $SupplyAdequate$ even if $CutBack$ occurs by making $SubContract$, because $SupplyAdequate$ is a consequence of $KO \cup \{CutBack, SubContract\}$.*
- *Making $SubContract$ is a reasonable action.*

The semantics of a contract under the doctrine of impossibility could be stated as follows: *Without occurrence of unexpected events, contract parties have to perform their parts as given by the contract specification. If an unexpected event occurred, making the contract impossible, then a party could rescind the contract provided that he is not allocated the risk of the event in the complete intended contract.*

3.2 The Doctrine of Frustration of Purpose

We first recall a famous court case below [10, 16] to illustrate this doctrine.

EXAMPLE 13. *(Krell v Henry, 1903) The plaintiff rent his apartment to the defendant for a two-day period. Defendant's purpose in making this contract is to view the coronation of King Edward VII. The defendant agrees to pay a price far beyond the ordinary rental value of the apartment for this privilege. The coronation is cancelled because the King is taken ill. The defendant does not use the premises, refuses to make the payment and is sued by the plaintiff.*

The support for the defendant's rescission is based on: 1)"King's sick" is unexpected and occurred after the contract making; 2) the non-occurrence of "King's sick" is a is a basic assumption of the contract since "King's sick" leads to the cancellation, eliminating the defendant's principal goal in entering into the contract; 3) "King's sick" is not caused by the defendant; and 4) no explicit clauses of the contract assign the risk of this event to him.

This doctrine and the impossibility doctrine only differ in condition 2 of definition 2. Under this doctrine, the party seeking relief needs to show that the occurrence of the unexpected event destroyed his principal goal in entering into the contract. Hence the notion of contract contexts under this doctrine is defined as in definition 3 except that a new component representing the contract goal of the party seeking rescission is added.

DEFINITION 6. *A context under the doctrine of frustration of purpose of a contract $\Gamma = \langle \tau, T, RA \rangle$ between contractor CO and contractee CE is defined as a nine-tuple $\langle \epsilon, g, CK_t, CK_d, KO, BO, KE, BE, Cost \rangle$ where CK_d representing the general common knowledge established by the court to determine whether ϵ eliminated goal g, and other components are defined as in definition 3.*

The notion of **frustration** covering conditions 1 and 2 (in definition 2) is defined as below.

DEFINITION 7. *Let $\Gamma_0 = \langle \tau, T, RA \rangle$ be a contract between contractor CO and contractee CE, and $CNT = \langle \varepsilon, g, CK_t, CK_d, KO, BO, KE, BE, Cost \rangle$ be a context of Γ_0.*

1. *We say that the* **non-occurrence** *of ε is a* **basic frustration-assumption** *on which the contract was made if the following conditions hold:*
   (a) *$BO \nvdash_{cr} \varepsilon$ and $BE \nvdash_{cr} \varepsilon$, i.e. ε is unexpected for both parties.*
   (b) *$CK_d \cup \{\tau\} \cup \{\varepsilon\} \vdash_{sk} \neg g$, i.e. the performance of the contract after event ε happened will not fullfill goal g.*
2. *We say that contract Γ is* **frustrated** *wrt context CNT if:*
   (a) *the non-occurrence of ε is a basic frustration assumption on which the contract was made, and*
   (b) *$CK_t \vdash_{sk} E \sqsubset \varepsilon$, i.e. event ε happened after the contract making.*

The notion of complete intended contract under this doctrine is defined as in definition 5, except that in 2, condition 2(b)ii $KX \cup \{\varepsilon, \alpha\} \vdash_{cr} m$ is replaced by $KX \cup \{\varepsilon, \alpha, \tau\} \vdash_{cr} g$ stating that by doing α, the goal g of party CX is possibly not eliminated.

EXAMPLE 14. *(Continue example 13) The contract is represented by $\langle RentRoom, T, \emptyset \rangle$ for some T not needed to be specified in our analysis. No risk allocation is given. The context is represented by $\langle KingSick, ViewCoronation, CK_t, CK_d, KO, BO, KE, BE \rangle$ where*

- *$CK_t = (\mathcal{R}_t, \mathcal{A}_t, \overline{\ })$ with $\mathcal{A}_t = \emptyset$ and $\mathcal{R}_t = \{E \sqsubset KingSick \leftarrow\}$ stating that the King is sick after the contract signing.*
- *$CK_d = (\mathcal{R}_d, \mathcal{A}_d, \overline{\ })$ with $\mathcal{A}_d = \{Coronation\}$, and $\mathcal{R}_d$ consists of the following self-describing rules:*
  $\neg Coronation \leftarrow KingSick$
  $\neg ViewCoronation \leftarrow \neg Coronation$
  Assumption Coronation says that the coronation is commonly assumed to be held.
- *$KO = KE = CK_d$, i.e. both parties are not expected to know that the King could be sick.*
- *$BO = BE = CK_d$, i.e. neither parties believe that King could be sick.*

The non-occurrence KingSick is a basic frustration-assumption on which the contract was made since:

- *$BO \nvdash_{cr} KingSick$ and $BE \nvdash_{cr} KingSick$.*
- *$CK_d \cup \{RentRoom, KingSick\} \vdash_{sk} \neg ViewCoronation$.*
- *$CK_t \vdash_{sk} E \sqsubset KingSick$.*

Neither parties are allocated the risk of *KingSick* in the complete intended contract since both can not do any thing to prevent *KingSick* or mitigate its consequences.

EXAMPLE 15. *(Lloyd v Murphy, 1941) [10] The defendant leases property from the plaintiff, for purpose of running a new-car dealership and gas station. Shortly thereafter, the United States enters World War II, and the Government sharply restricts the sales of new cars. The plaintiff waives a lease restriction, thereby allowing the defendant to use the premises for purposes other than the dealership and gas station. But the defendant declines to make alternative use of the property, and vacates, claiming that he is released from the lease because of frustration.*

The court held that D is not entitled to the defense of frustration as it was foreseeable for both parties at the time of contract making that the US might enter the war, and D's business of selling car was not entirely nullified, also his degree of frustration was eased by the possibility to use the property for other businesses.

At first it seems that the defendant seeks relief since his "car dealer" goal is frustrated. But his reasoning is denied by the court for the reasons:

- *People do business to make profit.*
- *Car dealership is just one kind of business.*

Thus the principal goal of the defendant is "Profit". The context is represented by $\langle War, Profit, CK_t, CK_d, KO, BO, KE, BE \rangle$ where

1. *$CK_t = (\mathcal{R}_t, \mathcal{A}_t, \overline{\ })$ with $\mathcal{A}_t = \emptyset$ and $\mathcal{R}_t = \{E \sqsubset War \leftarrow\}$ stating that the Government enter into the war after the contract signing.*
2. *$CK_d = (\mathcal{R}_d, \mathcal{A}_d, \overline{\ })$ with $\mathcal{A}_d = \{War, NotWar\}$ where $\overline{War} = NotWar$ and $\overline{NotWar} = War$ [4], and $\mathcal{R}_d$ consists of the following rules:*
   $r_1 : Profit \leftarrow HighProfit$
   $r_2 : Profit \leftarrow LowProfit$
   $r_3 : false \leftarrow HighProfit, LowProfit$
   $r_4 : Profit \leftarrow MoreProfit$
   stating that the defendant's principal goal $Profit$ is not totally eliminated if he can still make low profit [5].
   $r_5 : HighProfit \leftarrow NotWar$
   stating that the defendant makes high profit if the war does not happen.
   $r_6 : LowProfit \leftarrow War, \neg OtherBussiness$
   stating that the defendant makes low profit in war time if he does not use the property for other purposes.
   $r_7 : MoreProfit \leftarrow War, OtherBussiness$
   stating that the defendant can make more profit in war time by using the property for other purposes.
3. *$BO = CK_d$, i.e. the plaintiff believes that the US could enter into the war. He also believes that the defendant could make more profit by using the property for other purposes (as he waives a lease restriction).*

[4]The intuition of assumptions War, $NotWar$ is that at the time of making the contract, one should know that the United States could enter into the war at any time.

[5]This is a simplification of tests that courts apply to see whether *any* part of the principal goal could be still achieved.

4. $BE = (\mathcal{R}_e, \mathcal{A}_d, \overline{\ })$ *with* R_e *equals* R_d *minus rules that* CE *does not believe in. For example,* $r_7 \notin R_e$ *represents a situation that* CE *does not believe he could make more profit by running another business.*

5. $KO = KE = CK_d$*, i.e. both parties are expected to know that war could happen any time.*

That the contract is not frustrated wrt the context can be established by either:

- *Conditions* $BE \nvdash_{cr} War$ *and* $BO \nvdash_{cr} War$ *fail, i.e.* War *is not unexpected.*
- *Condition* $CK_d \cup \{\tau\} \cup \{War\} \vdash_{sk} \neg Profit$ *fails,i.e. the defendant's principal goal* $Profit$ *is not eliminated.*

The semantics of a contract under the doctrine of frustration of purpose could be stated as follows: *without the occurrence of unexpected events, both parties have to perform their parts as given by the contract specification. If an unexpected event occurred, making the contract frustrated, then the party whose goal is eliminated could rescind the contract provided that he is not allocated the risk of the event in the complete intended contract.*

4. MODELLING LEGAL DOCTRINES BY MODULAR ARGUMENTATION

4.1 The doctrine of Impossibility

We present a modular ABA framework consisting of submodules representing a contract context together with a main module representing the doctrine of contract breach, and the doctrine of impossibility.

Let $\Gamma = \langle \tau, T, RA \rangle$ between CO and CE that is impossible wrt context:
$CNT = \langle \varepsilon, CK_t, CK_d, KO, BO, KE, BE, Cost \rangle$.
A theory $Th_{\Gamma,CNT}$ consists of the self-explaining sentences $Contract(CO, CE, \Gamma)$, $Transaction(\tau, \Gamma)$, $Price(\pi, \Gamma)$, together with a material implication $Happen(E) \rightarrow RiskAllocatedTo(CX, \Gamma)$ for each rule of the form $E \rightarrow CX$ in RA, and the following rules.

1. The doctrine that a failure to perform a considered promise constitutes a breach of contract states that each party in a contract must perform his part of the bargain, namely the contractee should pay and the contractor must perform the transaction unless there are exceptions for him to rescind it. This doctrine is represented by two rules:

$$Pay(CE, \pi) \leftarrow Contract(CO, CE, \Gamma), Transaction(\tau, \Gamma), Perform(CO, \tau), \text{Price}(\pi, \Gamma), \neg Rescind(CE, \Gamma)$$

$$Perform(CO, \tau) \leftarrow Contract(CO, CE, \Gamma), Transaction(\tau, \Gamma), \neg Rescind(CO, \Gamma)$$

where $\neg Rescind(CE, \Gamma), \neg Rescind(CO, \Gamma)$ are assumptions.

2. The doctrine of impossibility provides a class of exceptions to the doctrine of contract breach when an unexpected event occurred after the contract making.

$$Rescind(CX, \Gamma) \leftarrow call(E \sqsubset \varepsilon, CK_t, sk), ViolateBA(\Gamma), \neg RiskAllocatedTo(CX, \Gamma)$$

where $\neg RiskAllocatedTo(CX, \Gamma)$ is an assumption.

The following rule establishes that the non-occurrence of event ε is a basic assumption on which the contract was made.

$$ViolateBA(\Gamma) \leftarrow UnExpected(\varepsilon), call(\neg m, CK_d \cup \{\varepsilon\}, sk), call(\neg\tau, CK_d \cup T \cup \{\neg m\}, sk)$$

where $UnExpected(\varepsilon)$ is an assumption [6] with contrary $Expected(\varepsilon)$ defined by:

$$Expected(\varepsilon) \leftarrow call(\varepsilon, BE, cr)$$

$$Expected(\varepsilon) \leftarrow call(\varepsilon, BO, cr)$$

3. The following rules allocate risks to parties causing unexpected situations

$$RiskAllocatedTo(CX, \Gamma) \leftarrow call(Cause(CX, \varepsilon), CK_t \cup CK_d, sk)$$

where $\neg Cause(CO, \varepsilon)$, $\neg Cause(CE, \varepsilon)$ are assumptions[7].

4. The following rules allocate risks to sufficient risk bearers

$$RiskAllocatedTo(CX, \Gamma) \leftarrow call(\varepsilon, KX, cr), Preventable(CX, \varepsilon)$$

$$Preventable(CX, \varepsilon) \leftarrow ReasonableAction(CX, \alpha), call(m, KX \cup \{\varepsilon\} \cup \{\alpha\}, cr)$$

$$Preventable(CX, \varepsilon) \leftarrow ReasonableAction(CX, \alpha), call(\neg\varepsilon, KX \cup \{\alpha\}, cr)$$

$$ReasonableAction(CX, \alpha) \leftarrow Action(CX, \alpha), Price(\pi, \Gamma), \pi \succ Cost(\alpha)$$

DEFINITION 8. *Given a contract* $\Gamma_0 = \langle \tau, T, RA \rangle$ *between CO and CE that is impossible wrt context* $CNT = \langle \varepsilon, CK_t, CK_d, KO, BO, KE, BE, Cost \rangle$*. The legal theory of* Γ *wrt the impossibility doctrine in* CNT*, denoted by* $\mathcal{F}_{\Gamma,CNT}$*, is the MABA framework consisting of* $Th_{\Gamma,CNT}$ *as the main module and ABA frameworks* $CK_t, CK_d, KO, BO, KE, BE$ *as submodules.*

THEOREM 1. *Let* $\Gamma = \langle \tau, T, RA \rangle$ *be a contract between CO and CE that is impossible wrt* $CNT = \langle \varepsilon, CK_t, CK_d, KO, BO, KE, BE, Cost \rangle$*. The following assertions hold*

1. $Th_{\Gamma,CNT}$ *has a unique extension that is grounded, preferred and stable*
2. *If* $\mathcal{F}_{\Gamma,CNT} \vdash_{sk} Rescind(CX, \Gamma)$ *then CX could rescind the contract* Γ *following the semantics defined in section 3.1.2*

[6] It is not the case that $UnExpected(\varepsilon) \leftarrow \neg call(\varepsilon, BE, cr), \neg call(\varepsilon, BO, cr)$. The principle that one should not be required to prove facts peculiarly within the knowledge of the other [16] would suggest that the party seeking relief, for example CO, should not be required to disprove $BE \vdash_{cr} \varepsilon$.

[7] Common sense assumes person does not commit crime unless he is found guilty

4.2 The doctrine of Frustration of Purpose

Let $\Gamma_0 = \langle \tau, T, RA \rangle$ between CO and CE that is *frustrated* wrt context $CNT = \langle \varepsilon, g, CK_t, CK_d, KO, BO, KE, BE, Cost \rangle$. The legal theory of Γ wrt the doctrine of frustration of purpose is defined analogously to the legal theory wrt the doctrine of impossibility (definition 8), except that the rules in parts 2 and 4 of the main module $Th_{\Gamma,CNT}$ are substituted by the following rules with CX being the party with goal g.

$$Rescind(CX,\Gamma) \leftarrow call(E \sqsubset \varepsilon, CK_t, sk), ViolateBA(CX,\Gamma), \neg RiskAllocatedTo(CX,\Gamma)$$

$$ViolateBA(CX,\Gamma) \leftarrow call(\neg g, CK_d \cup \{\tau, \varepsilon\}, sk), UnExpected(\varepsilon)$$

$$Preventable(CX,\varepsilon) \leftarrow ReasonableAction(CX,\alpha), call(g, KX \cup \{\varepsilon, \alpha, \tau\}, cr).$$

Thus the following theorem is analogous to theorem 1.

THEOREM 2. *Let $\Gamma = \langle \tau, T, RA \rangle$ be a contract between CO and CE that is* ***frustrated*** *wrt $CNT = \langle \varepsilon, g, CK_t, CK_d, KO, BO, KE, BE, Cost \rangle$. The following assertions hold*

1. *$Th_{\Gamma,CNT}$ has a unique extension that is grounded, preferred and stable*
2. *If $\mathcal{F}_{\Gamma,CNT} \vdash_{sk} Rescind(CX,\Gamma)$ then CX could rescind the contract Γ following the semantics defined in section 3.2*

5. CONCLUSIONS

To ask for rescission following the doctrines of impossibility or frustration of purpose, contract party needs to show that the promised transaction is impossible or his principal goal is eliminated due to an unexpected event. To grant the rescission, the judge needs to establish that the party did not cause the event or bears the risk of it. For this, the context of a contract consisting of different knowledge bases about beliefs and expertise of contract parties as well as about common social, legal domains at the time of contract making need to be established. This is done during legal proceedings by exchanges of arguments between the parties and the judge. The acceptance of the exchanged arguments are based on permissible evidences, permissible common domain knowledge and social norms. Protocols for such exchanges could be inspired by a huge body of research on this topic in the literature[5, 3, 13, 14, 20, 19].

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