Smart Contracts in View of the Civil Code

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ABSTRACT

Explicit legal regulation is still lacking in many countries for cryptocurrencies like Bitcoin, Ripple, Ethereum, and others. This is not unusual for a new technology. On top of such cryptocurrencies, another new technology, so-called smart contracts, has been established. Smart contracts are specialized computer code with the aim to automate the exchange of (digital) assets. In decentralized applications (Ðapps), parts of the business logic and the data storage of traditional web applications are replaced with smart contracts. They are credited with considerable potential for commercial use, especially in FinTech but also beyond. Smart contracts mostly lack explicit legal regulation as well. Hitherto there is little experience in applying current law to them. Building a business on uncertain terrain is at least risky. We seek a clarification of smart contracts in the legal context, especially against the background of the Civil Code.

CCS CONCEPTS

• **Applied computing → Law**; • **Security and privacy → Social aspects of security and privacy**.

KEYWORDS

civil code, civil contract, legal aspects, legal validity, smart contract

1 INTRODUCTION

Cryptocurrency-based smart contracts can be described as computer programs that run on a peer-to-peer network with the purpose of automating the exchange of digital assets without the need for an external trusted authority. Such assets (like coins and tokens) may be linked to non-digital objects or values.

Proposed application areas are notary services, open government, games, finance, and FinTech. Smart contracts and Ðapps (decentralized applications based on smart contracts) are hyped as a civil revolution and the end of conventional contracts [13]: In particular, intermediaries that are required to enter into conventional contracts (like notaries, lawyers, fiduciaries, and judges) are challenged by the blockchain community. They are to be replaced by smart contracts that automatically check contract terms and adjudicate.

Even if the hype is met with skepticism, smart contracts seem to have some potential to be explored. Supporters of smart contracts emphasize conceivable benefits in the following cases.

Cost reduction for ensuring the enforcement of contracts. If the terms of a contract can be expressed in computer code, including parts to ensure performance, the use of smart contracts might be preferable and save costs. "Private enforcement of contracts can reduce the need [...] of legal services provided by the state" [12].

Increased clarity with regard to the parties' intent. Clarity may be increased by the reduction of language ambiguity because the formal language of a smart contract code is less ambiguous than natural/legal language. Also, the "terms of the smart contract are explicitly laid out and each side's obligations and benefits are immediately apparent" [12].

Trust shift from parties to contract code. Smart contracts provide a "wider range of assurances to parties" [12]. If one party has an unclear reputation, the other party might be hesitant to enter into a contract. Smart contracts offer the opportunity to compensate for lack of trust by encoding some terms as being automatically enforced, independently of both involved parties. Additionally, "automated execution of a contract is a preemptive form of self-help" [12], although it is not ensured that it is legally permissible.

Party autonomy. One might favor smart contracts because they "use technology to enforce party autonomy" [12].

Efficiency. Smart contracts might reduce transaction costs and enable a more efficient corporate governance.

The legal assessment of this new technology varies greatly. Lawyers are called upon to investigate how these new technologies fit into applicable law. So far, smart contracts mostly lack explicit legal regulation. And there is yet little experience in applying current law to them. Critics either consider smart contracts as not being contracts at all [6] or frankly a "dumb idea" [9]. Some innovative lawyers propose to use smart contracts for notarial areas like a "smart will" [16]. Others even predict smart contracts being "the beginning of the end of classical contract law" [13] and use the term "contract law 2.0".

Within these far apart positions, we seek a further clarification of smart contracts against the background of the Civil Code by answering the questions:

- "What conditions must smart contracts fulfill to comply with current legal requirements?"
- "To what extent is the code of smart contracts (part of) a contract?"

To answer these questions we also review literature that is only available in German. We identify legal aspects that may be particularly interesting for start-ups as well as small and medium-sized enterprises that intend to use smart contracts in areas subject to the Civil Code (like continental Europe). Our paper is not intended as legal advice. Our results may be more relevant to vendors than to private customers.

In the next section, we explain the terminology used. Section 3 establishes the legal basis for contracts on a general level. Section 4 introduces relevant technical terms. In section 5, we present several scenarios for possible interactions with smart contracts. Section 6 elaborates how various aspects of smart contracts figure into the (Austrian) Civil Code. Finally, we discuss our findings in section 7, and draw some conclusions in section 8.

2 TERMINOLOGY

Throughout the text, we use the following terms in a synonymous manner since the difference in meaning is subtle and differentiating it would go beyond the scope.

2.1 Consent and Assent

As this paper addresses a more technology-oriented audience, we decided to use the term 'consent'. Legal literature often employs the term mutual 'assent' in the context of contracts and the 'meeting of the minds'.

2.2 Customer and Consumer

Even though the terms 'customer' and 'consumer' (or even 'client') express different aspects of persons in a commercial relationship, they are often used interchangeably. We opted for the uniform usage of 'customer', except in case of 'consumer rights', which apply irrespective of the term used.

2.3 Vendor and Related Terms

A similar situation arises with the terms 'vendor', 'trader', 'enterprise', 'seller', 'dealer', 'company', or 'business' in the sense of an entity that sells something to a 'customer'. We use the term 'vendor' to denote this entity.

2.4 Enforcement, Execution, and Performance

We do not discuss the nuances of contracts being performed, fulfilled, executed, implemented, or enforced. Nevertheless, we distinguish the usage of these terms as follows.

Citations are kept as they are. We use the term 'performance' (or 'perform') to denote a fulfillment aspect of a contract that might need to be ensured because it is not automatic. We do not use the terms 'fulfill a contract' or 'contract fulfillment'.

In the context of software (like a smart contract), we use the term contract 'execution' as it refers to the technological notion of program execution. We further extend this metaphor of computerized execution to civil contracts when parts of these civil contracts are 'implemented' through software and thus automated. Next to 'execution', this is also called 'enforcement' in order to emphasize that it actually happens, because the automatism of 'execution' by the used software guarantees (i.e. 'enforces') the respective parts

of the contract. The term 'implement(ation)' is only used in the technological sense of software implementation.

When referring to the 'legal enforcement of a contract' we explicitly add the word 'legal'.

2.5 Conclusion and Formation

The terms 'conclusion' and 'formation' of a contract are used synonymously.

3 CONTRACTS AND LAW

Our elaboration of the legal basis for smart contracts is carried out against the background of the Civil Code, in particular with regard to the Austrian Civil Code (ABGB, enacted in 1811). The latter one is close to the German Civil Code (BGB, enacted in 1896) which was influential in parts of Europe and Asia. These again belong to the civil law group which covers large parts of Europe, Latin America, and Asia [8].

Even though the legal systems differ among the individual countries, there is quite a substantial common ground for the regulation of contracts. Almost all contemporary codifications (including common law) apply the principle of freedom of contract, meaning that "the parties are free to enter into a contract and to determine its content" [19].

Furthermore, sources like [14] consider the categories 'civil law', 'common law', 'Muslim law', 'customary law', and 'mixtures of those' as problematic today, since "law has become predominantly international, transnational, or even global". In this spirit, our findings are not limited to the Austrian Civil Code.

3.1 Contract

In the Austrian Civil Code, the definition of a contract dates back to emperor Leopold II who laid the foundation in 1811: *"Wer sich erkläret, daß er jemanden sein Recht übertragen, das heißt, daß er ihm etwas gestatten, etwas geben, daß er für ihn etwas thun, oder seinetwegen etwas unterlassen wolle, macht ein Versprechen; nimmt aber der Andere das Versprechen gültig an, so kommt durch den übereinstimmenden Willen beyder Theile ein Vertrag zu Stande. So lange die Unterhandlungen dauern, und das Versprechen noch nicht gemacht, oder weder zum voraus, noch nachher angenommen ist, entsteht kein Vertrag."*

This is still in force today in § 861 ABGB. It asserts as necessary parts of a contract: promise/offer by one party, acceptance by another party. An offer is a statement of one party which includes that the offering party is willing to be legally bound, if the offer is accepted. For an acceptance it is essential that the accepting party 'agrees to the same thing' by communicating its intention in a way that is obvious. Acceptance may be done explicitly, but also by conduct. The mutual consent constitutes the contract.

Formation of a Contract. Apart from specific situations where law explicitly requires contracts to be in written form, an oral contract is valid and legally binding. Evidence by action or conduct can also constitute a valid contract ('contract implied in fact').

For example, going to a restaurant and ordering food from the menu constitutes an implied contract. Providing a menu is an invitation to offer, ordering is the offer (an action to indicate that the guest wants to receive the ordered food). The acceptance by a

waitperson can be orally or they just bring the ordered food. The implied contract is constituted from the actions of both parties.

3.2 Comparison of Contract Law

The principle of 'freedom of contract' is found all over the world, even if we see different approaches to it. While in common law jurisdictions a high degree of freedom is the norm, civil law typically applies certain overarching principles (like 'good faith').

With the increase in global trade, harmonization of contract law has been and further will be sought [3]. In 1980, the United Nations Convention on Contracts for the International Sale of Goods (CISG) [21] was signed in Vienna, and has been ratified by 89 states to date. These comprise most of the states with a civil or common law system. Furthermore, UNIDROIT started publishing its Principles of International Commercial Contracts [19] in 1995. Already, there is sufficient common ground for commercial contracts across different legal systems.

Formation of contracts under Civil Code systems (like Austria, Germany, or Italy) is quite similar. There is always the necessity for offer, acceptance, and the 'meeting of the minds.' The German Civil Code requires to agree on its essential content: parties, subject, place of performance, and any other rights and obligations. Similarly, the Italian Civil Code requires for the agreement to specify the so-called *causa* (i.e. essence that must be legal) and object (which must be possible, legal, determined, or determinable).

In common law systems, there is the additional requirement of consideration for a contract to be enforceable. Consideration is anything of value promised by one party to another when making a contract. Consideration does not need to be fair (or may even be lacking in case of a deed). Also, there is the necessity for the will to enter into a legally binding relationship for a contract to be enforceable.

4 TECHNOLOGICAL CONCEPTS

4.1 Blockchain

A *blockchain* is a collection of data items ('blocks'), each of which contains the hash code of one or more other blocks (in addition to the actual data stored in the block). The hash code is a unique fingerprint of the other block; any *a posteriori* change to the latter can be detected since the fingerprint of the modified block will no longer match the stored fingerprint. Since the fingerprint is taken including the fingerprints stored in the other block, a single fingerprint ensures the integrity of *all ancestor blocks*. In popular platforms like Bitcoin or Ethereum each block contains a single fingerprint, which leads to a linear sequence (a 'chain') of blocks, where each block contains the hash code of the previous block and thus ensures that no block of the chain up to this point can be changed without notice. For efficiency reasons platforms like Iota use more than one fingerprint per block, which leads to directed acyclic graphs instead of chains, but they are also considered as instances of the blockchain technology.

Besides being *tamper-evident*, blockchains are usually assumed to be *distributed* and *trustless*. Most platforms replicate the blockchain on the nodes of a network such that the failure or misbehavior of some nodes does not affect the integrity of the data. Moreover, specific protocols ensure that the nodes reach consensus about how

to extend the blockchain without having to rely on an authority that has to be trusted. In most cases blockchains are *public* in the sense that everyone is granted read access to the data on the blockchain.

4.2 Cryptocurrency

Cryptocurrencies are digital assets similar to fiat currencies or e-money. The creation, the ownership, and the transfer of these assets is controlled by cryptographic methods, using in particular cryptographic signatures and hash functions. The main problem to be solved is double-spending: How to make sure that digital assets are not replicated and used more than once? Cryptocurrencies have been around in academia for some decades, but became popular only with Bitcoin. The novelty was to use a public blockchain as a ledger to keep track of all transactions and coins.

4.3 Smart Contracts

Smart contracts date back to Nick Szabo's ideas in the late 90's [17, 18]. But only with Bitcoin and its successors, this idea took off and found technological implementations on top of some cryptocurrencies. Though some might argue that smart contracts are just another piece of computer program, there is something about them that renders them unique. While each single aspect might not be special, the combination of the particular aspects makes it a distinct and interesting technology.

Distinctive characteristics of smart contracts are: *immutability* (as long as the community does not decide otherwise), *transparency* (when the blockchain is public), *digital service* (or digital mapping of the service to be performed), *interface to the outside world* in order to enable interaction with it, *no central control/supervision* of transactions and contract execution, and for the contracting parties *no necessity to reveal their identity* to anyone.
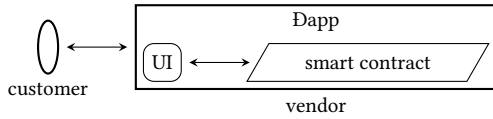
In a legal perspective, a smart contract is a contract with automated execution that "does not rely on the state for enforcement, but is a way for contracting parties to ensure performance" [12]. Effectively, the contract execution is 'outsourced' to the decentralized network of the underlying cryptocurrency which by definition is an independent/neutral third party. At the same time, the execution of a smart contract cannot be stopped once it has been started. This feature is usually considered a benefit. The possibility of a smart contract being stopped during execution must be provided (and coded) in advance, but this is usually considered an 'undesirable backdoor'.

5 SCENARIOS FOR SMART CONTRACTS

In this section, we discuss several scenarios of how vendors and customers may interact through smart contracts.

5.1 Đapp

Vendors use decentralized applications. Many vendors rely on internet platforms for conducting their business. The customers interact with a frontend like a web-based user interface (UI), while the main services run in the background. In this scenario we assume that the services use smart contracts to implement (part of) the business logic on a blockchain. All interactions with the smart contracts are handled by the Đapp. A customer may not even be aware that the vendor employs a smart contract.
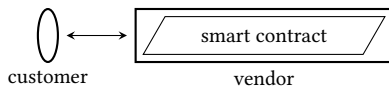
From a legal perspective, this scenario bears no difference to the usual practice of online trading. The vendor takes responsibility for the Đapp including the liability for the performance of the employed smart contract. In [12] the term "weak smart contract" is introduced for such a scenario.

In a variant of this scenario, the vendor uses a third party for developing and/or running the Đapp. The vendor's responsibility to the customer remains unchanged. The vendor and the Đapp provider may regulate their respective responsibilities by contract. In case of a lawsuit, the vendor may claim recourse against the party who provided the Đapp.

In a further variant of this scenario, the customer pays with a cryptocurrency via a private wallet (case 1) or a payment gateway (case 2). In the latter case, the situation for the customer is still the same: the customer does not directly interact with the smart contract. In case of a private wallet, the situation may be different, as discussed in the next scenario.

5.2 Vendor Smart Contract

Customers interact directly with the smart contracts provided by a vendor.
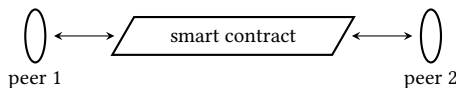

This scenario is covered by section 6. In [12] the term "strong smart contract" is employed for such a scenario.

An interesting question in this context is the extent to which the contracting parties need to identify themselves. According to the distance selling regulations (FAGG) the vendor must identify the company including address and contact possibilities, while the customer may remain anonymous. An example is a vending machine where the vendor is 'advertised' and the customer is unknown.

5.3 Peer Smart Contract

Peers interact via a smart contract, one selling to the other. In this case, the interacting parties are either all private persons (C2C), or all enterprises (B2B).

There is no vendor-customer relationship. Therefore, consumer protection laws do not apply. However, the other parts of section 6 are still relevant. This provides more freedom in the formulation of valid contracts. In particular, the contract need not be in natural language.
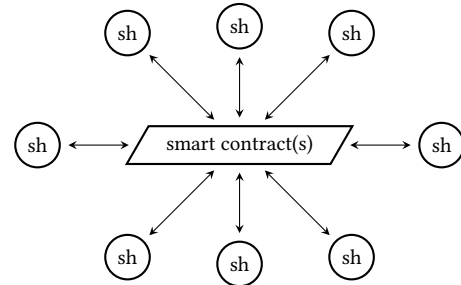
If a smart contract serves as (part of) a civil contract, the significance of its code for the overarching civil contract can vary greatly.

The Smart Contracts Alliance [15] distinguishes the following situations regarding the significance of the code:

- contract entirely in code without natural language version
- contract in code with separate natural language version
- natural language contract with contract execution in code
- natural language contract with encoded payment mechanism

5.4 DAO

A set of smart contracts forms a decentralized autonomous organization (DAO). This organization is run in an automated manner, its rules are encoded as smart contracts, which handle the interaction between stakeholders (sh). All transactions are recorded on a blockchain to ensure transparency. As an essential feature, a DAO provides means for stakeholders (like investors and enterprises) to conclude contracts or agreements in a predefined way.

A simple example is the Bitcoin platform used to transfer units of its built-in cryptocurrency. A rather infamous example is the DAO calling itself 'The DAO', which had the purpose of channeling venture capital from investors to commercial and non-profit enterprises; it ran out of business when a bug in the smart contract was exploited, causing considerable losses and a fork of the Ethereum blockchain.

The legal status of DAOs is hard to determine, on the one hand because DAOs are still in their infancy, on the other hand because of their versatility.

6 LEGAL CLARIFICATIONS

This section covers legal aspects of smart contracts in Austrian Civil Law. We set aside considerations concerning the practicability of litigation, like identifying the contracting parties or the competent court. We assume that companies who want to do genuine business over an extended period, intend to comply with legal requirements when using smart contracts.

Section 6.1 discusses the circumstances under which a smart contract may constitute a civil contract. Based on that, section 6.2 deals with the role of the code of a smart contract, while section 6.3 details the requirements for smart contracts as constituents of a civil contract. Potential points of conflicts of using smart contracts are mentioned in section 6.4, while section 6.5 discusses the burden of proof. The possibilities for including an arbitral tribunal into a smart contract are presented in section 6.6, while section 6.7 details the liability in case of programming errors.

6.1 Smart Contract is (not) Civil Contract

One of the arguments why smart contracts are not civil contracts is based on the observation that people use civil contracts to "enable cooperation, and help spread habits of warranted trusting around an economy" [9]. They serve a social function, and sometimes are even intended to be violated. They are drafted in the awareness of a possible litigation. "There is a balance between the words that each party signs to (the textual interpretation), and what each party wants out of the agreement (the intentional interpretation)" [9]. This interpretation cannot be coded. However, regarding a smart contract 'simply not as a civil contract at all' falls considerably short in its analysis. Rather, it has some legal consequences that we will explore.

From a legal perspective, a smart contract is considered to represent an 'other contract' [11]. This means it is not a 'classical' verbal contract. Furthermore, it is not necessarily understandable to everyone. But it still may be a valid contract. Generally, it constitutes a legally binding contract if it fulfills the pattern: offer, acceptance, and 'meeting of the minds' [8].

The 'meeting of the minds' takes place

- explicitly, when there is a written contract, a suitable electronic message, or the consent is given orally.
- implicitly, when there is an action (e.g. order in a restaurant) that implies the intention of a deal.
- tacitly, e.g. when there is a change of the general term and conditions (GTC) that is accepted without any action after a given period.

Regardless of form, the essential part of a contract is the mutual consent, which needs to be visibly declared. Hence, smart contracts can be used to declare mutual consent. The conclusion and use of a smart contract may be construed as an implied contract. A transaction sent to a smart contract (via a blockchain) can be considered as an implicit offer or acceptance of a legally binding civil contract [7]. Smart contracts thus can be regarded as civil contracts. Even [9] concedes that "routine or short-term commitments might be better served by algorithms than contracts."

Still, some aspects have to be considered when using smart contracts as (parts of) civil contracts, as will be discussed below.

6.2 Code is Law

The content of a classical civil contract is determined verbally (written or orally). This is called the 'classical track' [5]. When using smart contracts, there is a second contract track in the form of software or computer code. This expresses the intention of the contracting parties as well. In case of a divergence between the two tracks, the priority among the tracks has to be specified [5]. A divergence may be caused, for example, by the computer executing an operation that is not in line with or supported by the classical track.

The expression 'code is law' seems to suggest that the code of a smart contract has priority by being the only relevant aspect. The 'classical track' would then serve as a generally understandable textual representation of the authoritative software [5]. However, according to the applicable law, the declared intent and oral consent is regarded superior. Code becomes legally irrelevant when it

opposes the contracting parties' intent [2]. The evidence of contractual clauses is solely or at least primarily based on the classical track. The digital track rather has importance in determining whether contract-relevant incidents were fulfilled or plausible [5].

The situation is different when both parties are knowledgeable about the code of smart contracts. In this case, a smart contact can be regarded as superior [7]. The same applies if it is the explicit intent of both knowledgeable parties to blindly trust the software [7]. Still, applicable law has to be observed.

6.3 Civil Code Requirements

Even if smart contracts lead to the automatic conclusion of a civil contract, they are subject to the rules of private law [2]. The following requirements are essential, and companies actually incorporate them into their business models.

6.3.1 Incomprehensible Code, Misconceptions. If the code cannot be understood by one of the contracting parties and if the latter has misconceptions about content of the contract, the contract can be dissolved a posteriori (§§869ff ABGB) [7]. The essential contents of the contract and processes should be put into writing and enclosed with the smart contract in order to prevent contract errors.

6.3.2 Surprising Clauses. If a contract contains surprising, unusual and adverse general terms and conditions (GTC) that are not to be expected according to the external appearance, these clauses are not part of the contract (see §864a ABGB). This passage is applicable in the same way for smart contracts. Surprising and unilaterally disadvantageous software designs are not part of the contractual agreement in these cases, they are void [5].

An example of a surprising clause is a purchase contract for a coffee machine that includes a subscription to a coffee delivery. Also, jurisdiction agreements with customers are considered surprising.

6.3.3 Immoral Clauses. Contracts *contra bonos mores* (against ethical standards) are generally not concluded (§879 ABGB). Because the existence of these ethical standards is of such importance for the legal community, this general clause induces the nullity of infringing contracts. It does not matter whether the contract was concluded in writing, implied or through a smart contract. Profiteering or oppressive contracts are instances of such unconscionable contracts. Profiteering in the legal sense is when someone takes advantage of the carelessness, inexperience, or predicament of a particular person in order to obtain a benefit that is strikingly disproportionate to their own performance. Another example of an unconscionable contract is a long-term contractual commitment without termination option.

6.3.4 Distance Selling. If the sending of tangible goods is specified in smart contracts, then the law on distance selling applies. It regulates rights and obligations for vendors and their customers, like the following:

- Obligation to inform (see §4 FAGG): A vendor must inform about the essential characteristics of his goods and their scope. Furthermore, they must specify the company address and contact possibilities. The final price (including taxes and delivery costs) must be communicated to the customer

prior to the conclusion of the contract, as well as further conditions for payment, delivery, cancellation, and service.

- Right to withdraw (see §11 FAGG): The customer may withdraw from a distance contract or an off-premises contract within 14 days without giving a reason.

Smart contracts could be adapted accordingly to enable compliance with all the requirements mentioned above. Purchase withdrawal is not only required by law, but customers actually use it extensively. In fact the rate of returned goods is considerable, especially for clothing [10]. Also, customers often expect a free return, and prefer a free delivery.

6.3.5 Guarantee and Warranty. If a defect occurs within the warranty period of two years (one year for movable goods), the customer is entitled to repair, replacement, price reduction, or cancellation of the contract. In addition, a vendor is entitled to stipulate contractual guarantees in the contract.

Once a transaction has been processed successfully (e.g. a smart contract with a customer who pays a certain amount and a delivery service that sends a delivery confirmation), then it is not possible to reverse this transaction. The underlying blockchain technology makes transactions unchangeable, unstoppable, and irrevocable.

However, the argument that a transaction in the blockchain cannot be reversed, simply refers to the IT-technical handling. It does not change the fact that the parties must reach consensus or that claims such as dissolution, resignation or similar must be and must remain exercisable [2].

Moreover, the contracting parties may disclose their identity, even if a blockchain is used. This is obvious where a product is purchased in an online store and then shipped to the customer's address. This way, smart contracts are used at the contract level, while warranty claims are made the classic way [7].

Furthermore, it may be challenging to assert warranty claims in international business, but this is not a peculiarity of smart contracts.

6.3.6 Additional Requirements. Regardless of the form of contracts, they must comply with applicable law, regulations and standards. These requirements cannot be changed by the fact that IT tools such as smart contracts are used for the technical execution of the contract [2]. Smart contracts are therefore no special tool that is above the law and protected from civil law regulations. In order to enjoy legal validity, they must be designed in a legally compliant way.

6.4 Reasoning and Evidence

It is particularly important to know the potential points of conflict that may permit a party to litigate. When drafting a contract, these should be avoided or handled in advance.

6.4.1 Data Sources. The interface between smart contracts and the 'outside world' is established via data sources (so-called data feeds or oracles). These might stem from legal entities under public law with high authority (e.g. national weather services for storm warnings). On the other hand, if the data is collected by proprietary sensors and stored in internal databases, the measurements may be successfully contested in court (e.g. by calling witnesses) [5].

Therefore, neutral publicly available data sources are preferable to private ones.

6.5 Burden of Proof

As regards the burden of proof in civil law, the following principle applies: Normally, each party must prove the legal prerequisites for the norms favorable to them. Anyone who asserts a claim is under pressure to prove the preconditions of the claim [5].

For classic contracts, the burden of claim and proof lies with the customer who must find evidence that the vendor has made a mistake. For example, only a fraction of all potential claims according to consumer protection law are enforced, because those affected do not take the risk of a loss, even when it is highly unlikely. With scant evidence, the customer will either refrain from asserting the claim or otherwise lose the legal case. Therefore, vendors may be tempted to take advantage of this situation to save costs. They have an incentive to make minor mistakes and to cause damage to the customer as part of their business practice as they can assume to have to compensate only partially for these detriments due to difficulties in delivering satisfactory evidence [5].

Smart contracts may shift the burden of claim and proof between two or more contracting parties. Wherever a possible disruption of performance can be identified already when concluding the contract, the parties may agree on corresponding actions to be triggered automatically by the software. As a result, the burden of claim shifts to the party that the software has determined to violate the contract. This party then may assert a claim on account of unjust enrichment and to prove that their counterpart has received an automatic disbursement without an underlying legal reason. If the proof fails due to insufficient evidence, the arbitration arranged by the software is sustained, to the detriment of the disadvantaged party [5]. Summarizing, the competition among vendors and the ability of smart contracts to automatize refunds may lead to an improved enforcement of customer rights.

6.6 Arbitral Tribunal

Smart contracts run independently of a central entity, which becomes a disadvantage when a smart contract runs contrary to the contractual intent of a contracting party. For some cases, it might be useful to allow the algorithm access to an arbitral tribunal. The arbitrating body might be any person or institution to which the parties agree in advance as a neutral third party. The intervention of the arbitrating body could be that it decides about the accuracy of third-party information or on programming errors that contradict the civil contract. The arbitrating body could then be given the possibility to control the execution of the contract and thus the flow of assets, and if necessary even to revert it [7]. A future possibility is a legally mandatory implementation of judiciary interfaces in smart contracts to allow courts to review smart contracts and enforce jurisdiction [7].

Regarding international arbitration, the UN Commission on International Trade Law (UNCITRAL) prepared the 'New York Convention' [20] in 1958, which is ratified in over 150 countries. Also,

many countries adopted the UNCITRAL Model Law on International Commercial Arbitration from 1985 to recognize foreign arbitral awards. As for a pioneering example of on-chain arbitration, the 'EOS Core Arbitration Forum' [4] is a noteworthy approach.

6.7 Liability for Programming Errors

If the smart contract has any kind of programming error, there is the risk of inadvertent asset transactions since the execution is automated. It is important to understand that a programming error in a smart contract is always executed. In contrast, when a contract is written in natural language, interpretation may lead to the conclusion that a clause has to be understood differently than expressly written [7]. In order to reduce the risks of programming errors, it would be necessary to include into the smart contract code the possibility of reversing transactions, for example with the aid of a programmed arbitration board [7].

Furthermore, the question arises, who is liable if the blockchain has a programming error and thus smart contracts can be abused. It can be assumed that participants of a blockchain have to enter into legal relationships (against payment or free of charge) with the developers or providers. The providers are liable under §§917ff ABGB for performance problems and have to pay damages [2].

7 DISCUSSION

Smart contracts, blockchains, and cryptocurrencies are new technologies that have become popular in recent years with the upsurge of cryptocurrencies like Bitcoin (BTC), Ethereum (ETH) and others. Usually, legislators are one step behind in the regulation of new technologies. Moreover, it takes time from passing a law, over coming into effect, up to the time when there is relevant judicature (or even *stare decisis*, where the decisions of a court are foreseeable).

As legal regulations continue to evolve, and with increasing globalization, there is a tendency towards harmonizing international trade law, as can be observed be the work of UNCITRAL for example. This is favorable for smart contracts, too. Their usage in common and civil law is feasible, there is a suitable current legal basis for it.

Smart contracts may actually constitute parts of a (possibly implicit) civil contract used in a commercial setting. A civil contract is generally a multi-lateral binding declaration of intent and can be concluded in any form. Smart contracts are one way to capture the intent of two or more parties.

As a peculiarity of smart contracts, there are aspects that should be explicitly considered: Programming errors are not the intention of the contract. Also, a possible cancellation of a smart contract has to be provided in the code. In general, transactions on a blockchain cannot be reversed. Consequently, there have to be mechanisms in a smart contract to compensate for the impossibility of a transaction reversion.

7.1 Legal Compliance

For smart contracts to be legally valid contracts, they must comply with all legal requirements of the applicable law. For Civil Code systems this means that a smart contract must at least contain:

- understandable essential content
- no surprising or unusual clauses

- no immoral or price gouging clauses
- no exploitation of intellectual weakness, lightheadedness or predicaments
- information on essential properties of goods and on contact modalities
- in distance selling: a 14-day right of withdrawal
- warranty and guarantee to the usual extent

7.2 Code of Smart Contracts

The code of smart contracts may represent (part of) a written or oral civil contract. In the event that the code contradicts the civil contract and does not represent the intent of a contracting party, the civil contract takes precedence.

If two skilled programmers conclude a smart contract, and if the parties explicitly agree to trust blindly the code of this smart contract, the code takes precedence. If a contracting party is not a skilled programmer and thus does not sufficiently understand the code of the smart contract, its essential points should be put into writing.

7.3 Scenarios

We presented several scenarios of interaction with smart contracts in section 5. While neither the case of a Đapp nor the vendor or peer smart contract pose any interaction-specific challenges, the situation is different with a DAO (decentralized autonomous organization).

Since in a DAO stakeholders cooperate via smart contracts without a central (human) management, DAOs do not admit a uniform legal analysis at the moment. On the one hand, this is due to the fact that DAO is a general concept rather than a business model; depending on the business purpose different laws apply, resulting in differing legal assessments. On the other hand, there are hardly any examples of successful DAOs so far. It is likely that DAOs will raise legal problems, in particular due to the missing central entity that represents the organization in a legal sense. However, if DAOs become a relevant factor, it is to be expected that corresponding jurisdiction or regulations will evolve, e.g. to clarify tax liability. This uncertainty poses a substantial risk to innovative DAOs, as *a posteriori* jurisdiction may render a business model unprofitable.

Consider for example the Brooklyn Microgrid [1]. It is conceived as a network of small producers and consumers of renewable energy that is generated and distributed in the local neighborhood. It uses an online marketplace based on blockchain technology for handling energy transactions. The participants in this marketplace may be consumers and producers at the same time. In an Austrian context, such a project raises several legal questions, since specific laws for the electric power industry (ElWOG) apply [2]:

- Are the participants in this network to be considered as energy traders who sell to small costumers? If yes, they have to report their activities to the supervisory state-authority called E-control. Or is the network small enough such that the participants can be considered as producing energy for private, non-commercial use?
- Do the rules of ElWoG apply regarding contract cancelling?
- Which taxes have to be paid? By the participants, or rather by the whole virtual organization?

- Who is responsible for establishing a so-called balance group and who pays for the external energy if the solar energy produced in the network is not sufficient?

8 CONCLUSIONS

We attempted to clarify the legal embedding of smart contracts in the view of the Civil Code. We discussed possibilities for smart contracts to actually constitute (part of) a civil contract. We established a solid ground for smart contracts to comply with applicable law. Nevertheless, some interesting issues remain open.

8.1 Open Challenges

On the side of lawyers, it remains exciting to see how they will deal with smart contracts in the future. A constructive approach could include the establishment of appropriate procedures for a partial contract automation through software like smart contracts. "Smart contracts may require new types of due diligence by lawyers to provide comfort that the code is enforceable and embodies the intended provision" [15].

Developing smart contracts that are trustworthy and reliable, is a highly non-trivial task. It will remain demanding for developers to ensure the security and correctness of smart contracts. Furthermore, it might be even more "challenging for coders to build good faith, fair dealing and other subjective concepts into smart contracts" [15].

With regard to litigation concerning smart contracts, there are still challenges to be resolved. One concerns the issue of evidence with respect to blockchains. "The law would benefit from courts and arbitration forums adopting uniform standards for using ledger-related evidence in the course of disputes" [15]. Similarly, the contestation of smart contracts as parts of civil contracts may be problematic due to lacking standards for corresponding evidence.

Regarding regulators, the most interesting question is how (and when) they might change the current law with respect to blockchain and cryptocurrencies in general, or smart contracts in particular. For example, smart contracts might (be forced to) provide a judiciary interface through which courts enforce their judgments. A shift in the legal basis might render smart contracts infeasible. Since the general principle of 'freedom of contract' is deeply embedded in so many codifications, any limitation thereof must be commensurate.

8.2 Outlook

There is an actual potential for legally valid and beneficial uses of smart contracts.

Even without explicit regulation, there is a legal basis for smart contracts. Bypassing law with smart contracts will not work in constitutional states, at least not in the long run. The state and its rule of law usually win.

Some parts of the enforcement of a contract may be encoded directly into the smart contract if the parties so wish. This could save enforcement costs and possible litigation. However, "smart contracts that seek to encode the entirety of a natural language contract (a 'code is the contract' model) are very challenging from a legal perspective" [15].

Regarding consumer rights, smart contracts may offer an alternative for claims: they do not have to be asserted against the vendor, but are handled by the smart contract in a predefined manner. Furthermore, as discussed in section 6.5, smart contracts may bring a shift in the burden of proof in court.

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