

The Impact of Smart Contracts on Traditional Concepts of Contract Law

by Maren K. Woebbecking*

Abstract: The concept of smart contracts entered the legal discourse only a few years ago, yet the subject has already given rise to remarkably different approaches. While some assume that smart contracts can be fully integrated into existing contract law, others predict that they will mark the beginning of the end of contract law. The aim of this article is to contribute to the assessment of smart contracts by examining how they can be situated within the traditional Western concept of contract law and how they differ from traditional contracts in the individual phases of a contract's life cycle. In particular, these findings show that the automated execution of the promises contained in a smart contract, specifically their technical characteristics, lead to an

increased significance of the contract drafting phase compared to the execution phase. Among other aspects, smart contracts are considerably more difficult to modify than traditional contracts and they are limited by the fact that the encoding of contracts requires an increased formalization of the contractual terms. On the other hand, the technical architecture of smart contracts offers possibilities ranging from automatic self-help to the enforcement of legally unenforceable agreements. It is precisely this autonomy of smart contracts from existing contract law that finally raises the question of whether an adaptation of contract law will become necessary and what difficulties such an adaptation would face.

Keywords: Smart Contracts; self-execution of contracts; formalization of contracts; modifying smart contracts; regulation of cyberspace; code is law; contractual ambiguity

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A. Introduction

1 Contracts play a central role for the ordering of liberal market relations and therefore have an irreplaceable importance for Western and other societies.¹ Accordingly, contract law is probably the

most important private law institution of individual self-determination and autonomy and it evolved continuously to respond to the emergence of new contract models.² Today, like many other legal institutions, it faces the challenges of digitization. Next to Big Data analytics and Artificial Intelligence (AI), especially smart contracts pave the way for a new era of contracting and pose a potential challenge to the prevailing concepts of contract law.

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1 E Allan Farnsworth, 'Comparative Contract Law' in Mathias Reimann and Reinhard Zimmermann (eds), *The Oxford Handbook of Comparative Law* (OUP 2016) 901; Arthur von Mehren, 'A General View on Contract', *International Encyclopedia of Comparative Law: Contract in General*, vol VII/1 (Mohr Siebeck 2008) 19ff.; Caroline Bradley, 'Private

International Law-Making for the Financial Markets' (2005) 29 *Fordham Int'l L.J.* 127, 158f.

2 Regarding the history of the contractual concept in Europe and Germany, see Andreas Thier in HKK, § 311 Abs. 1 Rn. 4ff; on the respective development of society and contract law in the US, see Walter F Pratt, Jr., 'American contract law at the turn of the century' (1988) 39 *S. C. L. Rev.* 415.

- 2 This article deals precisely with the impact of smart contracts on German and European contract law with comparative references to American contract law. On a larger scale, it is intended to contribute to answering the question, whether predominantly nationally influenced, analogous law is ready for the challenges posed by ubiquitous and borderless digitization.
- 3 The remainder of the paper is structured as follows. Part B briefly describes how contracts and contract law have developed so far and why smart contracts, at least partially, represent the next step in this development. In part C, the individual phases of the life cycle of a contract are examined in order to determine how smart contracts can be accommodated within German and European contract law in particular. Finally, part D focuses on evaluating what impact smart contracts could have on the future of contract law.

B. The Development of Contract Law and the Advent of Smart Contracts

- 4 It has been thousands of years since the first contracts were concluded.³ However, many of the most significant changes in the development of contracting occurred in the course of the last century.⁴ Traditionally, contracts were mostly a result of a fair negotiation process between parties with equal bargaining power, i.e. parties negotiating at arm's length.⁵ This changed with the standardization of contract terms which allowed mass-market contracting, both nationally and internationally. This more simplified way of contracting minimized the human involvement in the negotiation process, thereby lowering transaction costs and brought with it a change to the bargaining process.⁶ Especially the rise of the information society made it necessary to adapt the contract law to these new conditions.
- 5 Accordingly, in the last decades one could observe the evolution of a plethora of regulations addressing standardized contracts. Be it regulations on the

use of general terms and conditions or consumer protection regulations.⁷ The overall aim was to restore the equal bargaining power that had been disrupted by standardization.⁸ Despite the resulting large number of regulations, there is not much left regarding the principle of contractual freedom, at least in the case of consumer contracts. Looking in particular at contracts in e-commerce, it becomes clear that consumers are commonly faced with a "take-it-or-leave-it" proposition.⁹

- 6 Yet, only recently a new kid on the block has emerged, that could bring about a change to this current approach: smart contracts. Even though not necessarily limited to blockchains, smart contracts are usually associated with the innovation of this technology.¹⁰ Blockchains, which are the most popular form of distributed ledger technology, have attracted a great deal of attention in recent years and, although crypto currencies have experienced setbacks due to price volatility last year,¹¹ the hype does not seem to cease after all.¹²
- 7 In a technical sense, smart contracts can be defined as computer protocols that are self-executing.¹³ Relying on the abilities of blockchains, they operate autonomously, transparently, and they are basically tamper-resistant and immutable.¹⁴ This provides the contracting parties with several significant advantages over traditional contracts: they can rely on contractual promises that are memorialized in the smart contract, i.e. the transaction protocol, to be executed without recourse to the courts and they do not need to trust in their contracting party anymore.¹⁵ This allows them to take calculated

3 Cf., e.g. James Gordley, 'Contract in Pre-Commercial Societies and in Western History', *International Encyclopedia of Comparative Law: Contracts in General*, vol VII/1 (Mohr Siebeck 2008) 12f.

4 Richard R Orsinger, 'The Rise of Modern American Contract Law' (2015) 1 <www.orsinger.com/PDFFiles/the-Rise-of-American-Contract-Law.pdf> accessed 22 January 2019.

5 Cf. Farnsworth (n 1) 911; Alexander Savelyev, 'Contract Law 2.0: 'Smart' contracts as the beginning of the end of classic contract law' (2017) 26 (2) *Information & Communications Technology Law* 116, 120.

6 Pratt (n 2) 416f; Karl-Heinz Neumayer, 'Contracting Subject to Standard Terms and Conditions', *International Encyclopedia of Comparative Law: Contracts in General*, vol VII/2 (Mohr Siebeck 2008) 8.

7 Neumayer (n 6) 8; Farnsworth (n 1) 913ff.

8 Cf. Farnsworth (n 1) 912f; cf. Von Mehren (n 1) 64ff.

9 Farnsworth (n 1) 911; cf. Neumayer (n 6) 8.

10 Accordingly, the following explanations concentrate substantially on blockchain-based smart contracts.

11 Cf. Jamie Redman, 'Year in Review: 2018's Top Cryptocurrency Stories' (25 December 2018) <<https://news.bitcoin.com/year-in-review-2018s-top-cryptocurrency-stories/>> accessed 22 January 2019.

12 See, eg, CryptoNynjas, 'IOHK launches two new smart contract tools for Cardano blockchain' (11 December 2018) <www.cryptoninjas.net/2018/12/11/iohk-launches-two-new-smart-contract-tools-for-cardano-blockchain/> accessed 22 January 2019.

13 Vitalik Buterin, 'Ethereum White Paper' (2014) 1 <http://blockchainlab.com/pdf/Ethereum_white_paper-a_next_generation_smart_contract_and_decentralized_application_platform-vitalik-buterin.pdf> accessed 22 January 2019; for a more detailed explanation of blockchain technology, see, e.g., Primavera De Filippi and Aaron Wright, *Blockchain and the Law* (HUP 2018) 33ff.

14 Joachim Schrey and Thomas Thalhoffer, 'Rechtliche Aspekte der Blockchain' (2017) *NJW* 1431, 1432; Martin Heckelmann, 'Zulässigkeit und Handhabung von Smart Contracts' (2018) *NJW* 504, 505; De Filippi and Wright (n 13) 72.

15 Cf. Timothy C May, 'The Crypto Anarchist Manifesto' (22

risks, even in those areas in which the parties are not directly opposed to each other but which are characterized by a certain anonymity and risk-laden enforcement, as is usually the case in e-commerce and international contracts. Consumers in particular could benefit from these advantages since they usually do not enforce their rights.¹⁶ Moreover, smart contracts open up the possibility of reducing transaction costs.¹⁷ In general, they mean a further minimization of human intervention and further formalization of contracts.¹⁸

- 8 However, formalization involves a certain limitation as to what smart contracts can contain.¹⁹ After all, encoding contracts also entails certain security vulnerabilities, such as the risk that the code is incorrect. For these and other reasons, smart contracts and blockchains are still a very controversial topic.
- 9 The fields of application of smart contracts are numerous. They can be used, at least in theory, wherever economic assets show interfaces to the internet and certain events can be verified digitally.²⁰ Thanks to the increasing interconnectedness of things (or the so-called “Internet of Things”),²¹ this affects more and more areas. In addition to the financial and insurance sectors, which have been particularly present up to now,²² smart contracts are suitable for use in areas such as Sharing Economy, Energy, Supply Chain or Identity Control.²³ Naturally, contracts that deal with access to digital content,

and are therefore easily translatable into software, are predestined for smart contracts. A noteworthy example is the distribution of music via blockchain-based smart contracts.²⁴

- 10 In a nutshell, with smart contracts the drafting stage of the contract *ex ante*, leading to an automatic execution, will become more important than subsequent law enforcement *ex post*. Whether the development of this new contract concept requires a modification of the applicable contract law is a different question. The answer to that depends mainly on how this new way of contracting is accommodated by existing legal provisions.

C. The Life Cycle of a (Smart) Contract

- 11 The characteristics of a smart contract affect different phases of the contractual life cycle. In the following, the phases that require a special legal evaluation with regard to smart contracts are to be identified decisively. The focus will be on German and European law.

I. The Legal Nature of Smart Contracts

- 12 Although the term “smart contract” originates from the nineties²⁵ and a real hype about smart contracts can be observed for some years now, no unanimous definition of the term exists to this day.²⁶ Especially defining their legal character has indeed proven to be one of the most controversial issues in connection with smart contracts. While some make a distinction between smart contracts, smart contract code and smart legal contracts,²⁷ others even stress that smart contracts are independent of the law.²⁸ As computer scientists and economists have shown on several occasions, it is quite possible to actually talk about smart contracts without even considering their

November 1992) <www.activism.net/cypherpunk/cryptoanarchy.html> accessed 22 January 2019.

- 16 Martin Fries, ‘Smart Contracts: Brauchen schlaue Verträge noch Anwälte?’ (2018) *Anwaltsblatt* 86, 88.
- 17 See, e.g., Goldman Sachs, ‘Blockchain: Putting Theory into Practice’ (24 May 2016) *passim* <<https://de.scribd.com/doc/313839001/Profiles-in-Innovation-May-24-2016-1>> accessed 22 January 2019.
- 18 Cf Savelyev (n 5) 120f.
- 19 Cardozo Blockchain Project, ‘Research Report #2: „Smart Contracts” & Legal Enforceability’ (2018) 8f <https://cardozo.yu.edu/sites/default/files/Smart%20Contracts%20Report%20%232_0.pdf> accessed 22 January 2019.
- 20 Cf., e.g., Florian Glatz in Stephan Breidenbach and Florian Glatz, *Rechtshandbuch Legal Tech* (C.H. Beck 2018) 111ff.
- 21 See, e.g., Christiane Wendehorst, ‘Consumer Contracts and the Internet of Things’ in Reiner Schulze and Dirk Staudenmayer (eds), *Digital Revolution: Challenges for Contract Law in Practice* (Nomos 2016) 189ff.
- 22 Several examples in Wolfgang Prinz and Alex T. Schulte (eds), ‘Blockchain und Smart Contracts: Technologien, Forschungsfragen und Anwendungen’ (2017) *Fraunhofer-Gesellschaft*, 27ff <www.sit.fraunhofer.de/fileadmin/dokumente/studien_und_technical_reports/Fraunhofer-Positionspapier_Blockchain-und-Smart-Contracts.pdf?_id=1516641660> accessed 22 January 2019.
- 23 Cf. Florian Glatz, ‘Blockchain – Bitcoin – Smart Contracts – Anwendungsmöglichkeiten’ in Walter Blocher, Dirk Heckmann and Herbert Zech (eds), *DGRI Jahrbuch 2016* (Otto Schmidt 2016) 83 with further references.

24 See, e.g., Ujo Music <<https://ujomusic.com>> accessed 17 November 2019.

25 Nick Szabo, ‘Smart Contracts: Building Blocks for Digital Markets’ (1996), <www.fon.hum.uva.nl/rob/Courses/InformationInSpeech/CDROM/Literature/LOTwinterschool2006/szabo.best.vwh.net/smart_contracts_2.html> accessed 22 January 2019.

26 Cf., e.g., the different definitions used in recent American legislation presented by Cardozo Blockchain Project (n 19) 23f.

27 Stéphane Blemus, ‘Law and Blockchain: A Legal Perspective on Current Regulatory Trends Worldwide’ (2017) *Corporate Finance and Capital Markets Law Review*, 13; cf ISDA and Linklaters, ‘Whitepaper on Smart Contracts and Distributed Ledger – A Legal Perspective’ (2017) 4ff.

28 Cf., e.g., Glatz (n 20) 115.

legal nature in the slightest. This may already be due to the fact that smart contracts, although they include the wording “contract”, are not necessarily seen as a legal issue, at least with regard to the blockchain.²⁹ One may agree with that as far as smart contracts in a technical sense are concerned, they actually show no legal relevance. The description of smart contracts as “account holding objects” on the website of the important Ethereum Blockchain illustrates that smart contracts do indeed not always have to be contracts in a legal sense.³⁰ In this regard, Ethereum’s founder’s recent finding, that a more technical term would have been more appropriate,³¹ is indeed plausible. In any event, however, smart contracts do not operate in a legal vacuum.³² As soon as legally relevant acts are concerned, laws are generally applicable.

- 13 Ultimately, in these cases the term could be understood in the way Nick Szabo originally coined it: smart contracts are “a set of promises, specified in digital form, including protocols within which the parties perform on these promises”.³³ He emphasized the increased functionality of smart contracts compared to non-coded contracts and consequently did not assume a detachment from the law. In light of this, a smart contract is nothing more than the encoding or digital memorialization of a contract or parts thereof.³⁴ Its legal evaluation depends on the law applying to the underlying contract.³⁵ Naturally, the conclusion of a contract and its digital representation in a smart contract can coincide.³⁶ Nevertheless, it can be assumed that most smart contracts will probably be contextualized in an additional written or electronic agreement in natural language.³⁷

29 See, e.g., MONAX, ‘Smart Contracts’ <https://monax.io/learn/smart_contracts/> accessed 22 January 2019 (“To begin with, smart contracts are neither particularly smart nor are they, strictly speaking, contracts.”).

30 <www.ethereum.org/greeter> accessed 22 January 2019.

31 Vitalik Buterin (13 October 2018) <<https://twitter.com/vitalikbuterin/status/1051160932699770882?s=12>> accessed 22 January 2019.

32 De Filippi and Wright (n 13) 78.

33 Szabo (n 25).

34 De Filippi and Wright (n 13) 79; see also Dimitrios Linardatos, ‘Smart Contracts – einige klarstellende Bemerkungen’ (2018) K&R 85, 87.

35 Markus Kaulartz and Jörn Heckmann, ‘Smart Contracts – Anwendungen der Blockchain-Technologie’ (2016) CR 618, 622; Gerald Spindler and Maren K Woebbecking, ‘Smart Contracts und Verbraucherschutz’ in Tom Hinrich Braegelmann and Markus Kaulartz (eds), *Rechtshandbuch Smart Contracts* (C.H. Beck 2019) (forthcoming).

36 Cf. Max Raskin, ‘The Law and Legality of Smart Contracts’ (2017) 1 Geo. L. Tech. Rev. 305, 322; see also Linardatos (n 34) 89.

37 Cf. Cardozo Blockchain Project (n 19) 4f; cf ISDA and Linklaters (n 27) 13.

II. Formation

1. Applicable Law

- 14 As they encode traditional contracts, the law applicable to smart contracts is determined according to general principles.³⁸ This means that the question of whether a legal contract was concluded depends on the applicable legal provisions, which may, for example, require certain formalities.³⁹ This could lead to a diverging assessment of smart contracts in different jurisdictions.

- 15 In the European Union, the applicable law includes not only respective national contract law but is also strongly influenced by European law. There are two important legal measures with respect to contract law at the European level.⁴⁰ Namely, the Directive 2000/31/EC on e-commerce and the Consumer Rights Directive 2011/83/EU. If it were to enter into force, the current proposal for a directive on certain aspects concerning contracts for the supply of digital content would complement them.⁴¹ Some of the provisions of these measures focus on the formation of a contract on the internet. For example, they establish pre-contractual obligations for a trader in e-commerce consumer contracts to inform the consumer about relevant facts, which could be interpreted as also containing certain information about security vulnerabilities of smart contracts.⁴² Although the General Data Protection Regulation (GDPR) is not contract law, it should not be ignored. Some of the provisions in it may prove problematic for smart contracts if they are based on a public, permissionless blockchain characterized by immutability and transparency.⁴³

- 16 Yet, apart from the applicable law and seen from a factual point of view, smart contracts also offer the possibility of enforcing certain agreements

38 This can lead to difficulties, especially with international smart contracts, see e.g. Alexander Djazayeri, ‘Rechtliche Herausforderungen durch Smart Contracts’ (2016) jurisPR-BKR Anm. 1 4; Gerald Spindler, ‘Kurzgutachten „Regulierung durch Technik“ (2016) SVRV 4.

39 Philipp Reusch and Niklas M. Weidner, *Future Law: Blockchain, Industrie 4.0, Internet of Things, Robotik* (Fachmedien Recht und Wirtschaft 2018) 109ff; Martin Heckelmann (n 14) 506f; cf., e.g., the requirements established by the “statute of frauds”, Cardozo Blockchain Project (n 19) 9 with further references.

40 Regarding the US, see Cardozo Blockchain Project (n 19) 9; cf. also De Filippi and Wright (n 13) 79f.

41 Proposal for a Directive of the European Parliament and of the Council on certain aspects concerning contracts for the supply of digital content, Brussels, 9.12.2015 COM(2015) 634 final.

42 Spindler and Woebbecking (n 35).

43 See, e.g., Schrey and Thalhofer (n 14) 1434ff.

which cannot be enforced in courts.⁴⁴ For instance, in order to be fully enforced in the US, a contract must generally contain consideration.⁴⁵ A smart contract can, however, enforce an agreement without consideration.

2. Contractual Terms

- 17 Smart contracts will formalize contracts more than is the case with traditional contracts.⁴⁶ This is simply for the reason that code cannot be as ambiguous as written text. One can certainly assume that smart contracts, more generally code, encounter difficulties with the implementation of ambiguous clauses and principles such as good faith in continental law or equity in common law.⁴⁷
- 18 In the foreseeable future, if there is a need to use ambiguous clauses in a smart contract, it is likely that interpretational difficulties will be resolved by assigning them to a human-based oracle.⁴⁸ This assignment to a human-based oracle naturally also means to rely on a centralized intermediary. Yet, this can still be seen as an improvement in comparison to traditional contracts, as the infrastructure requirements are at least reduced,⁴⁹ but there is still considerable reason to believe that in the foreseeable future, smart contracts will mainly be used for unequivocal cases, encoding those parts of an underlying contract that can be clearly defined.⁵⁰
- 19 Apart from the rather obvious fact, that encoded contracts will be more formalized than traditional contracts, the question whether they will also be more standardized requires considerably more complex consideration. Although it may seem obvious at first glance that commercial smart contracts used for mass contracts will lead to even greater standardization,⁵¹ this approach may be too short-sighted. As already mentioned, smart contracts are only one of many digital innovations that will have a great impact on society and revolutionize the

law. Especially during the contract drafting phase, companies as well as consumers will increasingly rely on technical support, such as data mining and scoring techniques, to assist in finding suitable contractual offers.⁵²

- 20 Electronic agents, sometimes referred to as AI agents or digital agents, might actually be the crucial factor to individualize and personalize contracts again. Depending on their autonomy they may conclude a contract on behalf of their principal by accepting an offer or generating a counter-offer.⁵³ The possibilities offered by smart contracts in combination with electronic agents, i.e. AI, could therefore offer consumers great opportunities in terms of more individual contract design, but they are also accompanied by new risks for consumer protection.⁵⁴

3. Interpretation

- 21 Interpreting contractual terms has in the past been the subject of a large number of court decisions and corresponding legislation.⁵⁵ This was mainly due to the fact that natural language is by definition ambiguous. In fact, ambiguity allows for a more concise version of contracts, as not all eventualities need to be differentiated (the same is incidentally true for legal provisions).⁵⁶ Ambiguity ensures a reduction of transaction costs in the context of contract drafting and therefore makes economic sense. Nevertheless, ambiguity always leaves room for interpretation and the associated risks. This resulted in the use of general terms and conditions for mass contracts, which provided an interpretation standard for court decisions and thus minimized conflicts over terms and made risks calculable.⁵⁷

44 A great concern in that regard is given to the possibility of enforcing illegal agreements through smart contracts, see, e.g., De Filippi and Wright (n 13) 87ff with further references.

45 Raskin (n 36) 322; for a detailed illustration see Val D. Ricks, 'In Defense of Mutuality of Obligation: Why "Both Should Be Bound, or Neither"', (1999) 78 Neb Law Rev 491, 494; see also Restatement (Second) of Contracts §§ 71ff.

46 De Filippi and Wright (n 13) 84; cf Savelyev (n 5) 120f.

47 Cf. De Filippi and Wright (n 13) 77.

48 Cardozo Blockchain Project (n 19) 6; Oracles can in general be described as agents that find and verify certain real events and transmit this information to the blockchain.

49 Buterin (n 13) 21.

50 De Filippi and Wright (n 13) 195f.

51 Cf. De Filippi and Wright (n 13) 86.

52 See, e.g. Natali Helberger, 'Profiling and Targeting Consumers in the Internet of Things' in Reiner Schulze and Dirk Staudenmayer (eds), *Digital Revolution: Challenges for Contract Law in Practice* (Nomos 2016) 138ff; cf. Michal S. Gal and Niva Elkin-Koren, 'Algorithmic Consumers' (2017) 30 2 Harv. J.L. & Tech. 309, 313f.

53 Stefan Grundmann and Philipp Hacker, 'Digital Technology as a Challenge to European Contract Law' (2017) 13 (3) ERCL 255, 283; see also the „Paid-Option Regime“ suggested by Ryan Calo, 'Digital Market Manipulation' (2014) 82 No 4 Georg Washington Law Review 995, 1047f.

54 Cf., e.g., Eliza Mik, 'The Erosion of Autonomy in Online Consumer Transactions' (2016) 8 (1) passim, Law, Innovation and Technology <https://ink.library.smu.edu.sg/sol_research/1736/> accessed 22 January 2019.

55 See, e.g., Armbrüster in Erman, BGB, 15. Aufl. 2017, § 157 BGB with extensive references to German court decisions; see also E Allan Farnsworth, "'Meaning" in the Law of Contracts' (1967) 76 5 Yale LJ. 939.

56 De Filippi and Wright (n 13) 77, 199.

57 Cf. Neumayer (6) 8; Farnsworth (n 1) 911.

22 Similar or maybe even further effects could be achieved by formalizing contracts, as it would be the case with the computer code used for smart contracts.⁵⁸ Yet, interpreting a programming language is likely to cause difficulties for courts. In such cases, recourse to competent extrajudicial dispute resolution is certainly an appropriate option. Particularly precarious, however, remains the interaction between the interpretation of the smart contract code and a respective underlying written contract. Extrajudicial dispute resolution can only provide a limited redress in this respect. Rather, it will be crucial that the parties stipulate explicitly to what extent the smart contract code should serve for interpretation. Such an agreement would, for instance, probably have evidential value before German courts.⁵⁹ It remains to be seen how courts will interpret smart contracts, which have no explicit agreement to that effect.

4. Modification

23 By design, a blockchain-based immutable smart contract cannot be adjusted in the same way as a traditional contract. Usually, once put in motion the encoded promises will be executed without any possibility of exerting influence.⁶⁰ Nevertheless, there are possibilities to modify smart contracts. A rather impractical solution might be for the parties to agree to reverse the smart contract afterwards. They'll be considerably better served if they conclude a dynamic contract from the outset. This would mean, that the parties plan for certain possibilities for modification or adaptation to external circumstances by including oracles. These oracles can then adjust and update certain contractual obligations.⁶¹ The possibilities for oracles are manifold and can range from human-based oracles to certain digitally verifiable events, such as current stock prices, to an AI algorithm.⁶²

III. Performance and Self-Help

24 With smart contracts, sections of or even all contractual obligations can be performed automatically the moment a certain digitally

verifiable event occurs. The triggers of certain performances defined in the smart contract can be of a different nature and depend on the individual case.

25 In principle, the parties to a smart contract benefit from this autonomous automation and no longer have to monitor performance obligations to the same extent as is the case with traditional contracts.⁶³ The automated performance also gains importance whenever a smart contract memorializes obligations that cannot be enforced by resorting to a court. In Germany, for example, claims arising from games and bets are usually not enforceable.⁶⁴

26 These benefits attributed to the autonomy of blockchains and the difficulties with changing or terminating smart contracts, can nevertheless become rather problematic if the performed contract provision violates the law.⁶⁵ A difficult topic to assess here is that some automation could turn out to be forbidden self-help. A prominent example is that of a starter interrupter which automatically prevents a leased car from starting if the debtor is in default. Some states in the U.S. already confirmed the legality of such devices.⁶⁶ Corresponding self-help measures in other smart contracts would certainly have to provide for various exceptions in order to be able to assess the corresponding individual case in such a way that the contract complies with the law.⁶⁷ An example could be rental agreements, where the door to an apartment could be locked automatically by the landlord if certain events occur. This is a sensitive topic, especially considering the fact that automated self-help will often be of importance in consumer contracts and thus consumer protection laws apply.

IV. Restitution

27 Apart from contractual amendments that both parties wish to make, there are cases in which the law prescribes a contractual adjustment. In particular, if the contract on which the smart contract is based is terminated, the effects of the smart contracts might need to be reverted.

58 Raskin (n 36) 324; De Filippi and Wright (n 13) 195 with further references; cf. Savelyev (n 5) 125.

59 Cf. Fries (n 16) 89.

60 Kevin Werbach and Nicolas Cornell, 'Contracts Ex Machina' (2017) 67 *Duke Law Journal* 313, 340.

61 Cardozo Blockchain Project (n 19) 6.

62 Grundmann and Hacker (n 53) 284; Vitalik Buterin, 'Ethereum and Oracles' (*Ethereum Blog* 22 July 2014) <<https://blog.ethereum.org/2014/07/22/ethereum-and-oracles/>> accessed 22 January 2019.

63 Cardozo Blockchain Project (n 19) 5; De Filippi and Wright (n 13) 80f.

64 § 762 German Civil Code.

65 Grundmann and Hacker (n 53) 281; De Filippi and Wright (n 13).

66 Reviewed in detail by Raskin (n 36) 330f with further references.

67 Regarding starter interrupters, see Eric L. Johnson and Corinne Kirkendall, 'GPS & Payment Assurance Technology: Are You Compliant?' (*Passtime*, 14 January 2016) <<https://passtimegps.com/starter-interrupt-and-gps-devices-best-practices/>> accessed 22 January 2019.

- 28 A striking example of this can be found in the right of withdrawal in European law, which is granted to consumers when concluding a particular type of contract, for example in e-commerce.⁶⁸ The obligation to return a performance received in case of the contract being withdrawn does not entail any special legal aspects for a smart contract. However, given that public, permissionless blockchains as the basis for the smart contract bring with it the characteristic that the transaction is basically immutable, particular attention must be paid to the technical implementation.
- 29 Generally, one can revert to a former state of a blockchain by using so-called reverse transactions.⁶⁹ However, this does not lead to the deletion of the transaction history and the withdrawn transaction remains permanently documented in the blockchain. From a contract law point of view, this is unproblematic, but problems may arise in data protection law.⁷⁰ Additionally, the execution of a reverse transaction can cause difficulties as it can only be triggered by the owner of the private key.⁷¹ Yet, it is hardly conceivable that a fork is used instead.⁷² However, it is quite imaginable that, at least with regard to the right of withdrawal, the transaction will initially take place off-chain and will only be integrated into the blockchain after expiry of the withdrawal period.⁷³ The same would apply to other legal reasons making it necessary to revert a smart contract.

V. Dispute Resolution

- 30 Due to their characteristics, smart contracts can contribute to conflict avoidance. However, a conflict cannot be prevented in all cases. Parties having a dispute over a contract can resort to a court system for enforcement. This principally also applies if the contract was encoded in a smart contract. Nevertheless, resorting to a court is often

expensive and time-consuming. Accordingly, the number of extrajudicial resolution options has grown enormously.⁷⁴ Both private and alternative dispute resolution proceedings, online dispute resolution, and arbitration proceedings could potentially be integrated into smart contracts.⁷⁵ In addition, legal tech applications, mostly used for simple cases, such as compensation for flight delays, have been increasing in importance for some time.⁷⁶ The development of AI in this area will open up unprecedented possibilities for smart dispute resolution in the future.

D. Quo Vadis Contract Law

- 31 Smart contracts are probably not “the mature end of the evolution of electronic agreements”,⁷⁷ notwithstanding, they represent a new era of contracting. As seen above, the existing contract law can stand up to some of the challenges posed by smart contracts. Apart from the parts where smart contracts and contract law intersect, there are characteristics of smart contracts that are not covered by existing contract law, while at the same time there are legal provisions whose requirements may be difficult to meet by smart contracts.
- 32 In this regard, a further adaptation of smart contracts to existing provisions is certainly conceivable, but at any rate limited by technical features. An adjustment of the law to smart contracts, on the other hand, is likely to be more feasible and seems more appropriate.
- 33 One of the reasons for this is that smart contracts, as outlined, will place the legal protection *ex ante* before the legal protection *ex post*. Western contract laws, however, are based on the opposite premise.⁷⁸ This increasing importance of the drafting stage of a contract should be reflected accordingly by the law. Additionally, smart contracts pose risks such as

68 Art. 9 Directive 2011/83/EU of the European Parliament and of the Council of 25 October 2011 on consumer rights.

69 Schrey and Thalhofer (n 14) 1435f; David Saive, ‘Rückabwicklung von Blockchain-Transaktionen’ (2018) RdTW 85, 88.

70 See n 43.

71 Under German law, the enforcement of such an act is governed by § 888 code of civil procedure (ZPO) which is regulating actions that may not be taken by others, cf. Merih E Kütük and Christoph Sorge, ‘Bitcoin im deutschen Vollstreckungsrecht’ (2014) MMR 643, 644.

72 A fork can be described as a way of using hash power to change the rules of the software, cf., e.g., ‘Amy Castor, A Short Guide to Bitcoin Forks’ (CoinDesk, 27 May 2017) <www.coindesk.com/short-guide-bitcoin-forks-explained> accessed 22 January 2019.

73 Cf. Raskin (n 36) 326f.

74 See, e.g., the example of private arbitration used in Ursula Stein, *Lex Mercatoria - Realität und Theorie* (Vittorio Klostermann 1995) 35ff with further references; cf. Martin Fries, ‘PayPal Law und Legal Tech - Was macht die Digitalisierung mit dem Privatrecht?’ (2016) NJW 2860, 2861.

75 Cf., e.g., Michael del Castillo, ‘Lawyers Be DAMNed: Andreas Antonopoulos Takes Aim at Arbitration With DAO Proposal’ (CoinDesk, 26 May 2016) <www.coindesk.com/damned-dao-andreas-antonopoulos-third-key> accessed 22 January 2019; see further Pietro Ortolani, ‘Self-Enforcing Online Dispute Resolution: Lessons from Bitcoin’, (2016) 36 3 Oxford Journal of Legal Studies 595.

76 See, e.g., the overview of legal tech solutions in Germany on <<https://tobschall.de/legaltech/>> accessed 22 January 2019.

77 Werbach and Cornell (n 60) 105.

78 See, e.g., Samuel Issacharoff, ‘Regulating after the Fact’, (2007) 56 DePaul L. Rev. 375, 377ff with further references.

security vulnerabilities, which are also not entirely covered by existing legislation. An unmanageable amount of pre-contractual information, which is largely guaranteed to consumers by European law, for example, only serves its purpose to a limited extent. Especially in light of the fact that most consumers do not even read this information.⁷⁹ A more progressive option could be a mandatory code testing tool that checks the smart contract for security vulnerabilities.⁸⁰

- 34 However, while such adaptations are mostly compatible with existing concepts of contract law, other aspects of smart contracts might not only challenge the existing contract law, but rather the concept of contract law as such. As the possibility to enforce legally unenforceable agreements through smart contracts shows, the technical possibilities of smart contracts can constitute a trusted third party. Even beyond legally unenforceable agreements, the self-execution of smart contracts will contribute to establishing them as a private regulatory framework.⁸¹ As Thomas Hobbes pointed out already in 1651, one of the essential roles of law is to provide a system that allows the parties to have trust in receiving their performance under a binding agreement.⁸² In some areas this role could be taken over by smart contracts in the future. In this respect, they are in line with the general increase in private legal rules and institutions which lead to a gradual loss of significance of state law.⁸³
- 35 Additionally, smart contracts are not limited to national borders but are rather particularly well suited for international contracts and will in some way be ubiquitous. Just like many other digital achievements, they will mainly be influenced by their technical architecture and the individual actors who promote their use,⁸⁴ e.g. by providing smart contract templates. A parallel can be drawn, for example, to e-commerce, which is largely dominated by platforms.⁸⁵ The controversy behind the frequently quoted term “code is law”, introduced by Lawrence Lessig, in fact gets to the heart of this

matter.⁸⁶ In order to maintain legal values that are usually not provided by the market, i.e. by code, such as the protection of minorities and representation of public interests,⁸⁷ the concept of contract law will have to reinvent itself in parts.⁸⁸ This might include having different conceptual regimes for traditional contracts and encoded contracts.⁸⁹ As a symptomatic example of internet regulation,⁹⁰ the regulation of smart contracts will be an exceptionally difficult task.

79 See Ian Ayres and Alan Schwartz, ‘The No-Reading Problem in Consumer Contract Law’ (2014) 66 *Stanford Law Review* 545.

80 Spindler and Woebeking (n 35).

81 This aspect of smart contracts has been described by several legal scholars using different terminological terms, cf., e.g., De Filippi and Wright (n 13) 5f, 194; see also Blemus (n 27) 14 with further references.

82 Thomas Hobbes, *Leviathan* (first published 1651, Penguin 1985) passim.

83 Volker Boehme-Neßler, ‘Die Macht der Algorithmen und die Ohnmacht des Rechts’ (2017) *NJW* 3031, 3033.

84 Boehme-Neßler (n 83) 3033; cf. Lawrence Lessig, *Code: version 2.0* (Basic Books 2006) 123f.

85 Fries (n 74) 2861; Grundmann and Hacker (n 53) 274.

86 Lawrence Lessig, *Code and other Laws of Cyberspace* (Basic Books 1999) passim.

87 Boehme-Neßler (n 83) 3035; cf. Grundmann and Hacker (n 53) 293.

88 Cf. Boehme-Neßler (n 83) 3035; see also De Filippi and Wright (n 13) 173ff.

89 Cf. Roger Brownsword, ‘The E-Commerce Directive, Consumer Transactions, and the Digital Single Market’ 165, in Stefan Grundmann (ed), *European Contract Law in the Digital Age* (vol 3 Intersentia 2018).

90 Regarding the challenges of cyberspace regulation see e.g. Viktor Mayer-Schönberger and John Crowley, ‘Napster’s Second Life?: The Regulatory Challenges of Virtual Worlds’ (2006) 100 *Nw. U. L. Rev.* 1775, 1802f; David R Johnson and David G Post, ‘Law and Borders: The Rise of Cyberspace’ (1996) 48 *Stanford LR* 1367, 1367; Joel R Reidenberg, ‘The formulation of information policy rules through technology’ (1998) 76 *Texas LR* 553, 553.