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Smart Contracts – How will Blockchain Technology Affect Contractual Practices?

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Abstract
Unlike conventional contracts established through speech, written words, or actions, smart contracts are algorithmic, self-executing and self-enforcing computer programs. In this article, we analyze smart contracts from the perspective of digital platforms and the Finnish contract law. We examine how well the formation mechanisms of the general principles of contract law can be applied to the new technological framework of smart contracts. In addition, the adoptability of smart contracts as a part of our current legislation is evaluated on the basis of this analysis.

We find that instead of a clearly defined single use case, smart contracts can be applied in a multitude of different ways, with highly varying goals and circumstances. We conclude that at least in some cases, smart contracts can create legally binding rights and obligations to their parties. The mechanism best suited for describing the formation of a smart contract seems to be analogous to a vending machine where the declaration of intent is implicitly expressed by performing contractual obligations.

Contracts have not been formerly percieved as a technical boundary resource in the sense that platform ecosystems could foster broader network effects by opening their technical contracting interfaces to third parties. Smart contracts are an example of the new kinds of technology-enabled contracting practices to which companies and public policy makers should start preparing well ahead of time. However, due to the relative immaturity of the smart contract technology, the number of current real-world applications is still very limited. The evolution of digital platforms requires an approach with a combination of technological, economic and legal perspectives.

Key words: Digital platforms, boundary resources, blockchain, smart contracts

JEL: K12, K19, O33, O38

Älykäs sopimus – Miten blockchain muuttaa sopimuskäytäntöjä?

Tiivistelmä
Poiketen tekojen, puheen tai kirjoituksen avulla syntyvistä tavanomaisista sopimuksista, älykäs sopimus on ohjelmointikoodille rakentuva, itsensä toteuttava tietokoneohjelma. Tässä artikkelissa tutkitaan älykkäitä sopimuksia digitaalisen alustatalouden ja kansallisen sopimusoikeudellisen lainsäädäntömme näkökulmista. Artikkelissa arvioidaan, miten hyvin sopimusoikeuden yleiset opit ja erityisesti niihin lukeutuvat syntymekanismit ovat sovellettavissa älykkäiden sopimusten kaltaisiin uusiin teknologisiin ratkaisuihin. Lisäksi tämän perusteella tarkastellaan älykkäiden sopimusten yhteensopivuutta nykylainsäädäntömme kanssa.

Artikkelissa havaitaan, että älykkäitä sopimuksia näyttää olevan mahdollista rakentaa muutamien käyttötapausten sijasta lukemattomasti erilaisia. Lisäksi niitä voidaan laatia hyvin erilaisista lähtökohdista ja täysin toisistaan eroaviin tarkoituksiin. Havaintojemme mukaan älykäs sopimus voi synnyttää ainakin osassa tilanteista oikeudellisesti sitovia velvoitteita sen osapuolille. Älykkään sopimuksen syntyä kuvaava mekaniikka näyttää selittyvän parhaiten rinnastamalla se myyntiautomaatin kanssa tehtäviin ns. hiljaisiin sopimuksiin.

Alustatalouden näkökulmasta perinteisiä sopimuksia ei ole aiemmin mielletty alustaan liittymisen kynnystä madaltavaksi tekijäksi siinä merkityksessä, että alustan verkostovaikutuksia voitaisiin kasvattaa yritysten teknisiä sopimusrajapintoja avaamalla. Älykkäät sopimukset ovatkin esimerkki teknologisen kehityksen kautta muodostuvista täysin uudenlaisista sopimuskäytänteistä, joihin tulee varautua ajoissa. Johtuen älykkäiden sopimusten varhaisesta kehitysvaiheesta, toistaiseksi todellisia käyttötapauksia on kuitenkin olemassa erittäin rajoittunut joukko. Digitaalisten alustojen kehitys edellyttääkin tässä vaiheessa laajamittaista teknis-taloudellis-juridista näkökulmaa.

Asiasanat: Digitaaliset alustat, rajaresurssit, lohkoketju, älykkäät sopimukset

JEL: K12, K19, O33, O38

1 Introduction

In 1994, American cryptographer Nick Szabo published an article in which he outlined the concept of smart contracts[1]. Regardless of the advanced ideas and advanced theory, the IT infrastructures were considerably behind the theory level, and the time was not yet ripe for practical experiments on smart contracts and corresponding digital platform applications[2]. Now years later, smart contracts have resurfaced and become the subject of experiments as technology has caught up, especially with the development of blockchain technology and decentralised consensus architectures build around it[3].

Szabo defined smart contracts as machine-readable transaction protocols which create a contract with pre-determined terms[4]. According to a newer definition, a smart contract is "a set of promises, specified in digital form, including protocols within which the parties perform on these promises"[5]. In its simplest form, a smart contract is a machine-readable program, written in code that will execute itself when a set of pre-determined terms are met. It is noteworthy that smart contracts do not need artificial intelligence to work, regardless of what their name may suggest.

Blockchain technology has enabled the construction of new kinds of platforms, writing smart contracts in a programming language, and the creation of ecosystems around them[6]. In the last few years, people outside the group of technology suppliers—especially players in the banking and finance sectors[7]—have tried to develop new ways to take advantage of the technology in their businesses and to renew or increase the efficacy of their digital platforms. In many other sectors the use of blockchain technology is still in its infancy[8].

New technical advances in blockchain technology have enabled moving from automatic contracts to truly autonomous smart contracts, capable of self-execution and self-enforcement.

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1 The original text "*Smart Contracts"* is available at: http://szabo.best.vwh.net/smart.contracts.html (17 June 2016). The text "*The Idea of Smart Contracts"* published in 1997 took the idea of smart contracts further: http://szabo.best.vwh.net/smart_ contracts_idea.html (17 June 2016).

2 See eg Glatz, 2014: *What are Smart Contracts? In search of a consensus.*

3 E.g. http://tech.cornell.edu/news/smart-contracts-the-next-big-blockchain-application (23 August 2016).

4 By transaction protocols Szabo meant protocols between different devices, which achieve the so-called Nakamoto consensus. Szabo, 1994: "*A smart contract is a computerized transaction protocol that executes the terms of a contract*".

5 Szabo, 1996.

6 Unbeknownst to everyone, in late 2008 an individual or group of individuals working under the pseudonym Satoshi Nakamoto published an article which presented a new way to execute a digital, decentralised peer-to-peer platform. The way in which the decentralised platform as presented in the article was executed was based on a new kind of distributed database structure now known as 'a blockchain'. Nakamoto's article soon led to the first application of blockchain technology: the cryptocurrency Bitcoin. It is noteworthy that Nakamoto's paper does not use the term blockchain itself; instead, the article uses the term "chain of blocks", to describe a data structure chained together through a cryptographic process. Even though the origin of the widely used term blockchain is somewhat unclear, its technological traits and first application were outlined in the very article published under Nakamoto's name. There has been a lot of conversation about the identity of Satoshi Nakamoto, and many people have been alleged to be Nakamoto, or they have claimed so themselves. See eg: http://www.coindesk.com/information/who-is-satoshi-nakamoto/ (23 August 2016). Previously in the spring of 2016, Craig Wright announced that he was Nakamoto. He never provided any evidence to support his claim (https://www.theguardian.com/technology/2016/ may/05/craig-wright-u-turn-on-pledge-to-provide-evidence-he-invented-bitcoin) (23 August 2016); See also https://www.ethereum.org/ & https://daohub.org/ (2 August 2016)

7 The R3CEV consortium was founded by many multinational banks to study the uses of blockchain technology in the financial sector. See: http://r3cev.com/ (23 August 2016). Also: https://next.ft.com/content/84f50b30-12d2-11e6-91da-096d89bd2173 (23 August 2016).

8 For example, in the legal sector there is interest towards blockchain technology, but so far only few applications exist: http://www.afr.com/technology/blockchain-smart-contracts-to-disrupt-lawyers-20160529-gp6f5e (23 August 2016). In addition, small actors have emerged, for example, in the health care sector, but larger innovations are yet to see the light of day: http://www.cio.com/article/3050664/healthcare/blockchain-collaboration-defines-the-fabric-for-healthcare-20.html?utm_content=bufferd8a86&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer#tk.rss_healthcare; https://medium.com/@Connected_Dots/blockchain-in-healthcare-for-dummies-190226e112eb#.ths1ug8dk (both 23 August 2016).

Digital platforms and the emerging business practices therein are creating new instruments which are not necessarily recognised by our current contract law. This has introduced the need to survey the relationship between technology and the current legal atmosphere, as well as the legal questions related to the use of smart contracts[9]. Evaluation of these technological developments should be started as early on as possible in order to prepare for the potential changes in the digital environment.

Internationally, the studying of blockchain technology and smart contracts has been initiated with caution amongst legal scholars, and the scarcity of research results is largely explained by the novelty of the subject at this point[10]. Nonetheless, the amount of legal research on the topic has started increasing in different parts of the world, and it has generally been of transnational character rather than focused on individual legal systems. As part of the discussion, legal research on blockchain technology has been said to lead to the development of a new legal field which can be described as *lex cryptographia*, or crypto law[11].

The relationship between blockchain-based smart contracts and contract law creates an interesting research environment in which the traditional definition of contracts is placed under review as coded programs begin to administer transactions. Determining the legal nature of smart contracts is in fact a key theme in the surrounding discussion[12]. It must be noted that smart contracts are not only administered by their programming logic or, in other words, the code they contain; they are inseparably also influenced by the state of the law[13].

With this in mind, it must, first of all, be clarified how the general doctrines of Finnish contract law are applicable to these new smart contracts. Can legal acts be concluded in the form of smart contracts, therefore conferring rights and imposing obligations on parties? Secondly, it must be determined whether all smart contracts are contracts in themselves or whether certain preconditions must be met. Based on these questions, the final task is to evaluate whether our national legislation must be developed due to new kinds of technological solutions[14]. In recent discussion surrounding the legal characterisation of smart contracts, they have to an increasing extent been assessed as legally relevant activity[15]. These questions and interpretations offer a good starting point and incentive for the technological and terminological definitions and further analysis presented in this article[16].

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9 Mattila – Seppälä, 2015, p 4: "*Lohkoketjuteknologia on teollisuuden ja yhteiskunnan digitalisaation näkökulmasta mielenkiintoinen tarkastelun kohde ja sisältää digitaalisten alustojen näkökulmasta monia lupaavia ja ainutlaatuisia teknisiä ominaisuuksia.*" ["Blockchain technology is very interesting from the perspective of digitalising industries and society, and it involves many promising and unique technical features from the viewpoint of digital platforms."]

10 Out of Finnish legal scholars Riikka Koulu has studied this subject, focusing on the usage of smart contracts in dispute resolution. More about this: Koulu, Riikka: *Blockchains and Online Dispute Resolution: Smart Contracts as an Alternative to Enforcement*, 2016.

11 A new legal field "*Lex Cryptographia*" focuses on rules which are managed through self-executing smart contracts and decentralised autonomous organisations. See Wright – De Filippi, 2015, p. 48.

12 About the nature of smart contracts more generally: "*They are defined variously as 'autonomous machines', 'contracts between parties stored on a blockchain' or 'any computation that takes place on a blockchain'. Many debates about the nature of smart contracts are really just contests between competing terminology […]*", http://www.coindesk.com/making-sense-smart-contracts/ (23 August 2016).

13 See eg: *Blockchain 2.0, smart contracts and challenges*: http://www.twobirds.com/en/news/articles/2016/uk/blockchain-2-0--smart-contracts-and-challenges#1 (23 August 2016).

14 In addition to the questions above, it is also important to consider how programming is viewed by Finnish contract law. Is it possible to equate the programming of a smart contract to a middleman, comparable to counsel drafting a traditional contract? These interesting questions are mostly brushed aside in this text, but the importance and role of programming will be an increasingly important topic.

15 Glatz, 2014: "*It is however undeniable, that smart contracts have to be classified as legally relevant behavior. […]*" See also Koulu, 2016, p. 54.

16 Previous interviews and conversations with various researchers and players in the field of blockchain technology, as well as texts from different reputable publications and websites, have been used in this study.

Decentralised Autonomous Organisation

Smart contracts can be used advantageously in many different ways. One of the more complex applications is the so-called decentralised autonomous organisation (DAO). A web of interconnected smart contracts can be used to create a fully autonomous organisation, which is capable of carrying out the same functions as traditional organisation structures. DAOs operate independently of their developers[17]. In their structure, humans are moved from the centre of the organisation to its outskirts, as the system is used to organise human activity algorithmically[18]. An open organisation based on smart contracts may solve the problem of bad leadership or issues with the transparency of the organisation. However, if left unregulated and ungoverned, errors in the programming code may prove to be very harmful or even dangerous.[19]

The DAO is one of the first large-scale projects trying to achieve a decentralised autonomous organisation[20]. Even though The DAO is open source, a German blockchain technology company called Slock.it[21] has had a considerable influence on its development. After its introduction in late April 2016, The Dao gathered over USD 150 million within 28 days in crowdfunding in the form of Ether[22] cryptocurrency[23]. The DAO is intended to support development projects related to the sharing economy by reinvesting the capital it has gathered. Based on the contracts of the organisations, anyone who bought so-called "DAO tokens" has the right to vote on the investment of funds[24]. Any profit is shared between the token holders, who also have the right to make decisions about the curators who are tasked with preventing problems[25].

In June 2016, however, The DAO faced a severe problem when a group of hackers started transferring funds from the organisation by using a known fault in the programming of the smart contract[26]. In a matter of days the attacker managed to move tens of millions of dollars to another decentralised autonomous organisation[27]. The developer community Ethereum took countermeasures and managed to stop the attack and freeze the stolen assets[28]. Two new approaches were considered: black listing the stolen assets (soft fork) or returning them by altering the transaction history of the whole blockchain (hard fork). The latter solution might however undermine the entire stability and reliability of Ethereum. The community divided into two schools of thought. One side was in favour of justice, in other words returning the funds. The other side argued, however, that since The DAO had explicitly stated that all of its terms of use were defined by its programming code directly, no

17 Wright – De Filippi, p. 17.

18 Mattila, 2016, p. 18: "*In robotic systems, humans coordinate machine operations while in decentralized autonomous organizations, machines coordinate human operations".*

19 Wright – De Filippi, 2015, pp. 16–17.

20 https://daohub.org/; https://en.wikipedia.org/wiki/The_DAO_(organization) (both 24 August 2016).

21 Slock.it is a private blockchain and IoT company, which has in addition to The DAO project developed smart locks which use the Ethereum blockchain technology. See eg: https://slock.it/index.html and https://github.com/slockit/dao (24 August 2016).

22 Ether (ETH) is a cryptocurrency used in the Ethereum blockchain and is somewhat similar to Bitcoin.

23 http://www.coindesk.com/understanding-dao-hack-journalists/ (23 August 2016) and http://www.taloussanomat.fi/yritta-ja/2016/05/17/ yritys-toimii-pelkalla-koodilla-nosti-120-miljoonaa-dollaria-rahoitusta/20165331/137 (23 August 2016).

24 "*The DAO's objective is to support sharing economy projects delivered by 'contractors' by allocating ETH raised during its creation phase*" (http://www.coindesk.com/the-dao-just-raised-50-million-but-what-is-it/) (23 August 2016).

25 The curators are sort of a fail-safe mechanism. More information on different roles: https://blog.slock.it/on-contractors-and-curators- 2fb9238b2553#.jdkuokk9k (23 August 2016).

26 The error in The DAO's code had been noticed earlier, and the developers were aware of it; see eg: http://vessenes.com/more-ethereum-attacks-race-to-empty-is-the-real-deal/ (23 August 2016).

27 http://www.coindesk.com/dao-attacked-code-issue-leads-60-million-ether-theft/; https://www.reddit.com/r/ethereum/ comments/4oi2ta/i_think_thedao_is_getting_drained_right_now/; https://blog.ethereum.org/2016/06/17/critical-update-re-dao-vulnerability/ (each 23 August 2016).

28 Even though The DAO was separate from Ethereum, which was developed by a private party, the developer community of Ethereum (Ethereum Foundation, https://www.ethereum.org/foundation, 24 August 2016) was very interested in it and, therefore, many invested their own funds into it. Consequently, as problems arose, they were very active in fixing the situation.

theft had ever happened as the "attacker" had only adhered to the smart contract's programming[29]. In the beginning of August, the developers had enough support in favour of the hard fork. The Ethereum blockchain was divided in the implementation as some updated their software and some held onto the original version. At the time of writing, both versions of the blockchain are in use[30]. In conjunction with the hard fork, a new smart contract was created, which allows those who had funds stolen to be reimbursed.[31]

The development of decentralised autonomous organisations and The DAO effectively demonstrate the potential of new instruments but also reveals new types of risks. The organisational character of The DAO in itself raises the question of, for instance, the distribution of liability for damages within such new types of applications. In addition, it involves ties to the question of determining the correct legal entity in economic activity based on new models of co-operation, as is the case with The DAO. Are the rights and obligations of the organisation divided amongst its coders, committed members, or the decentralised autonomous organisation itself? The latter interpretation would require a legally recognised status, making it most likely that liability will be directly distributed in various ways amongst the creators of the organisation[32]. The justified question of who should actually be liable for the performance of these types of applications based on an entirely new operating logic can also be raised within this context. Although decentralised autonomous organisations and their legal status will not be further discussed in this publication, this example illustrates how new applications create pressure to develop our current legislation much more effectively than before.

[29] https://medium.com/@pullnews/understanding-the-dao-hack-for-journalists-2312dd43e993#.8cp5mipgn (23 August 2016).

[30] About the two Ethereum blockchains, see eg: http://www.coindesk.com/can-two-ethereum-markets-co-exist/ (23 August 2016).

[31] http://www.coindesk.com/hard-fork-ethereum-dao/ (23 August 2016).

[32] Wright – De Filippi, 2015, pp 54–55. The interpretation that legal responsibility should lie with the developers is supported at least in this case by the fact that The DAO was created by developers with the private company Slock.it. If a decentralised autonomous organisation was given legal responsibility like this it would require recognition of its legal standing.

In this article, we will discuss the relationship between smart contracts based on decentralised consensus architectures, and Finnish contract law. In the second section, we will explore terminology related to digital platforms, boundary resources and blockchain technology. In the third section of the article, we will outline the definition of smart contracts, describe a number of examples, and discuss the creation of a smart contract from the perspective of contract law. In section four, we will seek to answer the question of whether legal acts can be concluded with smart contracts, and finally, in section five, we will discuss the impact of smart contracts in the context of development trends of digital platforms and the surrounding ecosystems.

2 Digital Platforms, Boundary Resources and Blockchain Technology

2.1 Blockchain Technology

In short, blockchain technology refers to a method in which parties unknown to each other can jointly maintain and edit databases in an entirely decentralised manner, with no intermediary party exercising central control. One of the key features of blockchain consensus architectures is their ability to maintain a uniform view on the state of things and the order of events without any centralised body dictating them from above. Thanks to the decentralised

consensus mechanism, the blockchain network maintains its agreement of the content of the system, even if contradicting changes were simultaneously attempted.[33]

In recent years, the development of blockchain technology has allowed customizable programming logic[34] to be stored in blockchains, in addition to regular databases. This course of development has also enabled the creation of smart contracts. In this article, smart contracts are defined as digital programs based on a blockchain consensus architecture that automatically implement their internal logic as certain preconditions are met, and which are also able to prevent unauthorised changes of their internal logic as a result of their decentralised nature.

2.2 Digital Platforms and Boundary Resources

Digital platforms are shifting the boundaries of industry ecosystems, transforming how value is created and captured, as well as changing job descriptions and the trust relationships between different parties in the economy. Making predetermined boundary resources available to anyone willing to participate is a key strategy in platform innovation management.

The term "digital platforms" refers to IT systems via which different parties can do business that adds value to the whole ecosystem. The parties may be users or suppliers of the platform or inter-organisational interest groups such as application developers or advertisers. Typically the different parties create, provide and maintain complementary products and services to the various distribution channels and markets, while adhering to the jointly agreed upon rules and user experiences. The platforms commit and attract different parties with the financial benefits generated by the network.[35]

The effect of digital platforms on agreements and technological compatibility is best showcased by boundary resources.[36] Boundary resources refer to contractual and other co-operative regulations as well as software tools and interfaces which act as an open interface between the digital platform company and any other third party. It is characteristic for these digital boundary resources to be openly available and free (or almost free) to any third party on the internet, which allows a heterogeneous population of users to participate in the development and maintenance of various commodities in different platforms and system architectures[37].

Boundary resources can be understood as the opposite of barriers to entry. The use of boundary resources is aimed at lowering the often large development and commercialisation costs related to new innovations, therefore helping to create wider network effects than seen previously. Digital platform owners mostly benefit from sharing boundary resources with third parties by capitalising on split revenue business models.

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33 More about the ways the technology works: Mattila – Seppälä, 2015, p. 4; Mattila, 2016, pp. 4–7 and 24; Tapscott – Tapscott, 2016, pp. 31–33.

34 Mattila, 2016, p. 8.

35 Seppälä et al., 2015, p. 9.

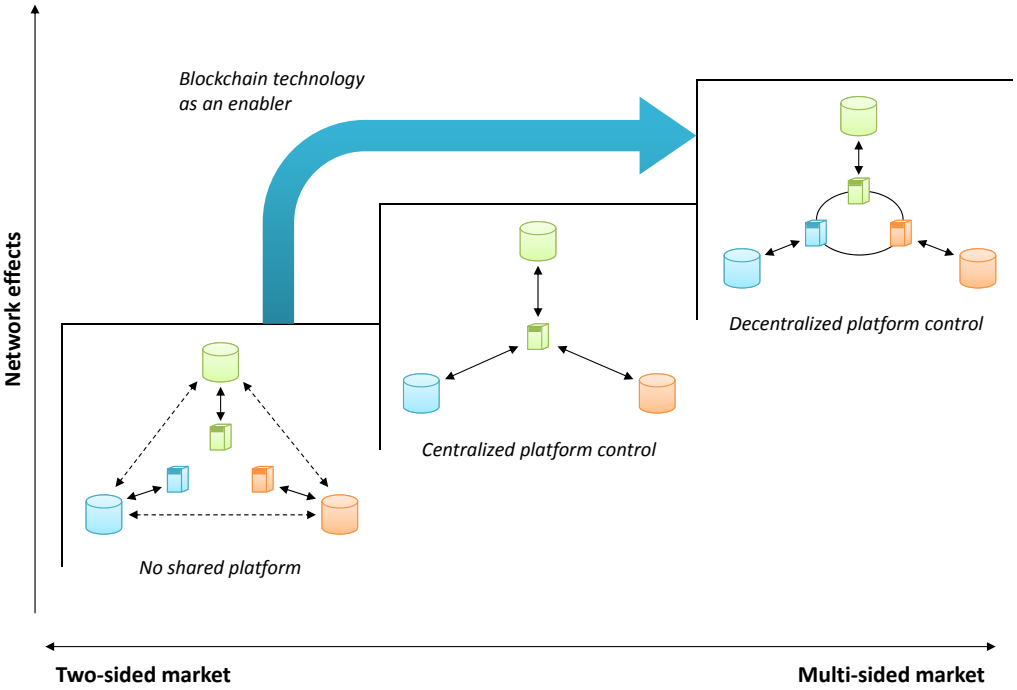
36 Gawer, 2009; Yoo et al., 2010; Ghazawneh, 2012; Ghazawneh – Henfridsson, 2013.

37 Seppälä et al., 2015, p. 7.

2.3 Blockchain Technology as an Enabler of Decentralised Platforms

One way to perceive blockchain technology is to look at it as a potential enabler for next generation digital platforms and their boundary resources, e.g. smart contracts. Typically, digital platforms have been understood as company-specific internal platforms or platforms controlled by a certain central operator but not as decentralised systems maintained together by a multitude of equal parties (see Figure 1). Then again, smart contracts can be utilised in all the three different situations.

Figure 1 From centralized platform control towards a decentralized consensus



Source: Mattila – Seppälä – Holmström, 2016.

Next, we will analyse the legal status of smart contracts based on the general doctrines of Finnish contract law.

3 Contracts vs Smart Contracts

3.1 Contract Law and the Interpretation of Smart Contracts

Contracts are a key legal instrument for private operators as they execute changes in their legal relations or try to prepare for future turns of events. Contracts also enable organised collaborative activity and are often used to carry out economic activity[38]. The definition of the term "contract" contains a number of different meanings. First of all, the term may refer to the

[38] Hemmo, 2003, p. 4; 2006, p. 27.

conclusion of the agreement itself, therefore describing the parties' commitment to the contract. Secondly, it may refer to the contents of the agreement, therefore determining the parties' rights and obligations in relation to one another. Thirdly, it may refer to the actual document in which the terms of the contract have been specified.[39]

Contract law is traditionally non-mandatory, in other words the parties can disregard certain rules of presumption by implementing their own terms. The principle of freedom of contract is the premise from which Finnish contract law starts. For a number of reasons, however, freedom of contract is restricted by certain mandatory rules regarding the content of agreements.[40] The main principle is nonetheless that parties can exercise full freedom in deciding whether to enter into a contract, with whom the contract will be concluded, and how and with what terms the contract is to be concluded. The right to decide on the dissolution of a contract has also been considered an important, yet separate, part of freedom of contract.[41]

In addition to the principle of freedom of contract, the Finnish legal system also acknowledges the principle of *pacta sunt servanda*; that is, agreements must be kept, which by law can be derived from Section 1 of the Finnish Contracts Act (228/1929, as amended)[42]. Various sanction mechanisms also make it necessary to abide by the contracts one has entered into, since the other party has the opportunity to claim damages or enforce the contract by help of the authorities. Based on case law alone we are able to conclude that the principle of *pacta sunt servanda* is a prevailing reality in our legal system without which society would not function properly.[43]

In this publication, we will address contracts as individual agreements with the main purpose of organising economic legal relations and which have been concluded between rational and equal private parties. Due to practical reasons, our presentation of Finnish contract law will be limited to a rather general level focusing on the mechanisms leading to the conclusion of a contract. Our goal in this publication is to analyse through doctrinal research[44] and as straightforwardly as possible those aspects of contract law which are relevant to the interpretation of smart contracts. This perspective leaves out several significant legal themes which we are not able to explore in this publication. Since there has been little research on smart contracts, this type of approach is necessary in order to define them and assess them in a legal context.

3.2 Legal Acts, Declarations of Intent and Contracts

The relationship between legal acts and contracts has so far been widely discussed in Finnish legal literature, and scholars have tried to find differences in the meanings of these terms. Recently, however, these terms have increasingly often been used as synonyms for each other[45], although Finnish legislation still includes well established expressions which utilise the

39 Saarnilehto et al., 2012, p. 310.

40 Hemmo, 2003, p. 77.

41 Hemmo, 2003, p. 69, 72 and 75–77.

42 Section 1(1) of the Contracts Act: *"An offer to conclude a contract and the acceptance of such an offer shall bind the offeror and the acceptor as provided for below in this chapter".*

43 Hemmo, 2003, p. 14; Saarnilehto, 2009, pp. 161–163.

44 Doctrinal research, or legal dogmatics, attempts to study law as it currently stands. See more: Hirvonen, 2011, pp. 21–26.

45 For example Mika Hemmo has used these two terms as synonyms. For more, see Hemmo, 2003, pp. 10–11 and Hemmo, 2006, p. 26.

term legal acts. In this publication, we will adhere to the practice of using the two terms synonymously.

Consent, declaration of intent and the purpose that this intent becomes known to the other party have all been considered sine qua non for a legal act. Consent refers to a party's free will to become bound by the contract. In addition, this consent must become known to the recipient in one way or another.[46] Declaration of intent refers to the expression of a party's[47] free will as a prerequisite to the conclusion of a contract. Both parties are free to decide what their will is and how they are bound to the decision. Although the declaration of intent should by principle be directly addressed to a certain other person or group, even a declaration of intent addressed to a more vaguely specified person or group of people can be seen as valid.[48] This, however, requires a restriction of some sort regarding the targeted group, as entirely unspecified public declarations of intent have by principle been considered non-binding. The reasonable impression that the declaration has had on the recipient has been utilised as a key argument in assessing whether or not the declaration has binding effects. For instance, an advertisement in a newspaper has not as such been considered a sufficient offer.[49] On the other hand, an automat which has been set up with its for-sale items and relevant information (regarding prices, methods of payment, products, etc) may be considered a de facto offer which has been made to a sufficiently limited audience, that is those who are willing to buy the products placed in the automat.

The declaration of intent must be expressed clearly. That said, an implied expression of intent is also valid, and intent can be expressed through various forms of communication. The thought or idea of an agreement alone, however, does not constitute a declaration of intent. The method, form and audience of the declaration are not subject to overly strict regulation, and it is in fact sufficient that consent is expressed in one way or another.[50] It is also not imperative to apply an overly strong presumption on the necessity of such a declaration. Not all methods of concluding a contract even require a proper declaration of intent. Additionally, the declaration of intent does not need to be entirely separate from the agreement, as a contract can also be concluded based on passivity or concrete actions.[51] It follows that a party's true will to be bound and some expression of this intent are of key importance.

A contract is a bilateral legal act which establishes rights and obligations for the parties to it. Only the parties to a contract may demand that these obligations should be met. A third party only has this right in certain exceptions[52]. In Finnish jurisprudence, contracts have traditionally been defined as the combination or amalgamation of two or more legal acts requiring one another. In some cases, specific requirements as to form must also be met or certain

46 Saarnilehto et al., 2012, p. 323.

47 In Finland, "legal acts" can be concluded by all natural persons (ie humans) and legal persons for whom requirements have been set in order to have legal capacity. Questions about legal entities may arise especially in relation to decentralised autonomous organisations, but also about the different interpretations relating to the nature of smart contracts. Some researchers have considered smart contracts as agents based on algorithmic contracts acting for and on behalf of their principal, or even independent legal entities. See eg: Scholz, Lauren Henry: Algorithmic Contracts (draft, 2016) and Bourque – Fung Ling Tsui, 2014, pp. 18–19. Questions about legal entities have their own connection to smart contracts, but that will not be considered any further in this text.

48 Saarnilehto et al., 2012, p. 323.

49 Hemmo, 2006, pp. 78–79.

50 Saarnilehto et al., 2012, p. 328.

51 Hemmo, 2003, pp. 11–13.

52 Norros, 2007, pp. 1–3.

actions must be performed before a contract can fully enter into force[53]. The conclusion of a contract is often related to the organisation of economic activity[54]. In recent decades, however, the social dimension of contracts has also been emphasised. A reasonable balance in terms of the material content of a contract has been considered a prerequisite for the binding effect of a contract. In addition, parties in a weaker position are not thought to have a very extensive duty to investigate or make enquiries.[55]

A wide range of diverse contracts is continuously being concluded in our society. Some of these are being registered in a separate contract document, while others rely on the de facto validity in the relationship between the contracting parties.[56] A contract, therefore, is an array of obligations and corresponding rights disposed by two or more parties under private law, which dictates the relational responsibilities of each party according to specific norms concerning liability. In addition, parties are typically aware of the obligations to which they are committing in the contract.[57]

3.3 Smart Contracts

A fully established definition for smart contracts has yet to be formed, and the official legal status of smart contracts is not perfectly clear. In this publication, smart contracts are defined as digital programs, based on the blockchain consensus architecture, which will self-execute when the terms of the agreement are met, and due to their decentralised structure are also self-enforcing and tamper-proof. As this article focuses on the utilisation of computer programming in order to create contracts, the definition of smart contracts is restricted to programs which have similar qualities to contracts and are also meant to replace, or add to, traditional contracts.

Diverging from contracts concluded in form of action, speech or writing, a smart contract is characteristically a computer program built on code. Some smart contracts, however, contain similar logic and characteristics that can be likened to those of conventional contracts, at least from a theoretical viewpoint[58]. In addition to traditional contract terms and conditions listed in the agreement, smart contracts are capable of actions such as collecting data from outside resources and processing it according to the terms specified in the contract, as well as adopting concrete solutions based on the results of this procedure[59]. There is indeed reason to note that the term "smart contracts" is also commonly used in connection with many other programs in the blockchain and not only those resembling a formal agreement.[60]

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53 Saarnilehto, 2009, p. 3; Saarnilehto et al., 2012, pp. 367–368.

54 This characteristic has at least been heavily emphasised. See Hemmo, 2006, p. 24.

55 See eg Hemmo, 2003, pp. 19–24. So-called social civil justice emphasises the mutual trust between the parties and the principle of equity of contracts. An unreasonable contract or individual term may, therefore, be amended by the court for reasons of equity. This feature of Finnish contract law will most likely be applied to smart contracts as well. Only time will tell, however, whether courts will have the competence to evaluate whether a smart contract written in computer code is equitable.

56 It is typically recommended that contracts should be drawn up in written form, mainly for legal protection. Requirements that contracts should be in written form are however quite scarce in Finnish law.

57 Hemmo, 2006, pp. 26–27.

58 Koulu, 2016, p. 65: "*[…] the smart contract operates with a similar logic to 'traditional' contracts: the will of both parties to enter the agreement is needed in order for it to be valid*".

59 BBVA Research – Digital Economy Outlook October 2015, p. 4 (https://www.bbvaresearch.com/wp-content/uploads/2015/10/Digital_Economy_Outlook_Oct15_Cap1.pdf) (23 August 2016).

60 See eg: Stark, Josh: *How Close Are Smart Contracts to Impacting Real-World Law?*, http://www.coindesk.com/blockchain-smarts-contracts-real-world-law/ (23 August 2016).

According to Nick Szabo, creator of the concept behind smart contracts, the most primitive type of smart contract is the vending machine in which transactions are based on simple automation. The vending machine, with its automated mechanisms, accepts the coins, returns the change and finally hands over the sold item. The vending machine therefore completes the transaction on its own when the necessary prerequisites are met, that is, a sufficient amount of money has been handed over to the machine. Anyone in possession of a sufficient amount of coins and with the desire to purchase an item is capable of becoming a contracting party in this type of transaction. Additionally, since the items for sale are situated within the vending machine, it is capable of protecting the contract from unauthorised changes.[61]

Smart contracts further develop the concept of the vending machine, as they can be applied to all digitally manageable assets of value. Szabo defines smart contracts as computerised transaction protocols that execute the terms of a contract. The purpose of a smart contract is to execute the general terms of a contract and limit the amount of exceptions and other errors. This simultaneously removes the need for third parties responsible for checking the accuracy of the process. Szabo's theory states that smart contracts diminish the number of frauds and other malicious phenomena while lowering transaction costs as contract terms are automatically implemented.[62]

The blockchain that the cryptocurrency Bitcoin is based on was for long the only functioning large-scale blockchain system. Due to technical restrictions caused by the programming language, the decentralised performance of applications other than cryptocurrency had its challenges in the Bitcoin blockchain[63]. In 2013, programmer Vitalik Buterin[64] published an article describing a new type of blockchain-based platform called Ethereum[65]. Ethereum was launched in 2015. As a significant advancement from Bitcoin, Ethereum finally offered a real opportunity for the decentralised performance of programs within the blockchain. These programs, which according to Buterin are cryptographic "boxes" containing value that only unlock where certain conditions are met, can also be called smart contracts[66]. Buterin later presented a definition in which smart contracts are described as automated mechanisms with at least two (contracting) parties. In addition, one or more of the parties must provide an asset or assets to be managed by the smart contract. After this, the assets are re-distributed between the parties according to the plan presented in the contract, so that the execution of the transaction is based on data that was not yet available when the contract itself was concluded.[67]

In a smart contract based on blockchain technology the terms of the contract are thus formulated in programming language, after which the smart contract is usually transferred to a blockchain in which it self-executes automatically without the assistance of the contracting parties when pre-defined conditions are met. In addition, it is capable of preventing unauthorised changes of its internal logic. A party cannot therefore intentionally prevent the execution

61 Szabo, 1994.

62 Szabo, 1994.

63 https://techcrunch.com/2016/05/22/all-the-cool-kids-are-doing-ethereum-now/ (23 August 2016).

64 Vitalik Buterin is a Russian Canadian programmer known for his "uncanny mind". He is best known for co-creating and innovating the Ethereum blockchain. See eg: https://en.wikipedia.org/wiki/Vitalik_Buterin; https://about.me/vitalik_buterin and https://backchannel.com/the-uncanny-mind-that-built-ethereum-9b448dc9d14f#.9l6w5ln7y (all 23 August 2016).

65 https://www.ethereum.org/ (23 August 2016).

66 Ethereum White Paper 2013.

67 Buterin, 2014.

of a smart contract or unlawfully alter its content.[68] From a more technical point of view, smart contracts are autonomous programs situated in a certain address in the blockchain, which can be rerun infinitely and can also be programmed to contain a wide array of business-model logics. Once the event specified in the contract takes place and the transaction containing data arrives to the address of the smart contract, the distributed virtual machine[69] of the blockchain executes the programming code.[70]

Our traditional understanding of contracts rarely covers contract-like programs. If a traditional contract were to be created in code, this would require the contract to be arranged and presented as a process depicting interdependency: "if X, then Y, otherwise Z"[71]. Since the way in which traditional contracts are worded can often result in ambiguity, this new use of formulas can in at least some cases reduce the need for interpretation[72]. This kind of development can at best lead to significant reductions in the costs caused by drafting contracts and overseeing their execution.

Smart contracts are thus automatic programs built on code which have been placed in a blockchain to perform certain processes. They begin to show contract-like characteristics once digital (or other) assets have been transferred to them for management and are transferred again or redistributed once certain conditions are met. In this phase, another party may join the smart contract and can initiate automatic execution by meeting certain preconditions. This could mean an action such as transferring a predetermined sum of cryptocurrency to the smart contract. It must be noted, however, that the aforementioned course of events is only a presumption, and the smart contract can also remain at a stage where it functions purely as a re-router built to transfer data or, for instance, the contents of one crypto-wallet to another[73]. The legal status of such smart contracts can indeed be questioned with good reason, at least from the perspective of contract law.

As a term, "smart contracts" can at times be misleading, for there are several types of smart contracts in existence. From a contract law perspective, therefore, their interpretation would seem to require case-by-case evaluation.

3.4 Mechanisms for Concluding Contracts

The so-called offer–acceptance mechanism, as it is regulated in the Finnish Contracts Act, is seen as the traditional method for concluding a contract and is based on two legal acts. As contracts are becoming all the more diverse, the offer–acceptance mechanism is not, however, always the most accurate description of the process leading to the conclusion of a contract.[74] Under section 1 of the Contracts Act, the offer to conclude a contract and the acceptance of

68 Mattila, 2016, p. 15. The irreversibility of some contracts may prove to be a problem in some situations. This issue will, however, not be discussed further in this text.

69 Ethereum is an example of a decentralised virtual machine situated into a blockchain, which allows for programs to be run in a decentralised fashion. See eg: http://ethdocs.org/en/latest/introduction/what-is-ethereum.html (23 August 2016).

70 BBVA Research – Digital Economy Outlook, October 2015, p 4 (https://www.bbvaresearch.com/wp-content/uploads/2015/10/Digital_Economy_Outlook_Oct15_Cap1.pdf) (23 August 2016).

71 Mattila, 2016, p. 15.

72 Wright – De Filippi, 2015, pp. 11 and 24–25.

73 Bourque – Fung Ling Tsui, 2014, p. 10.

74 Hemmo, 2003, pp. 96–97.

such an offer are binding in regard to the offeror and the acceptor. The Contracts Act, however, does not apply to contracts of standard form or contracts which require acting upon in order to become effective.[75] The response to the offer must be delivered on time and must accept the original offer as such. The Contracts Act provides that a response that purports to be an acceptance, but includes additions or restrictions, is to be deemed a rejection constituting a new offer directed at the original offeror.[76]

Mechanisms for concluding a contract not regulated by the Contracts Act include contracts concluded through negotiation, implied contracts and tacit agreements. Standard form contracts are also considered to be formed outside the offer–acceptance mechanism.[77] Aside from contracts concluded via the offer–acceptance mechanism, implied contracts and tacit agreements are the most relevant to smart contracts. In addition, smart contracts may contain similar characteristics to contracts requiring acting upon in order to become effective.

Implied contracts refer to a situation where a contract is seen to have been concluded without explicit expressions of intent, but rather based on social norms. In these situations a contract has been concluded based on some action, without any oral or written exchanges. Typically these actions have similar qualities to a contract and are part of a prevalent social convention which both parties are deliberately participating in.[78] Examples offered by legal literature of such social conventions could be using public transportation or parking in a paid parking lot. Using an automat has also sometimes been placed in this category. In summary, implied contracts are contracts based on certain facts inducing a contractual relationship but where no explicit offer–acceptance mechanism takes place.

The term "tacit agreements" is also used to describe a slightly similar phenomenon. The term refers to the conclusion of a contract through a situation in which no explicit declaration of intent can be detected, although the parties collaborate in a way that indicates the existence of a contractual relationship.[79] It has been stated in legal literature that it is mostly a matter of taste which term to use[80, 81]. When parties collaborate in a way that denotes a contractual relationship, a contract is seen to have been implicitly concluded, even though the method and time of conclusion and the contract itself cannot be shown. Therefore, if parties have commenced action as if the contract were in force, despite the contract's itself remaining in the stage of negotiations or not yet having being concluded, an implicit contract may be in force between the parties. The interpretation of whether a tacit agreement has been concluded is based on overall evaluation, in which circumstances strongly speaking in favour of the existence of a contract can prove that a tacit agreement has entered into force. However, even rather minor arguments against the existence of a contract can relatively quickly lead to the conclusion that no

[75] These kinds of contracts, which require acting upon (the interposition of something), are called real contracts, and in legal literature have been considered to have very little importance in Finland. "*Reaalisopimuksen sitovuuden edellytyksenä on sopimuksen kohteen luovuttaminen toisen hallintaan*" [For a real contract to be binding the subject matter of the contract must be handed over to the other party's possession]. See Hemmo, 2003, pp. 100 and 180–181.

[76] Finnish Contracts Act (228/1929,as amended): http://www.finlex.fi/fi/laki/ajantasa/1929/19290228#L3 (23 August 2016). The Contracts Act includes more detailed provisions about responses given on time, power of attorney and invalidity of juristic acts.

[77] Hemmo, 2003, pp. 129–137.

[78] Hemmo, 2003, pp. 131–133.

[79] Hemmo, 2006, p. 88.

[80] Implied contract or tacit agreement.

[81] Saarnilehto et al., 2012, p. 385.

tacit agreement has been reached between the parties.[82] Interpretation should not be too liberal in order to avoid parties being bound to contracts they have not declared their intent for.[83]

According to legal literature, a declaration of intent leading to the conclusion of a contract can be expressed by the parties through the exchange of assets or services with one another. A similar transaction-based interpretation has also been outlined in regard to smart contracts.[84] A declaration of intent by acting upon it can, for instance, take place in the purchase of items from a vending machine. In this case, the proprietor selling items and services via the vending machine has implicitly displayed its desire to conclude a contract with the terms specified by the vending machine. This is supported, for example, by the fact that the proprietor has first had to obtain the vending machine and a location for it, set up the vending machine and fill it with products, program the vending machine and make it operational before any contracts can be concluded. The user also expresses their will to be bound to the transaction similarly via the vending machine. The vending machine example can also be described using the offer–acceptance mechanism; however, tacit agreements seem more relatable to the reality of the phenomenon.[85]

The Supreme Court of Finland has stated in case KKO 2010:23 regarding private parking enforcement that the offer–acceptance mechanism of the Contracts Act no longer corresponds with all situations related to the conclusion of a contract. Contracts concluded via automats were mentioned in the ruling as another relevant example of these types of contracts.[86] The conclusion of a contract can therefore also be attributed to external characteristics presented in the parties' actions[87].

3.5 Conclusion of a Smart Contract

In the previous section, we presented a number of mechanisms for concluding a contract. In this section, we will be comparing these mechanisms and evaluating how well contract law doctrines regarding the conclusion of contracts are applicable to smart contracts.[88]

Especially in the offer–acceptance mechanism of the Contracts Act, the parties' declarations of intent are explicit, in other words the acceptor is given the details of the offer and the offeror is given information on the response. On the other hand, as explained previously, consent can be expressed implicitly, for instance through co-operation with the other party or the performance of duties. Since the doctrine on declaration of intent holds a strong principal position

82 Hemmo, 2003, pp. 133–136.

83 Hemmo, 2006, p. 88.

84 Koulu, 2016, p. 65.

85 Saarnilehto et al., 2012, pp. 384–385.

86 KKO 2010:23: "*Esimerkkeinä sopimuksista, joiden syntymisen edellytysten tarkasteluun oikeustoimilain periaatteet tuntuvat riittämättömiltä, on usein mainittu muun muassa erilaisia teknisiä välineitä, kuten automaatteja hyväksi käyttäen tehdyt sopimukset sekä sellaiset sopimukset, joita tehdään päivittäin ja toistuvasti suuria määriä ja jotka keskeiseltä sisällöltään ovat aina samanlaisia […]*". [As examples of contracts the conclusion of which the principles of the Contracts Act seem insufficient to explain, two similar contract types can be mentioned: contracts concluded using various technical devices, such as automats, and contracts concluded again and again in large quantities which are essentially always the same by content.]

87 Saarnilehto et al., 2012, pp. 384–385.

88 This may also be interesting in order to evaluate the effects on third parties, ie *ultra partes.* Even though the matter will not be discussed further in this text, it contains very important follow-up questions outside of contract law, eg in relation to tort liability, consumer protection, jurisdiction, conflicts of laws as well as dispute resolution.

in the Finnish legal system, this must also be taken into account when discussing the conclusion of a contract from the perspective of smart contracts.

In reference to what has been discussed previously, it appears possible that smart contracts can be concluded based on the parties' declaration of intent. Although it seems that the offer–acceptance mechanism can be applied to smart contracts, their conclusion seems to be better explained by the processes leading to tacit agreements and implied contracts. In the context of the offer–acceptance mechanism, the parties would come to a binding agreement via the offer of one party and the acceptance of the other. Only thereafter are transactions or other actions performed in accordance with the contract. With smart contracts, the intent of the party responsible for placing the smart contract in the blockchain seems to manifest in the same context where a contracting party transfers a certain digital asset to be managed by the smart contract.[89] Declaration of intent does not therefore appear to occur separately from the conclusion or execution of a smart contract, but is rather an immovable part of the contract itself.[90] Then again, if observed in light of the offer–acceptance mechanism, a public smart contract added to the blockchain to which the party has transferred assets for management may perhaps be interpreted as an offer[91]. Respectively, another party's joining the smart contract may be seen as acceptance of the offer[92].

The expressions of intent in the conclusion of a smart contract share many characteristics with a tacit agreement, where the contract is concluded by parties exchanging assets. When a party transfers the sum into the smart contract, and the other party begins to act based on the smart contract, the expressions of intent of both parties are included in the actions taken. Even though no deliberate expressions of intent are given, the actions of the other party are required in order to be bound to the contract[93]. A parallel can be drawn between this situation and the previously mentioned situation involving an automat. This interpretation is enforced partly by the fact that Szabo has mentioned in some of the first publications about smart contracts that an automat is the simplest form of a smart contract.[94]

Based on aforementioned details, acts performed by the parties of a smart contract can likely be thought to fulfil the definition of declaration of intent.[95] Therefore, at least certain types of smart contracts can feasibly be concluded either by acting upon them or implicitly, as demon-

[89] This manner of concluding a contract includes some similarities to the aforementioned real contracts. While real contracts often require the subject matter of the contract to be lodged in the custody of the other party, it would have to be separately evaluated to what extent the transferred sum controlled by a smart contract could constitute such a subject matter.

[90] Koulu, 2016, p. 65: "*The declaration of intent is not separate from the formation of the contract or from the execution of it*".

[91] It is a question of its own whether this type of offer and its acceptance are precise enough to meet the requirements of the offer–acceptance mechanism. When an announcement alone that a party is willing to conclude contracts does not necessarily constitute an offer (but rather an invitation to make one), the smart contract in the blockchain might not be such a specific offer either. See eg Saarnilehto, 2009, pp. 42–43.

[92] What may become interesting is the type of situation in which a complex smart contract has a wide range of unspecified creators, where it may be impossible to identify the offering party. A compelling question here is for instance how a group like this can validly act as an offeror. This theme will not, however, be discussed any more widely in this article.

[93] A different interpretation could be formed in a situation where it would be possible to commit to a smart contract by mistake or without understanding its true code-form content. These types of situations may be possible as the use of smart contracts becomes more popular, and it will be important to observe these situations in the future.

[94] Despite previous evaluations, a smart contract is not, for example, a mechanical automat containing beverages, but rather a program which performs a specified action based on its programmed execution logic. A nearly infinite amount of different kinds of smart contracts can be programmed, so it is quite probable that not all smart contracts can be seen to involve the type of (at least implied) declaration of intent that is required to conclude a legally relevant act.

[95] In this chapter we have discussed smart contracts in accordance with the definitions described previously in this publication. In addition, it has been considered that a smart contract only has one creator and is joined by only one other party.

strated in the aforementioned vending machine example. Here the "creator" of the smart contract announces their will to conclude contracts by building a smart contract in the blockchain and transferring, for example, certain assets to it. The other party of the smart contract expresses their will to be bound by performing an act in accordance with the terms of the contract, therefore accepting the offer without a distinct and explicit declaration of intent. Finally, when the preconditions specified in the smart contract are met, it executes itself automatically and for example redistributes the digital assets placed under its management or performs other tasks it has been appointed with, following which the contract can be thought to have been expired.[96]

However, not all smart contracts are as simple in reality. Next, we will discuss examples of different types of smart contracts and aim to highlight their various characteristics.

3.6 Three Examples of Smart Contracts

The following three examples[97] are simplified, but nevertheless contain some possible applications of smart contracts. In addition, each example is written in English pseudocode rather than an actual computer programming language, but still follows the logic with which the transaction described in the example could be implemented as an actual smart contract.

(1) API router ("oracle service")

The first example is about so-called oracles, in other words routers connecting a set of application programming interfaces (APIs). In this type of smart contract a program based on blockchain technology collects data from one or more third-party software interfaces or other sources, and relays the collected information as a report to a pre-determined recipient. In addition, a time limit up until which data should be collected can be set.

The main purpose of oracles is to provide information to other smart contracts in order to monitor the fulfilment of the terms of the contract. This is to ensure that one of the basic requirements of a functional consensus architecture is met: each party must be able to check the validity of the information in the blockchain. If the smart contracts were to monitor the fulfilment of the terms of the contract via information available on typical websites or third-party software interfaces then the risk would be that each party would find different results, thereby undermining the reliability of the contracts. Hence all factors which will affect the smart contracts must be brought into the blockchain through oracles.

Quite understandably, there are some trust issues related to using individual oracles, where one wants to maintain the benefits of using decentralised consensus architecture. In its simplest form, however, a smart contract functioning as an oracle would contain the following:

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[96] The true intelligence of smart contracts can be questioned, as they do not contain artificial intelligence in themselves, as has been stated previously in this publication. A smart contract should thus be perceived as an automated mechanism which performs its defined functions as certain preconditions are met. The established term "smart contracts" is thus somewhat deceiving.

[97] The service https://smartcontract.com/ which enables the programming-free creation of smart contracts via a web platform has been utilised in the two first examples. The third example has been written by applying for instance the following article: http://www.coindesk.com/blockchain-smarts-contractsreal-world-law/ (28 July 2016).

Terms of contract:

ORACLE will collect data from the address: http://www.zzz.fi/openAPI
AND REPORT data to the address: http://www.yyy.fi/ownAPI
UNTIL 2016-12-15

Obviously the oracle in itself does not resemble what is commonly understood in our contract law as a contract. The example given above contains no typical features of a contract. In addition, the contract does not include any parties and therefore does not include anyone's expression of intent. Its only purpose is to collect data from one source and send it to another for a pre-determined period of time. This type of smart contract functions exactly as a program designed to relay data. This example quite clearly illustrates the problems caused by the discrepancies between the terminology and contents of smart contracts. Even though the entirety of the contracts which the oracle is a part of may resemble a typical contract, the oracle in itself would still be nothing more than a program designed to relay data.

(2) Service level agreement

A slightly different type of smart contract could be a service level agreement. This type of contract could, for example, be used to estimate the success of search engine optimisation. In this scenario, a company (X) offering search engine optimisation services has created a smart contract into a blockchain, based on which it is offering optimisation services for EUR 1,000. Another company (Y) purchasing the service will deposit the required sum (EUR 1,000) into the contract in order to get search engine optimisation for its own domain. The created smart contract will assess whether X has been able to get company Y's domain into the top three Google search results before the due date 15 December 2016. If the terms of the contract are met, company X will receive the deposited sum, and if they are not, then the sum will be returned to Y.[98] The smart contract could look something like the following:

Terms of contract:

IF the domain http://www.example.com/,
RANKS between 1 to 3,
USING SEARCH TERM example,
IN SEARCH ENGINE http://www.google.fi/,
BY 2016-12-15,

THEN Term 1 IS MET, and
DEPOSIT is transferred to X.

OTHERWISE Term 1 NOT MET, and
DEPOSIT is returned to Y.

In this example company X has drafted a contract-like digital instrument, which X has then placed in a blockchain. This act can be interpreted as an indication of X's willingness to enter

[98] This type of smart contract seems to include characteristics of a contract containing conditions precedent or subsequent. In so-called conditional sales it can be agreed that the sale is only concluded if a certain future event takes place. Conditions subsequent refer to uncertain events. In this case the condition subsequent would manifest as the cancellation of the sale (and the return of the deposit to Y) in case Y's domain is not within the first three search results on the due date. For more about the conditions of a contract, see eg Saarnilehto et al, 2012, pp. 401–402. Conditions and conditional sales will not be further discussed in this publication.

into an agreement. Company Y demonstrates the same willingness to enter into an agreement by depositing the pre-determined sum into the contract. Such a construction is very similar to a tacit agreement, and is therefore quite a good example of how legal acts can be performed with smart contracts.

The example can be reversed so that company Y creates the smart contract in order to purchase search engine optimisation services. The agreement could be seen to have originated as a smart contract if, for example, company X would sign the smart contract digitally.[99] It follows that company X would have accepted company Y's expression of intent to conclude an agreement (the original smart contract which was used to order the search engine optimisation), and after the digital signature (ie affirmative reply) a legal agreement in the form of a smart contract would be in place between the two companies. Without the digital signature it would be troublesome to find company X's expression of intent. It is noteworthy, however, that a smart contract could be used simply as a tool to execute a deal, which could have been made earlier orally, or tacitly if both parties would have started to abide by the terms of the smart contract.

Based on this example, when evaluating the legal position of smart contracts, it bears some significance how and between which parties the smart contract was created.[100] In light of our current legislation dealing with contract law, the casuistic nature of the evaluation is emphasised.

(3) Domain purchase

Smart contracts could be useful when purchasing domains. In this example person A buys a domain (http://www.example.com/) from person B for EUR 500 by using a smart contract. According to the due date set by B, the transaction must take place before 15 December 2016. A simplified version of the smart contract could be drafted as follows:

Contract information:

PRICE = EUR 500
SELLER = A
BUYER = B
ASSET = Domain name, http://www.example.com/
DUE DATE = 2016-12-15

Contract function:

IF Message sender = Buyer, and
IF Present date < Due date, then

> Buyer sends (EUR 500) to Seller, and
> Seller sends (Domain name) to Buyer

[99] Digital signatures can be created in blockchain architecture for example via the use of public encryption key PKI infrastructure.

[100] Regarding the latter example, declaration of intent may manifest in different ways within the scope of the applied conclusion mechanism, depending on which party is the creator of the smart contract and which party is the one reacting to the smart contract. If a party of the arrangement does not act as the creator of the smart contract or react to it by making a payment or digital signature, their declaration of intent may be very difficult to prove.

The first part of the contract is used to specify all the information the smart contract requires in order to evaluate the fulfilment of the contract. The seller has transferred the asset (domain name) to the smart contract. In the second part of the contract the buyer is given the possibility to accept the terms by transferring the sum into the smart contract before the due date. If the buyer does so before the due date then the contract will verify that the sender is indeed the buyer and that the due date has not passed. If both of these results output the value true, then the smart contract will execute itself automatically by transferring EUR 500 to B and the rights in the domain name to A. Had the terms not been met, for example if the sum deposited was too low or the due date had passed, then the contract could be programmed to return the sum and the asset to their respective owners.

In this example the expressions of intent of the two parties are quite clear, and the contract can be seen to have been concluded tacitly. Person B's expression of intent (offer) is placing the domain name with the smart contract into a blockchain, and person A's reciprocal acceptance is depositing the sum into the smart contract. The situation can be interpreted via the offer–acceptance mechanism found in the Finnish Contracts Act such that B has shown their willingness to enter into the contract by placing the smart contract into a blockchain, and A has reciprocated by transferring EUR 500 into the smart contract. If the offer has been sufficiently identifiable then this interpretation is viable. The third example seems to reinforce the understanding that a smart contract can be a contract in the typical legal sense of the word, if an offer–acceptance mechanism can be sufficiently identified. This view is further reinforced when the example is interpreted analogously in comparison with the vending machine example.

4 Can Smart Contracts Be Used to Perform Legal Acts?

Smart contracts can be concluded on very different bases and for entirely dissimilar purposes. Some smart contracts are clearly of contract-like character, and the parties' declarations of intent become apparent during the process, while in other cases it seems unclear whether the "contract" even has parties or whether it is merely a matter of decentralised computer program. It seems impossible to come up with an unambiguous answer that applies to all smart contracts and, therefore, different situations must be analysed on a case-by-case basis based on our existing legislation. Although smart contracts are certainly not in their final stage as applications, they have come to stay. The previously presented description of The DAO also functions as a stark example of both the opportunities brought by smart contracts and the damage they may cause when faultily implemented.

Based on previous discussion, it seems rather clear that contracts can also be concluded as smart contracts. Especially the manifestation of intent through the exchange of performances appears to be of focal importance. In this case, the parties' declarations of intent are inseparable from the contract itself. A similar mechanism has previously been presented in legal literature in the case of the vending machine, where the implicit nature of declarations of intent is highlighted. This way of presenting the conclusion of a contract also seems to be the best theoretical starting point for analysing the types of smart contracts discussed in this publication.[101]

[101] However, it is likely that for example various reliable digital signature mechanisms can be used to explicitly confirm both parties' declaration of intent in the future.

To recapitulate, smart contracts are code-based programs that can be used to generate contractual effects between parties. The conclusion of a contract in the form of a smart contract is best explained by externally detectable characteristics of the parties' actions. Examples of these types of characteristics are, for instance, the placement of a smart contract containing assets into the blockchain for the purpose of concluding contracts, or participating in a smart contract by performing a transaction that meets its terms. On the other hand, in some cases the conclusion of a contract can perhaps be analysed in light of the offer–acceptance mechanism, if the creation of the smart contract and its placement into the blockchain are seen as a sufficiently individualised offer and acceding to this smart contract under its terms is seen as an accepting response of proper form[102]. In applications based on blockchain technology the parties are primarily unidentifiable. It seems, therefore, clearest to think that the declarations of intent are aimed at entities willing to conclude contracts in the specific matter at offer, as is the case in the vending machine example.

It has previously been emphasised that not all smart contracts meet the legal requirements or characteristics of a traditional contract. These types of different smart contracts can, for instance, be programs in which different parties do not appear distinctly and which are not in particular of contractual character to begin with. If intent cannot even implicitly be detected between the parties (if there are any), the smart contract does not constitute a contract with legal effects and is rather no more than a computer program built into the blockchain. The variety presented in smart contracts may cause various legal issues for which the effects may be hard to evaluate at this early stage[103]. In addition, it is possible that smart contracts will at times be only used as a mechanical device for concluding contracts, in other words to automate the execution of contractual obligations. In this case the factual contract between the parties must be either oral or written and must constitute the entire framework for the terms of the smart contract.

With the focus on potential challenges, so-called dual integration systems[104] and systems based on various model agreements[105] have already been developed to help prove the existence of a contract.[106] In solutions based on dual integration, for example, the goal is to ensure that contracts are concluded in a legal context as well, and not only as a smart contract. This can be of use by producing evidence or by facilitating the recognition of such flexible terms that are difficult to present as code alone. In these cases the contract is concluded as a smart contract, but the system used for this also produces a physical document in ordinary language in addi-

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[102] According to traditional Finnish contract law, offers cannot be presented to an entirely unspecified group.

[103] Such questions may regard for instance the existence of a contract or the verification of its content (code vs the parties' true intent) as well as possible unintended errors left in the code. For such errors related to the intent of the parties, it is likely that section 32(1) (concerning so-called error in declaratione) of the Finnish Contracts Act can be applied if there is a conflict between content and intent due to an error in the contract code. See eg Hemmo, 2003, p. 396.

[104] Dual Integration: "*The idea of dual integration is to allow users to be able to have the certainty of having a real world contract which can be taken to a court and enforced using established dispute resolution processes in the jurisdiction(s) of the user(s) while also using a smart contract as the primary mechanism for administering the data-driven interaction which attends to the agreement between the parties*" (https://erisindustries.com/components/erislegal/ (23 August 2016).

[105] Out of these openly developed solutions the perhaps most significant one is Common Accord: "*[…] an initiative to create global codes of legal transacting by codifying and automating legal documents, including contracts, permits, organizational documents, and consents. We anticipate that there will be codes for each jurisdiction, in each language. For international dealings and coordination, there will be at least one 'global' code*". Well-known lawyer and crypto-oriented legal researcher Primavera De Filippi is part of the Common Accord group. See: http://www.commonaccord.org/ (23 August 2016).

[106] One way to solve possible issues is by aiming to create general conditions of contract such as INCOTERMS or Creative Commons for the use of smart contracts.

tion to the smart contract in code form[107]. This way, the contract in paper form can be used to prove the parties' declarations of intent with increased certainty with the added possibility of using separate contract terms to agree upon the resolution of potential issues or disputes before they arise. The smart contract created simultaneously can be used to guarantee the efficiency of the agreement via automated execution.

Based on Finnish legislation, smart contracts seem to constitute at least a type of contract instrument which can be used while concluding contracts. In addition, it seems that the question surrounding the legal status of smart contracts can at least in some cases be answered by contract law doctrines. This depends on the function of the smart contract and the way in which its parties' declarations of intent are presented. There seems to be no reason to doubt whether smart contacts can be used to perform legal acts as long as the parties' intent is at the very least made evident by facts. Furthermore, performing legal acts in form of smart contracts and acceding to these appears to be possible in at least some smart contracts. At its best, the wide-scale exploitation of smart contracts increases the efficiency of contractual procedures and execution processes thanks to automatisation, and may simultaneously reduce the need for interpretation as a result of their logical structure. Only time will tell, however, how smart contracts will be utilised in the future and how, for instance, courts will respond to contract terms written in code form as legal issues arise.[108]

As outlined in this publication, the conclusion of smart contracts and their legal status can be interpreted analogously through various other mechanisms in the field of contract law. In spite of this, many significant legal questions concerning smart contracts remain unsolved[109]. At this stage of development, Finland would have an excellent opportunity to become a pioneer in the use of contractual instruments based on blockchain technology[110]. This would require ambitious research as well as flexible and modern legislation which would be used to prepare for potential issues and to enable the wide-scale use of smart contracts for the automation of contractual relations[111].

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107 Eris is an example of these kinds of dual integration systems.

108 It is quite likely that smart contracts can especially be utilised in the context of standard-form and otherwise simple contracts. Development may be much slower as far as contracts involving a large scale of possibly ambiguous terms are concerned, and it would be preferable to continue to conclude such contracts traditionally in the near future. However, certain double integration models can be used for such contracts, therefore automating either parts, or the entirety, of the contract. See eg: http://www.krogerus.com/news_events/newsletters#blockchain-and-smart-contracts-game-changing-technology (23 August 2016).

109 In this publication, it is not possible to discuss central guidelines not related to the content of smart contracts or the interpretation of such content. Questions regarding parties and legal entities in general have also been left undiscussed apart from a few mentions. In addition, the question of which country's national legislation should be applied to smart contracts is also interesting. Smart contracts exist in a blockchain that functions in a decentralised environment, and the parties (which may be several) may be unknown to one another. Therefore it may not be clear which jurisdictions are relevant to the contract unless specifically referred to in its terms. It is important to study this question, but it is likely that any factual solutions to this issue will only be found through practice.

110 Substantive law can naturally influence the extent at which smart contracts become more prevalent in Finland and in which forms they present themselves to consumers. Without proper legislative support, it may be impossible or very difficult to utilise new types of technological applications in business.

111 This type of development should be connected to more wide scale projects regarding the utilisation of blockchain technology. Finland's neighbour Estonia is an excellent example of a country in which the government is already actively seeking to utilise blockchain technology in healthcare, for instance. See eg: http://www.forbes.com/sites/dell/2016/06/14/the-tiny-european-country-that-became-a-global-leader-in-digitalgovernment/#57c30ed34c7f (23 August 2016); https://e-estonia.com/e-health-estonian-digital-solutions-for-europe/ (23 August 2016). An additional example from the field of international actors is the European Securities and Markets Authority's (ESMA) Discussion Paper published in the early summer of 2016, which is meant to open discussion and survey the effects of blockchain technology in the securities market. For more, see the following: https://www.esma.europa.eu/sites/default/files/library/2016-773_dp_dlt.pdf (23 August 2016).

While analysing the legal questions related to automated data processing, the Contracts Act Committee[112] stated in the early 1990s that, for instance, legal acts concluded via automats can become an issue in view of the conclusion mechanism outlined in the Finnish Contracts Act. At that time, it was not found necessary to amend the law based on technological development alone, as it was seen that the Contracts Act could be applied to these new situations when interpreted accordingly.[113] As has been stated previously, the vending machine example seems to be analogously applicable to smart contracts, judging by their similar theoretical character. Approximately 25 years have passed since the Committee's report, and technological development has happened incredibly fast during the past few years. The contracting environment of the 2010s is significantly different from that of the early 1990s, not to mention what Finland was like during the 1920s when the Contracts Act entered into force[114]. Even though the old doctrines of contract law have sufficed for now, digitalisation is bringing us new types of instruments the mode of origin or contents of which no longer necessarily reflect the idea of a contract enshrined in our legislation.

By interpreting smart contracts through traditional contract law doctrine, we are in at least some cases able to find their method of conclusion compatible with the way our legal system defines contracts. That said, today's legal tools will not necessarily function in tomorrow's environment, and this should be prepared for sooner rather than later. Smart contracts are likely to be only one of several new applications with which contracts will be concluded or executed in the future. Their novel character alone creates reason for examining our legislation with the focus on technological development and automatisation. Even though Finnish contracts law has traditionally been open to rather flexible interpretation and emphasises the trust between parties, technological development can cause new types of issues which would require interpretation to depart rather far from the original content of our legislation in order to be solved. There is therefore good reason to examine the topic on a national level. In addition to the legal qualification of smart contracts based on blockchain technology and technology's effects on contract law, discussion should also be directed to questions surrounding legal entities, a topic which has previously been considered not so worthwhile. Such a discussion is now well-founded, seeing that blockchain technology and smart contracts enable entirely new modes of co-operation.

Based on previous observations, it appears that at least some smart contracts can be used to perform legal acts. Nonetheless, significant changes to contracts and contracting culture will be seen as digitalisation gains further momentum. Our legal system will inevitably be pressured for change and face the need for development. Since our current perception of contracts seems somewhat incompatible with some of the new tools generated through digitalisation, a wide-scale analysis of our current national contract law in the light of technological development ought to take place as soon as possible.

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112 In 1987, the Ministry of Justice set up a committee to scope out the need for modernising and amending national contract law in view of developments in automation and information technology (Committee Report on the Contracts Act, KM 1990:20, p. I–III).

113 Committee Report on the Contracts Act, KM 1990:20, pp. 11, 38 and 67–68; Saarnilehto et al., 2012, pp. 368–369.

114 Although the traditional opinion is that the Contracts Act has adequately remained up to date with development, it has been the subject of updates every now and then. The most recent partial reform is from 2004 (Act 128/2004 regarding the amendment of section 23 of the Contracts Act). Nonetheless, the Contracts Act is still mostly in its original form as it was shaped through Nordic legislative collaboration.

5 Decentralised Consensus – Preparation and Regulation

5.1 How Smart Contracts Affect Platform Economy

In literature surrounding the topic of platform economy, boundary resources have traditionally been understood as technical tools used to lower the threshold for third parties to join part of a company's platform ecosystem. The perspective of technical tools, however, has yet to be applied to co-operative boundary resources on a similar scale. Smart contracts are a clear example of how co-operative boundary resources are developing in an increasingly technological path. As digitalisation continues, co-operative boundary resources should therefore be perceived as technical enablers, similarly to technical boundary resources[115].

Traditional contracts in themselves have also yet to be perceived as boundary resources in the sense that the network effects of a platform ecosystem could be boosted by opening up the company's contract interfaces. This would mean, for instance, the application of even further automated digital contracting mechanisms, process automation that reaches further beyond a company's own information systems as well as further automated and more dynamic networks of contracting parties.

A significant starting point for the development of the internet of things is that in the future devices will be capable of interaction and economic transactions even with such devices with which the exchange has not been planned in advance or agreed upon with the device's owners. Smart contracts could bring significant improvements to this as they enable the use of process automation beyond a company's own systems in a much larger scale than seen previously. Regardless of whether these contracts would be seen as concluded between the devices or the companies owning them[116], the main question is whether smart contracts can establish valid legal relations in the first place.

Blockchain technology and blockchain-based smart contracts offer the opportunity for companies' information systems and process automation to move further towards systemic internet-based units[117]. From a company viewpoint, it is important to solve which of their functions can be agreed upon in the form of smart contracts and which functions should be left to be managed through traditional contracting processes. Companies may have several contract interfaces intended for their clients, suppliers and other interest groups. In the next phase, companies should attempt to solve which interfaces are suitable for the use of smart contracts with which respective parties. In addition to this, it would be recommended that companies carry out research on the ways in which smart contracts could be used to lower the threshold for third parties to join the companies' own platform ecosystems in the same way that technical boundary resources have been used for opening interfaces and offering ready-to-go tools for development.

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115 For comparison: Gaver, 2009; Ghazawneh, 2012; Ghazawneh – Henfridsson, 2013.

116 Regarding interaction between devices, there is the important legal question of who is seen as the correct legal entity. This theme is connected to the previously mentioned wider discussion surrounding legal entities, in the context of which one may evaluate the need to recognise an independent legal status for certain types of code or artificial intelligence.

117 See also Ailisto et al., 2015; Mattila et al., 2016.

5.2 Smart Contracts Require a Wider Technical, Economic and Legal Perspective

Digitalisation is leading to the development of new types of instruments that challenge our traditional understanding of contracts and their mechanics. When co-operation is in extreme cases organised by the programming code of a smart contract alone, this can mean a challenge when trying to understand the true content of these types of arrangements. Although this paper has described three examples of smart contracts, in reality the number of possible applications may be practically infinite. In some cases it is clear that the essential elements of a contract are lacking, while in some cases the criteria for a legal contract are most likely almost always met. Between these two extremes lies a variety of cases in which the legal effects of a smart contract are most likely dependent on how exactly the smart contract has been concluded.

Therefore, if it is perceived that smart contracts written in code form are seen as legal contracts in some but not all cases, the question of who should be the judge of this inevitably arises. Since no model for classification or case law exists yet, an important question from the perspective of legislation is which public entity has or should have the technical skills and capacity for analysing the legal character of smart contracts at a case-by-case basis or on a larger scale.

Should the validity of a smart contract be evaluated in court at a case-by-case basis? On the other hand, would it be possible for public or governmental entities to take responsibility for clarifying the legal status of smart contracts? Respectively, it can be asked whether the industries should take pre-emptive measures and create model contract terms that support the exploitation of smart contracts.

While examining technological disruptions the techno-economic point of view has traditionally been selected as the dominant way for understanding various phenomena and their effects. In recent years, legal regulation has also been increasingly understood as an equally important factor in developing innovations[118]. Reality has also shown that techno-economic anticipation alone has not always led to functioning regulatory practice in the case of platform economy. For instance, the new business model which has gained recognition since 2007 and has formed the basis for services such as Uber has created the need for new regulation directed at the right subjects. In the current environment it is no longer enough to be aware of the technologies being developed, but their effects must also be understood.

Blockchain technology can therefore be predicted to disrupt the development of platform economy by enabling, for example, unprecedented ways to communicate and co-operate as well as new technical contracting practices. In terms of maturity, blockchain technology is so far at a stage of development and, according to various technology suppliers, it should be ready for wide-scale application development in approximately two and a half years' time[119]. It follows that, from the legislator's point of view, it would now be the perfect moment to learn to understand the blockchain technology and come to grips with its effects whilst studies into this new technology are ongoing.

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[118] Chander, 2014.

[119] http://www.aaltopro.fi/blog/new-york-lontoo-ja-berliini-lohkoketjuosaamisen-keskittymat (29 August 2016).

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