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SUPPLY CHAIN USING SMART CONTRACT BLOCKCHAIN TECHNOLOGY IN ORGANIZATIONAL BUSINESS

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Abstract:
The key distinction among a smart contract and most other blockchain platforms is that it can comprehend a general-purpose programming language. With the introduction of smart contracts and a blockchain platform capable of executing them, the possibilities for their application are endless. A smart contract is an electronic transaction protocol that is intended to facilitate, verify, and enforce the negotiation and execution of the terms of an underlying legal contract to satisfy common contractual conditions such as payments, legal obligations, and enforcement without the involvement of third parties. As a result, smart contracts attempt to reduce transaction costs, such as arbitration and enforcement, by establishing trackable and irreversible transactions on distributed databases through blockchain technology. On the other hand, smart contracts have the potential to go far beyond cost reductions by enabling the entrepreneurial collaboration of cross-organizational business activities that are prevalent in smart supply chains. A closer examination of current or continuing smart contract projects reveals that the most prevalent smart contract applications in business are supply chain management, the Internet of Things, and Industry solutions. The author completed many European initiatives involving transnational entrepreneurial networks and supply chains. As a result, the study examines how and to what degree smart contracts and blockchain technology might aid in the establishment of collaborative company structures for long-term entrepreneurial activity in supply chains. The study was performed using expert online interviews, questionnaires.

Keywords: Supply Chains, Smart Contract, Blockchain Technology, Organizational business

1. INTRODUCTION

Blockchain systems enable the execution of scripts on top of the blockchain, referred to as smart contracts, which enable parties to codify business rules like those found in signed legal agreements. Thus, a smart contract may be thought of as an electronic transaction protocol that enables the digital enforcement of the provisions of an underlying legal contract intended to satisfy requirements such as payment, legal duties, and enforcement without the involvement of a third party. Parties. Since such a smart contract is trackable and irreversible, it enables the digital execution of legal agreements and connected transactions between dispersed units within a network or supply chain at a lower transaction cost. Thus, smart contracts and their associated transactions are executable without the participation of a third party, and recent research indicates that these technologies may be used to address critical supply chain problems [,3,4,9,16]. Thus, blockchain technology and smart contracting seem to be appropriate ideas for redesigning and optimizing collaborative business processes and supply networks However, the significance of smart contracts and blockchain technology may extend beyond cost reduction and supply chain efficiency. It enables the integration of SMEs into organizational business operations by establishing an open and standardized IT environment that enables the SME sector to participate fairly in supply chains due to the already connected IT systems. The underlying business structures remain often closed because of the dominance of large companies and their specialized IT systems and business regulations, which control market conditions inside supply chains and create high entry hurdles for SMEs and entrepreneurs [4,18]. Thus, historically, linked business processes have been conducted by depending on central third-party suppliers according to their standards, and these centralized architectures not only foster dominance and entry obstacles, but also constrain process innovation. Blockchain technology allows these procedures to be conducted decentralized, without the requirement for a central authority or mutual confidence between the parties involved.

Supply chain management enquires into and attempts to optimize cross-company business processes defined by downstream flows of products and services and upstream flows of information and money (Jacobs & Chase, 2014). Coordination of the underlying supply chain flows is a difficult job, owing to the diverse interests of engaged parties, the complexity of business operations, and the dispersed nature of the supply chain. Significant characteristics of SCM issues include the hegemony of large companies, fragmentation, difficulties with supply chain financing, and difficulties with supply chain lead-time and throughput [14,22,28]. These problems are currently being addressed in the area of smart manufacturing and logistics, but with a focus on fractals, networked cyber-, organizing and optimizing, as well as machine-to-machine (M2M) systems [18]. Thus, in the context of industry, traditional SCM problems become more intelligent; they become more networked, fragmented, and dispersed [15]. Recent study demonstrates that blockchain technologies have the potential to facilitate entrepreneurial cooperation across networks and smart supply chains in order to address issues linked to Fragmentation and agglomeration of independent entities [4,13]. The academics believe that without a central authority, blockchain technology allows an expanding collection of participants to maintain a secure, permanent, and timestamped record of transactions. In other words, transactions are not centrally recorded, and each party maintains a local copy of the ledger consisting of a linked list of encrypted blocks containing a collection of transactions that are hashed and grouped into blocks and thus broadcasted and recorded by each participant in the blockchain network. When a new block is suggested, the network's members agree on a single legitimate copy via a consensus process. Once a block has been collectively accepted, it cannot be altered or deleted; therefore, a blockchain may be thought of as a replicated append-only transactional data store that can be used in lieu of a centralized register of transactions maintained by a trusted.

This paper of this article is to explore how and to what extent smart contracts and blockchain technology may be used to facilitate and enhance the implementation of collaborative business structures for sustainable entrepreneurial activities in smart supply chains. The study is based on expert interviews, surveys, and case studies conducted as part of European initiatives involving entrepreneurial activity in supply chain contexts.

2. SMART CONTRACT, BLOCKCHAIN

As previously stated, the term blockchain refers to both a distributed database and a data structure, namely a linked list of blocks containing transactions, where each block is cryptographically chained to the previous one via its hash value and cryptographic signature, in such a way that altering an earlier block requires re-creating the entire chain. Smart contracts, which are associated with blockchain technology, are scripts that are run whenever a certain kind of transaction happens and that may read and write to the blockchain. Smart contracts enable parties to impose the requirement that if a certain transaction occurs, other transactions also occur [11]. Consider delivery inside a supply chain in which all data regarding suppliers, recipients, products, and business circumstances is dispersed across supply chain databases. Selling products or services may be accomplished via a transaction that is cryptographically signed by both the seller and the buyer, as well as through the use of a smart contract. When the sale occurs and all other agreed-upon criteria such as paperwork, tax payments, and quality checks are met, the execution of the associated money and rights may be enforced, i.e., smart contracts can ensure the proper execution of collaborative, entrepreneurial processes. The underlying business processes and legal agreements are often mathematically represented using Petri-Nets that describe the underlying workflows and tokens that represent primarily permissions ("authorization tokens") or information. Thus, a critical job is to convert a conventional Business Process Model and Notation (BPMN) to a Petri-Net and then to compile this Petri-Net into a smart contract. A smart contract's technological implementation needs a formal language, such as sourcing Markup Language (eSML), to describe potential interactions and contracts and to enforce the agreements made [10,11,12,13].

However, for smart contracts to be widely adopted in the business world, a general framework for their operation and development is required, including legal protections for technological protection measures and rights management information, collectively referred to as Digital Rights Management (DRM) [3,1].Technical protection measures refer to technologies that limit the actions that may be taken in relation to a copy of a work, while right management information refers to electronic data associated with a work. The current distributed ledger technology includes built-in tools for automating transactions, allowing users to write sophisticated software using a smart contracting language such as sourcing Markup Language (eSML) that interacts with the distributed ledger and shares its self-enforcing or immutable characteristics. Thus, smart contracts may be thought of as algorithmic account holders on a blockchain, representing bits of code that execute transactions when their encoded criteria are met. In general, a smart contract encodes 'if-then' conditions in such a way that a user pays an amount to the smart contract account if the underlying contract's preconditions are met. Thus, a smart contract may divide income depending on Petri-Net-like circumstances represented by colored tokens. [11,12.3]. ability of smart contracts to facilitate cross-company and network activities is also reflected in existing or ongoing smart contract projects, with over 70% of the top domains for smart contract applications in business life being supply chain management (SCM), Internet of Things (IoT) solutions, and related topics. The primary reason for depending on smart contract applications is to create transparency and trust, which are also required components of Industry which aims to build cyber-physical systems and dynamic production networks in order to accomplish flexible and decentralized manufacturing. In the production of sophisticated mass customization goods in small series up to lot size 1, open value chains are used. A closer examination of the Industry 4.0 concept reveals additional goals for smart manufacturing and logistics, including increased energy and resource efficiency, shorter innovation and time-to-market cycles, and increased productivity using 3D printing, big data, IoT, and the Internet of Services. Thus, Industry results in the emergence of new supply chain paradigms based on complex and interconnected production networks, redefining the roles of designers, physical product suppliers, clients, and logistical service providers. The method enables the identification and tracking of individual goods throughout their full life cycle, and even beyond, since Industry enables products to self-organize and select their own path through the manufacturing and associated logistics processes.

3. DELIVERY SCENARIO

[18] examined a modular manufacturing company's value and supply chains in the context of networked cross-company value and supply networks. The case study demonstrates all the characteristics of networked business structures based on fractals, self-organization, self-optimization, and distributed systems cooperating in the form of a networked modular enterprise, i.e., the networked modular enterprise concept approaches existing models for implementing pre-Industries structures. Thus, the use of blockchain technology and smart contracts seems to be a natural fit for modular businesses. In general, the term "industry" refers to interactions amongst CPS that collaborate beyond corporate boundaries through the internet as part of smart manufacturing and coordination networks. The underlying procedures for cross-company value creation include automated objects in various fractals, as well as M2M communication and associated workflows, and business operations need agreements in a dispersed IT environment. Here, blockchain technology and smart contracts provide an appropriate solution that is traceable and transparent and can follow an Industry product throughout its life. This characteristic is critical at the interface between a smart supply chain and the client, since on the one hand, the supply chains must satisfy customer expectations, while on the other hand, the client interface is defined by the last-mile issue and associated high costs. [23]. continued to explore the last mile problem in the conventional contexts of B2C and ecommerce; they suggested an unattended receipt of products, which may save up to 60% on home delivery expenses. The method to unattended delivery is founded on two fundamental concepts: the receiving box idea and the delivery box concept: The welcome box is placed in the customer's garage or yard, while the delivery box is an insulated, safe box with a locking mechanism. Meanwhile, new technical breakthroughs integrated into new business models have enabled new options for bridging the last mile to the customer via drones and delivery scenarios well as food and grocery services obtaining their first experiences with autonomous devices [21,23]. traditional delivery box concept can be applied to an Industry context of internet–connected manufacturing and logistics, and autonomous delivery scenario can be viewed as cyber-physical systems of Industry 4.0-related last-mile delivery that typically involve three stakeholders: the seller, an intermediary, and the client. Technical scholars focused mostly on M2M systems and the development of autonomous logistical agents in the setting of industry. [25] studied M2M systems in the context of embedded internet and proposed a vision for the Internet of Things that included low-cost/high-performance devices, scalable connectivity, and cloud-based device administration and services. By examining M2M examples for mobility assistance, they examined the framework conditions for M2M network standards, and [27]. emphasized the importance of self-organization and self-management as critical elements for the success of M2M systems. This is because little human involvement is a critical need. Meanwhile, several entrepreneurs established start-ups to develop autonomous transport equipment based on Industry ideas to service the last-mile delivery automatically. Following an early emphasis on distribution through flying drones, land-based delivery scenario are now being considered for the last-mile [20] . A closer examination reveals that autonomous delivery scenario have a competitive advantage over other modes of delivery because the underlying business model emphasizes the cost savings associated with last-mile delivery, which are estimated to be less than $2 per unit/delivery, up to 15 times lower than current costs. For the client, the fact that robot delivery offers a 15-to-20-minute delivery window as standard, a considerably more exact specification than conventional delivery, which can only specify a general date (calendar day) in advance, adds another layer of convenience. A prominent example of a delivery robot is Starship Technologies Ltd., which was established in 2014 in Tallinn by Skype co-founders Janus Friis and Ahti Heinla with the goal of addressing the last-mile issue via the development of autonomous delivery robots. Today, Starship Technologies is a European technological start-up with operations in Estonia, the United Kingdom (UK), and the United States of America (USA), that pioneered the development of commercially accessible autonomous delivery robots. to "revolutionize the business of local delivery" [21].

4. FINDINGS

Modular businesses and autonomous delivery scenario in their current configuration do not fully use Industry's potentials, most notably the employment of robots for food and flower delivery. The picture alters significantly if the supplied item is a high-tech industrial device that is always connected to the internet, since in this scenario, the product itself becomes an object of tentative transactions through a smart contract even after delivery. If we see the customer as another fractal inside the framework of a networked modular business and suppose that autonomous robots deliver between the modular company's connected components, we obtain a more realistic image of the future state of the industry. The associated workflows and cross-company value processes can be thought of as an internet-connected smart manufacturing network or supply chain in which goods and services are produced and delivered downstream, information and finance flow upstream, and smart contracts execute electronic transaction protocols in both directions. Thus, the adoption of blockchain technology in conjunction with smart contract solutions augments the already-existing foundation technology for the purpose of achieving desired Industry solutions. The sequel discusses the additional value of smart contracts to supply chain performance, legal concerns, and product customization in the context of autonomous delivery scenario.

4.1 Performance of the Supply Chain:

[14]. developed logistic operation curve theory and throughput-oriented lot size for the purpose of controlling and optimizing operations management and supply chain activities. However, empirical study demonstrates that the theoretical ideas are too imprecise for practical applications, necessitating the adaptation of the underlying models based on real-time data to align the processes with their optimum models (Schmidt et al. 2015). Smart contracts are used to start transactions amongst supply chain units to coordinate and optimize the whole supply chain. This method addresses both time-related problems such as throughput, cycle time, and lead time, as well as money flows throughout the supply chain. [21,26]. emphasize the significance of blockchain technology for supply chain finance, although academics continue to debate the most suitable currency for supply chain financial transactions. At the time of the transaction, visible features such as conditional money transfer transactions are available. Smart contracts with additional changes such as the blocking of certain product features if the customer does not comply with certain criteria, specific payment agreements, may be used to rapidly implement product delivery by the scenario. [12]. advocate for the use of cryptocurrencies in financial transactions since the management of digital money may be accomplished via smart contracts without the need for media discontinuities. This issue becomes moot in the event of a fully integrated e-government infrastructure similar to e-Estonia, where digital access to financial services may be protected in a digital manner.

4.2 Legal implications:

[3]. examined copyright and license problems that may arise in the context of robot deliveries when using blockchains and smart contracts. They found many areas in which the combination of blockchain technology and smart contracts seems to be promising, including private ordering, copyright concerns, and equitable compensation. Nonetheless, all of these problems are connected to unresolved issues. To begin, it is necessary to state that there is no such thing as an international copyright. The Bern Convention establishes 176 distinct national bundles of copyright rights that vary in scope and duration. Another critical point is that copyright transfer frequently requires a written instrument, making it appear doubtful that courts will interpret smart contracts as an appropriate written instrument, highlighting a problem field that touches on numerous other types of transactions that require written form. Additionally, using blockchain technology for copyright licensing raises the issue of on- and off-chain transactions. While it seems possible to automate the coordination of purely on-chain purposes and users through smart contracts, conflict resolution may need off-chain organizations. Additionally, the development of blockchain-based smart contracts will be connected to the issue of retaining copyrights and licenses if agreements are subsequently violated, particularly in light of the Berne Convention's framework requirements. In the event of retention, conflicts between smart contracts and conventional licenses may arise, for example, if off-chain transactions are not correctly recorded on a digital ledger, a blockchain may desynchronize. Thus, rather than decreasing information uncertainty and fostering trust, implementing a blockchain-based system may have the opposite effect. Thus, the need for coordination emerges, and it is not yet clear how and indeed, whether platforms developed, using blockchain technology can address these issues.

4.3 Product customizing:

[7]. define mass customization is the method of effectively postponing the task of differentiating a product for a specific customer until the latest possible point in the supply network. For Industry manufacturing of complex mass customization products in a small series up to lot size 1 represents one of the main motivations, which require close interaction and a good relationship with current and potential customers. The postponement task of mass customization is solved too significant extent by the concept of modularization, i.e., a deconstruction into independent units, called modules, to reduce the complexity of a system, e.g., a business process, an organizational structure, or an IT application. The modules exist independently from each other, but the system can only function as an integrated structure. Product modularity provides flexibility and responsiveness that enables firms to serve a variety of customer needs. [6]. investigated modularization and its impact on supply relationships and found out that an advantage of modularity concerning supply chain design is that pursuing product variations has only a limited impact on production and assembly processes. Modular design allows a firm to differentiate its product to a high degree by combining a limited number of standard parts and modularity has been extensively applied successfully in the in electronics and automotive sectors. [17]. differentiated four types of mass customization, namely collaborative, adaptive, transparent, and cosmetic customization. In the case of product delivery by a robot, the adaptive customization scenario seems to be the most exciting case since here to a company produces and delivers a standardized, modular designed product and the product customization takes place at the client. By assuming an Industry product that enjoys internet linkage during its full life cycle, smart contracts can activate or block product or module functions according to agreements between supply chain units and the client. Based on this concept, sustainable business models suitable for Industry can be implemented [20]. Hence, already the case of autonomous delivery scenario highlights that the use of blockchain technology and smart contracts complement the existing solutions for smart supply chains and to spur the development towards Industry by filling essential gaps in the context

of technical Industry applications.

5. CONCLUSIONS

Smart contracts are electronic transaction protocols for executing and enforcing underlying legal contracts via the use of distributed database technologies such as blockchain. They are intended to self-enforce contractual terms such as payments and legal responsibilities without the assistance of an established trustworthy third party. Thus, smart contracts aim to minimize transaction and enforcement costs by enabling tamper-resistant and irreversible transactions. The study demonstrates that the potential of smart contracts extends far beyond cost savings by enabling entrepreneurial cooperation on cross-organizational business activities that are typical of smart supply chains. Applications of smart contracts in conjunction with intelligent supply chain management, the Internet of Things, and Industry has the potential to address key problems in smart manufacturing and coordination.

By examining the case of autonomous delivery scenario, the paper demonstrates how Industry blockchains, and smart contracts all fit structurally well together and complement one another by adding self-enforcing capabilities to the well-known Industry characteristics of self-organization and self-optimization. Thus, the implementation of blockchain technology in conjunction with smart contract solutions augments the already existing foundation technology to facilitate the implementation of Industry solutions, such as the establishment of collaborative business structures for sustainable entrepreneurial activities in smart supply chains. Smart contracts offer value to autonomous delivery scenario by improving supply chain performance, resolving legal problems, and customizing products.

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