THE ECONOMIC ADVANTAGES OF BLOCKCHAIN TECHNOLOGY IN E-PROCUREMENT

Jurij Matyskevic[1], Inna Kremer-Matyskevic[2]

DXC Technology / Mykolas Romeris University (Lithuania)

ABSTRACT
This article aims to review economic advantages of the one of the most modern cutting edge technologies, namely blockchain for eProcurement. As eProcurement (including its part – Supply chain) is a concept consisting of plenty of different processes, therefore specific advantages per such major different processes are explained. Assumptions and pre-conditions of Blockchain application are explained. Article's main conclusion is that due to the main characteristics of Blockchain technology (safety, transparency, reliability, speed and cost efficiency) payment settlement and products' shipping tracking/inventory management are eProcurement's phases that could benefit from this technology the most, among others (such as analysis – requirements' gathering, sourcing/vendors' selection and contract management cycle).
KEYWORDS: *Blockchain*, *eProcurement*, *Supply chain*, *Technology application*.

JEL CODES: O31, O32
DOI: http://dx.doi.org/10.15181/rfds.v31i2.2094

Introduction

Procurement as an economic concept constitutes one of the most essential drivers for economic development and innovation. As e-Procurement (including its part – Supply chain) is a concept consisting of plenty of different processes (analysis – gathering requirements for demand/product design, sourcing – selection of vendors, contract management cycle – negotiating, concluding and implementing the contract, payment settlement and inventory management including product's shipment), therefore specific advantages per such major different processes shall be explained.

On another hand as Blockchain brings solid state of trust between different stakeholders, this technology is extremely useful when we do speak about variety of market players involved in multiple transactions among them, especially when we do speak about value capture.

Problem is to search and select proper technology that could accept current challenges in e-Procurement related to globalization (increased amount of stakeholders, international transactions with different legislation), increased amount of non – structured data, different level of technological advancement, residual risks related to fraud and human errors.

Purpose is to examine suitability of Blockchain application in modern e-Procurement taking into account above mentioned problems and to define what economic advantages this technology can bring.

Object is Blockchain application in e-Procurement.

[1] Jurij Matyskevic – DXC Technology, Advisor, Bid/Capture management
Scientific interests: Technology application in economy, Innovations and invention in Economy
E-mail: jmatyskevic@dxc.com
Tel.: (+370) 640 63798

[2] Inna Kremer-Matyskevic – Mykolas Romeris University, Economic department, Economic security
Scientific interests: Economic security in global economy, Energy as Economic driver
E-mail: inna_kremer@hotmail.com
Tel.: (+370) 686 00502

Tasks:

- to review and describe the technological background of Blockchain, highlighting its most appropriate features for e-Procurement;
- to provide pre-conditions of Blockchain application in e-Procurement;
- to review specific economic benefits of Blockchain application per different e-Procurement phases.

Methodology of the Research – analysis of the scientific articles, analysis of best practice use cases, comparison, analytical descriptive and generalization methods. It shall be noted that due to the topic's novelty and practical application authors have put a lot of focus on practical sources.

1. Techological background

Despite the fact that blockchain technology is incredibly popular and quite well known in IT world, to my opinion it is still worth providing general description of its technological roots to economic society. So in simple terms blockchain is a technology which empowers creating distributed or decentralized in economic and legal world ledger (in IT world log) to record the transaction. As a relatively new technology, blockchain is designed to achieve decentralization, real-time peer-to-peer operation, anonymity, transparency, irreversibility and integrity in a widely applicable manner (Tijan, Aksentijevic, Ivanic, Jardas, 2019: 1). Even literal analysis of this technology allows to draw a conclusion that we are speaking about chain of blocks – or blocks of information within one logical chain. The changes made by the various parties are assembled and stored in the database at regular intervals as bundled packets called 'blocks'. When new blocks are added to the original database, they form a blockchain, or an up-to-date database containing all the changes made (Mattila, Seppälä, 2015: 4). Blocks contain the useful data (initiated by the owner – or node) and technical information for encryption, so called hash. The block after initiated by one participant is sent to all participating nodes and their content and hashes will be accordingly verified by all participating nodes. This creates a block interdependency accessing up to a chain – the Blockchain (Hackius, Petersen 2017: 5). The origins and the purpose of the transactions could vary, but for economic sciences main priority is the value – capturing value and registering any modifications – tracking it (like owner, quantity, price, etc.). We'd like to elaborate 3 main features that describe blockchain technology the best:

Distributed or decentralized ledger. This feature implies that there is no one single authority controlling the database, as it is based on peer to peer principle. We have proposed a system for electronic transactions without relying on trust. To solve this, we proposed a peer-to-peer network using proof-of-work to record a public history of transactions that quickly becomes computationally impractical for an attacker to change if honest nodes control a majority of CPU power (Nakamoto, 2008: 8). This feature gives us incredible flexibility (avoiding time and effort costs associated with one – registrar, filling complex procedures, registration lags, paying additional verification and registering fees etc.) which is of great demand in multifaced environment;

Public, transparent and verifiable. When it comes to publicity – blockchain can be realized in different ways, but the main principle that it is based on well known in IT security Public and Private key infrastructure. Regarding transparency – as we already mentioned before all participants have the same full database – full amount of the same information (that was before verified together as well), therefore there is no room for data misinterpretation. Overall, I wish to provide a system such that users can be guaranteed that no matter with which other individuals, systems or organizations they interact, they can do so with absolute confidence in the possible outcomes and how those outcomes might come about (Wood, 2014).

Immutable and reliable. Under blockchain technology new data do not replace old blocks, instead of this new blocks being put „on top" of the current blocks thereby representing complete and exhaustive log or register possessing also historical records with proper time marks of the transactions, which allows to have a big picture with all details of respective facts' alterations. Consequently, the blockchain technology is extremely reliable as a distributed method of data storage (Mattila, Seppälä, 2015: 7).

As a conclusion – blockchain technology is extremely useful when we do speak about variety of market players involved in multiple transactions among them. Above mentioned features ultimately result in trust –

trust in transaction‘s participants (who is who), its amount, time and overall integrity (Genuity). In this manner, as it is easy to verify the origin and accuracy of the information whatever its source, no external intermediary (such as a central server) trusted by all the parties is required to validate the data (Mattila, Seppälä 2015: 7). Moreover, some scientists have also found mathematical proof of economic advantages of Blockchain application: From the equilibrium analysis, we first show that a platform offers a higher QoS (Quality of Service) can set a higher equilibrium price and get a larger revenue (Lee, Sung, Lee, Lee, Min, 2018: 10).

2. Pre-conditions for blockchain application

As could be inferred from eProcurement concept itself level of technological advancement shall be quite high, general ERP (Enterprise Resource Planning) or specific Procure to Pay (P2P), billing systems properly cross integrated – fully interoperable and covering main functional areas such as eSourcing platform designed for vendors‘ selection, catalog/inventory management, purchase order and contract management, invoice processing, etc. Subsequent Blockchain deployment would essentially rely on above mentioned IT software. On top of that separate blockchain related front end applications might be designed as well addressing specific topics if current software lacks any type of functionality needed.

Another important topic is business processes behind IT infrastructure. Processes shall be flexible enough to allow full usage of blockchain (intense cooperation between different entities based on trust without any additional certification intermediaries). So far Agile framework (Agile manifesto, 2001) fits the best that concept and companies shall be ready to adopt that working practice as predominant for any project management (including sourcing projects). As we‘ve already mentioned before the main Blockchain promotion engines are IT providers and consultants, however when it comes to the general business – like small and medium size logistics operators (who as industry can benefit probably the most from this technology) they still complain about having little knowledge about Blockchain (Kersten, Seiter, von See, Hackius, Maurer, 2017: 8). Explanation of this on one hand that research of Blockchain‘s practical application is still in its premature phase which can be called as childhood (Zhao, Fan, 2016: 5) on another hand these research shall reveal all possible alternatives and scenarios of such application (Zheng, Xie, Dai, Chen, 2017: 358).

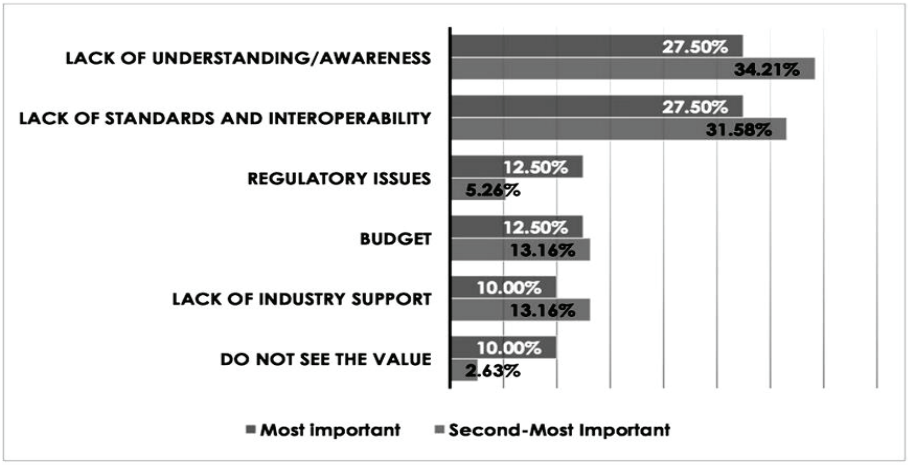

Figure 1. Obstacles to adopt Blockchain

Source: De Covny S. *Benchmark survey: Blockchain in Supply Chain: Edging toward higher visibility.* Chain Business Insights 2017, p. 8.

The main statement can be adopted – the more presice and tight integration we manage to achieve the more benefits we will get. For commercial transactions, companies might look to permissionless-public ledgers such as bitcoin, which allows unknown or untrusted users to access the ledger (Panetta, 2017).

3. Blockchain advantages as per different e-procurement stages

Procurement is one of the main driver of world's economical growth and innovation. In EU context European Public Procurement is a key driver to one of the EU creation objectives – Single market, as at average EPP constitutes about 14-16% of EU GDP (in 2017 EPP resulted in EUR 2,448 billion, with 16% of 2017 EU GDP) (Becker, Niemann, Halsbenning, 2018: 11). The blockchain has the potential to transform the supply chain and disrupt the way we produce, market, purchase and consume our goods. The added transparency, traceability and security to the supply chain can go a long way toward making our economies safer and much more reliable by promoting trust and honesty, and preventing the implementation of questionable practices (Dickson, 2016). Needless to say that overall allocation of goods and services via procurement is enormous as this is predominant purchasing technique by all regulated industries and large scale businesses. Therefore the more efficient procurement process is, the more efficient economy we could enjoy. Logistics and supply chain management are regarded as domains where blockchains are good fits for a series of reasons. During the lifecycle of the product, as it flows in the value chain (from the production to consumption) the data generated in every step can be documented as a transaction creating, and thus, a permanent history of the product. Moreover, the blockchain can contribute effectively, through its decentralized nature, in sharing information about the production process, delivery, maintenance, and wear-off of products between suppliers and vendors, bringing new modalities of collaboration in complex assembly lines (Litke, Anagnostopoulos, Varvarigou, 2019: 5). Typical eProcurement process looks like classic waterfall project (Fair, 2012) with each phase logically sequenced:

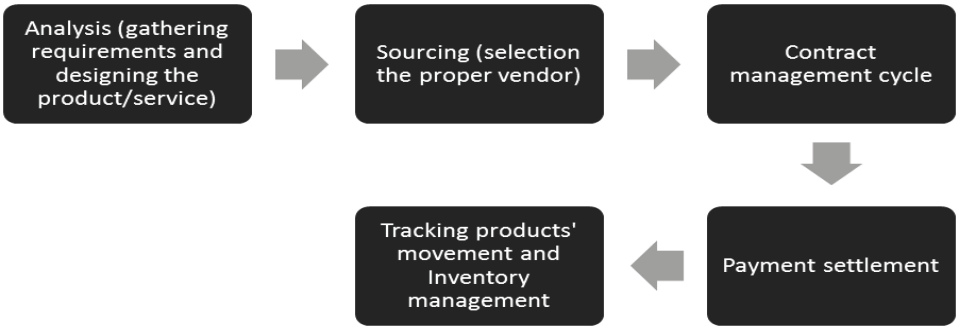

Figure 2. Sequence of eProcurement phases

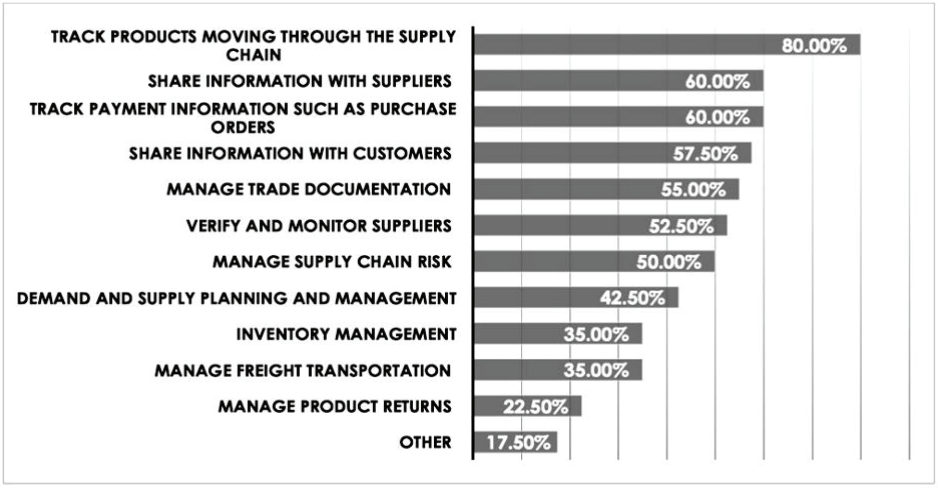

Figure 3. Probable usage of Blockchain per activity

Source: De Covny S. *Benchmark survey: Blockchain in Supply Chain: Edging toward higher visibility.* Chain Business Insights 2017, p. 4.

4. Analysis phase (gathering the requirements for product – service design)

Primarily Blockchain technology was not invented to help organizations solving its internal issues. However if we have a look how much time average organization spends on gathering requirement for service or product design, and quite often how inefficient process is, any technology that could help shall be considered. Essentially requirements gathering is about timely and proper communication between internal company's units on needed product characteristics – therefore if we remember the basics of this technology – open and transparent online data/information transmission it comes naturally that we shall use it for current process as well. In case of no shared platform for product-centric data management information asymmetries in product data are likely to occur between the companies over time. Companies not in control of the platform become the underdogs in value capture potential (Mattila, Seppälä, Holmström, 2016: 5). This will allow us to track different opinions from all stakeholders for product/service demands, check the latest approvals and in general to increase visibility and transparency across organization (as usually different stakeholders have different opinions and purposes), even to increase „time to market" criteria if we consider drafted RFP as procurement unit's product. In the latter case the speed presents a crucial KPI for company competitiveness in our global economy. Thus, data on a blockchain is more accurate, consistent and transparent than when it is pushed through paper-heavy processes. It is also available to all participants who have permissioned access. To change a single transaction record would require the alteration of all subsequent records and the collusion of the entire network (Hooper, 2018). In 2004 PMI (Project Management Institute) found out that project initiation (every project according to waterfall methodology starts with requirements, and procurement project as well) is the main reason why projects fail (PMI, 2014). Moreover the same study claims that only 56 percent of strategic initiatives meet their original goals and business intent. This poor performance results in organizations losing US$109 million for every US$1 billion invested in projects and programs. Other sources report other major losses: For example, British food retailer Sainsbury had to write off its $526 million investment in an automated supply-chain management system. The U.S. Federal Aviation Administration spent $2.6 billion unsuccessfully trying to upgrade its air traffic control system in the 1990s.

5. Sourcing

Nowadays selection procedures usually take place via specific dedicated eProcurement portals like Ariba, Sprint, etc. These portals usually possess quite well developed functionality and cover such actions as Procurement documents' (RFP/RFI, RFQ) publication, Q&A sessions (Questions and Answers), Vendors' proposal uploading, etc. However Vendors' identity management (identification, authentication and authorization) even given that it is digital (access managed by the passwords) is already outdated compared to today realities due to the following reasons: First traditionally digital means that identity is managed by centralized server, which serves as a perfect target for hackers. Thus, identification of security related requirements, vulnerabilities, and threats are keys to the development of a trustworthy system (Habib, Torjusen, Leister, 2015: 74). Federal Trade Commission reports that in Fraud related to Identity theft resulted in $1.48 billion loss in 2018 (Siciliano, 2019). Second traditional digital identity management systems heavily dependent on personal data processing, which impose additional risks of non – compliance with GDPR (Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data). As of January 21st 2020 amount of EU wide fines of GDPR non – conformity resulted in $126 million loss (Ip, 2020) (since GDPR came into force 25 May 2018). Lat but not least even digital identity management is still static – that means that persons shall maintain their actual records (validity of passport and its ID, position, email address and phone number, etc.) manually. Blockchain eliminates all these problems, offering trusted decentralized (near impossible to hack), verified by relationships identity solution which doesn't require personal data at all and which is dynamic in nature. This feature accompanied with market realities – procuring organization's demand to deal with great variety of reliable vendors in order to find best quality vs price ratio and provider's demand to penetrate new markets makes

Blockchain application highly attractive. On top of that strict KYC (Know Your Customer) and KYS (Know Your Supplier) procedures imposed on majority of regulated industries, therefore trusted and transparent identity management with blockchain enables to ensure great global companies‘ compliance function.

Another important aspect also relates to the blockchain ability to capture timely actions of already identified persons, such as – RFP, Q&A, Proposal submittal time and authenticity, deadline management. As through blockchain all parties possess the same identical online source of truth, there is no pretext to object later procuring organizations' decision, as its judgement is based on trusted, in advance agreed objective awarding criteria – therefore such technology prevents the parties from subsequent costly and time consuming litigation.

6. Contract management cycle

After proper vendor has been selected – establishment of legal relationship comes to the scene. This is usually done by concluding legally binding documents – contracts. Contracts are society's programming language. Corporations are defined by contracts with investors, employees, customers, etc. Countries are defined by social contracts with citizens, representatives, corporations, etc. But today's contracts are confusing and expensive to create and enforce. They are written in bad programming languages and enforced by slow, complex, expensive, and unpredictable mechanisms (Omohundro, 2014). Blockchain can help on all contract management cycle – agreeing on the specific terms and conditions, approving them and even executing. If first 2 action shall be quite clear in view of advantages of this technology explained earlier (decentralized and reliable ledger that all parties can verify at any moment). However contract execution shall be reviewed separately. First of all speaking about full blockchain contract we have to highlight that this is purely digital – so called „smart contracts“ that means coded with software. Because blockchain transactions are programmable and self-enforcing, parties might use smart contracts to design contractual relationships that are automatically executed without the additional costs of monitoring or enforcement (Kiviat, 2015: 38). At least with this feature it is possible to optimize system of alerts and notifications to be shared with all stakeholders, but what is much more important – this allows to put separate triggers that automates execution – like under certain pre-agreed conditions at a certain time to run the process – place the order, send the invoice, make payment, etc. Some specific and distinct advantages can be found in each major contract management phase:

On OMS (Order Management System) – Blockchain improves the whole efficiency of the process by reducing the number of operations, precisely tracing the orders and in general enhancing visibility to supply chain stakeholders. Modern OMS are also multichannel and 24/7, so above mentioned efficiencies are online available to the stakeholders.

On Invoicing and e-Billing – first of all EU wide legislation already provided e-invoicing standards as per EU directives 2014/24/EU and 2014/55/EU. In sum, the technology's potential to lower transaction costs with respect to contracting and transferring title to physical and personal property should generate special interest in the legal community (Kiviat, 2015: 39). One of the most advanced blockchain industry company – SophiaTX made a study which found out that estimated size of E-invoicing market was 3.3bln euro in 2017 with expected growth to 16.1bln in 2024 (Sophiatx, 2017).

Table 1. Average cost comparison between paper and e-Invoicing per 1 invoice

Cost category	Paper	E-Invoice
Print, envelope, send	$4.15	0
Payment reminders	$0.53	$0.43
Remittance and cash management	$4.73	$3.19
Archiving	$2.34	$0.19
Total	$11.81	$4.47

Source: Sophiatx case study. Blockchain based invoising, 2017.

Invoicing through smart contracts automatically processes and records payments (Peters, Panayi, 2015: 24). On another hand it should be noted that still traditional contracts shall be maintained, as smart contracts are fully M2M (machine to machine) based collaboration, they will not cover and process any specific event (like damages, as this shall be initiated by further processed by person).

7. Payment settlement

We‘ve decided to put Payment settlement as separate chapter due to the following reasons: First of all blockchain derived from payment sphere as it was and it predominant technology supporting Bitcoin cryptocurrency and second reason – its sensitivity and the biggest effect. Blockchain was first invented in 1991 by Stuart Haber and W. Scott Stornetta as a mean to avoid document‘s timestamp tamper, in 2008 Nakamoto described how a network of users could engage in secure peer-to-peer financial transactions, eliminating the need for financial intermediaries and reducing the cost of overseas payments (Peters, Panayi, 2015: 3) and soon after it gained real worldwide application with commercial launch in January 2009. In 2015 the number of retailers accepting the cryptocurrency bitcoin has passed 100,000 (Cuthbertson 2015), while according to the Cambridge Centre for Alternative Finance study (Hileman, Rauchs, 2017) in 2017 there were already 5.9 million Bitcoin (and consequently Blockchain) users. Since it (Bitcoin) allows payments to be finalized without any bank or intermediary, blockchain can be used in various financial services such as digital assets, remittance and online payments (Adams, Parry, Godsiff, Ward, 2017: 418).

Speaking about blockchain impact on payment industry first thing which comes to the mind is hacker – proof reliable system (Fraud security. Blockchain is “unhackable”. It decreases the probability of any kind of fraud. Furthermore, it does not work on patches, which makes blockchain the securest in the market of cybersecurity initiatives (Robinson, 2016), Bitcoin has never been hacked (Banker, 2016) which allows to eliminate or at least significantly reduce fraud in this industry. Moreover, it is a cryptographically secure electronic payment system, and it enables transactions involving virtual currency in the form of digital tokens called Bitcoin (Conti, Kumar, Lal, Ruj, 2018). According to European Central Bank 2018 Fifth report on card fraud: The total value of fraudulent transactions conducted using cards issued within SEPA and acquired worldwide amounted to €1.8 billion in 2016 (ECB, 2018). Another major banking and finance European player is UK market on which UK banking and finance industry association – „UK Finance“ in its 2019 report (finance, 2019) revealed, that Unauthorised financial fraud losses across payment cards, remote banking and cheques totalled £844.8 million in 2018, an increase of 16 per cent compared to 2017. In addition to this, in 2018 UK Finance members reported 84,624 incidents of authorised push payment scams with gross losses of £354.3 million.

Another distinct advantage is its efficiency and cost saving. Blockchain technology is uniquely positioned to tackle the problems of both speed and cost. In sum, blockchain technology solves an important problem in electronic value transfers. The blockchain does not only move value; it also integrates several components of the trading-clearing settlement value chain in an elegant, efficient, and mathematical way (Kiviat, 2015: 19). Consumer of typical banking or financial institution usually is being charged commission for any type of operation, and a lot of these operations (like opening account) can be fulfilled only during standard working hours. In a like manner with location, cost is significantly reduced with blockchain technology in a supply chain system. Mainly due to large distance transactions being slower through banks than with cryptocurrency technology, blockchain provides an economic solution for the supply chain (Litke, Anagnostopoulos, Varvarigou, 2019: 8). On top of that consumer shall often be in front of the bank agent who will verify face to face genuity of such application. In contrast blockchain operates 24/7, as it is decentralized there is almost no commission fees, it is remotely from its origin and average operation lasts about 10 minutes – time needed to form the block and put it into the chain. Bitcoin payment services are only of the order of 0.01%–0.05%, largely due to the lower cost of not needing to process or perform disputes in transactions (Peters & Panayi, 2015: 30). European Bank – Santander estimates that blockchain could reduce banks’ infrastructural costs by $15-20 billion a year by 2022 (Perez, 2015). French consultancy giant – Capgeminy predicts that consumers‘ wallets could save up to $16 billion in banking and insurance fees also per year (Capgeminy, 2016).

Table 2. Value of Card Fraud losses in Europe

	2012	2013	2014	2015	2016	GR 15/16	CAGR 5Y
Total card fraud losses with SEPA acquired worldwide (BEUR)	1.330	1.436	1.656	1.808	1800	-0,4%	9,2%
-thereof CNP fraud losses (BEUR)	0.794	0.958	1.031	1.292	1.320	2.2%	15.2%
Value of card fraud losses as a share of value of transactions	0.038%	0.039%	0.038%	0.042%	0.041%	-2.4%	2.6%
-thereof ATM fraud in %	17%	14%	12%	9%	8%	-11.1%	-15.9%
-thereof CNP fraud in %	60%	67%	69%	71%	73%	2.8%	5.4%
-thereof POS fraud in %	23%	19%	19%	20%	19%	-5.0%	-5.3%
Volume of card fraud losses as a share of number of transactions	0.017%	0.020%	0.020%	0.020%	0.023%	15.0%	7.5%
-thereof ATM fraud in %	11%	9%	7%	5%	3%	-40.0%	-22.9%
-thereof CNP fraud in %	63%	71%	75%	76%	77%	1.3%	7.8%
-thereof POS fraud in %	26%	20%	18%	19%	20%	5.3%	-11.1%
NOTE: the total number of cases of card fraud using cards issued in SEPA amounted to 17.3 million in 2016. The total number of card transactions using cards issued in SEPA amounted to 74.9 billion in 2016.							

Source: Nets. European Fraud report, Payment Industry Challenges. 2019.

8. Tracking products' movement and inventory management

According to US biggest logistics and supply chain association – MHI „The 2019 MHI Annual Industry Report - Elevating Supply Chain Digital Consciousness" (MHI, 2020) in 2018 usage of blockchain technology in inventory management was at about 5 % level but it is forecasted to grow at 54 % within next five years. The advantages are quite straight forward – with blockchain companies are able to track movement of goods proactively in real time mode, which is crucial, especially for big retailers and logistics companies running huge stocks and variety of products' movements flows. Tracking goods through blockchain can improve the decision-making process with end result being a more satisfying service for the end user (Tijan, Aksentijevic, Ivanic, Jardas, 2019: 1). Blockchain introduction allows the companies to synchronize the data between different supply chain players like suppliers, distribution centers, transportation companies, retail partners and their different stock locations establishing single time saving working procedure (as each of these potentially uses their own different data processing methods and tools – which could result in delay for market needs and consequent financial loss) and therefore to increase time to market criteria and avoid under/over stocking. On another hand it also leads to human error, fraud (according to PwC 2018 report 47 % of respondents experienced a fraud in past 24 months with overall loss of $ 42 billion for the same time period (PwC, 2018)) and general workforce costs reduction through efficient digital automation, which also contributes to competitive advantage. According to 2013 World Economic Forum's Report. Enabling Trade. Valuing Growth Opportunities (Forum, 2013): Blockchain can help all parties involved in shipping to increase sustainability, reduce or eliminate fraud and errors, improve inventory management, minimize courier costs, reduce delays caused by paperwork, waste and identify issues faster. This could increase worldwide GDP by almost 5% and total trade volume by 15%.

However it also should be noted that maximum advantage of the blockchain can be achieved in conjunction with another cutting edge technology such as Internet of Things (IoT). IoT is supposed to connect the different smart objects vis Internet (things having sensors connected to the Internet) and to provide that management tools of that to authorized users. Concrete usage example can be seen from below statement: Sensors and the Internet of Things (IoT) are enabling goods container store port when a value limit has been exceeded, e.g., temperature, tilt or incoming light intensity. The freight being forwarded remains in clear view across the entire supply chain (Tijan, Aksentijevic, Ivanic, Jardas, 2019: 6).

Conclusions

Based on the above findings according to the authors it goes without any saying that Blockchain indeed has a distinctive positive impact on eProcurement – main economic advantages are efficiency (speed, performance, error free, cost savings) and security due to the nature of this technology. However the strength of this impact varies as per different e-Procurement stages:

For Product's shipping and Inventory management authors recommend using Blockchain along with the IoT to get maximum advantage from this synergy – which is predominant and the most promising research sphere for Blockchain today.

In Payment settlement positive experience of Blockchain application from crypto currencies (primarily Bitcoin) shall be considered.

Bitcoin application in Smart contracts is preferred to introduce more higher automation level, however nowadays this can be applied only for standard contractual clauses, while for non – standards human interaction is still needed.

In Sourcing Blockchain would allow to expand the set of available vendors which in turn directly affects efficiency of e-Procurement.

Advantages of Blockchain application in analysis phase are typical of such application in IT projects, that in general constitutes significant amounts of savings.

Authors opinion – with current technological level it's highly recommended to extend Blockchain application in Product's shipping and payments, while other e-Procurement phases would be able to fully enjoy Blockchain in recent future due to the need of more interoperable IT systems.

References

Adams, R., Parry, G., Godsiff, P., Ward, P. (2017). The future of money and further applications of the blockchain. *Strategic Change*, Vol. 26, No. 5, p. 417–422. Doi: https://doi.org/10.1002/jsc.2141.

Banker, S. (2016). *Will Blockchain Technology Revolutionize Supply Chain Applications* [interactive]. Access: https://logisticsviewpoints.com/2016/06/20/ [accessed 2020-02-12].

Contribution to Growth – European Public Procurement. (2018). European Parliament. Luxembourg: Office for Official Publications of the European Communities.

Capgeminy. (2016). *Consumers set to save up to sixteen billion dollars on banking and insurance fees thanks to blockchain-based smart contract* [interactive]. Access: https://www.capgemini.com/news/consumers-set-to-save-up-to-sixteen-billion-dollars-on-banking-and-insurance-fees-thanks-to/ [accessed 2020-02-21].

Conti, M., Kumar, S., Lal., C., Ruj, S. (2018). A Survey on Security and Privacy Issues of Bitcoin. *IEEE Communications Surveys & Tutorials*, Vol. PP, No. 99, p. 1–36. Doi: 10.1109/COMST.2018.2842460

Cuthbertson, A. (2015). *Bitcoin Now Accepted by 100,000 Merchants Worldwide* [interactive]. Access: http://www.ibtimes.co.uk/bitcoin-now-accepted-by-100000merchants-worldwide-1486613 [accessed 2020-02-03].

Dickson, B. (2016). *Blockchain has the Potential to Revolutionize the Supply Chain* [interactive]. Access: https: //techcrunch.com/2016/11/24/blockchain-has-the-potential-to-revolutionize-the-supply-chain [accessed 2020-02-13].

Fifth report on card fraud. (2018). European Central Bank. Frankfurt am Main: European Central Bank.

Fair, J. (2012). *Agile versus Waterfall: approach is right for my ERP project?* [interactive]. Access: https://www.pmi.org/learning/library/agile-versus-waterfall-approach-erp-project-6300 [accessed 2020-02-11].

UK finance. (2019). *Fraud the facts 2019* [interactive]. Access: https://www.ukfinance.org.uk/policy-and-guidance/reports-publications/fraud-facts-2019 [accessed 2020-02-05].

Enabling Trade. Valuing Growth Opportunities. (2013). World Economic Forum. Geneva: World Economic Forum.

Habib, K., Torjusen, A., Leister, W. (2015). Security Analysis of A Patient Monitoring System for the Internet of Things ine-Health. *eTELEMED 2015, The Seventh International Conference on eHealth, Telemedicine, and Social Medicine*, p. 73–78.

Hackius, N., Petersen, M. (2017). Blockchain in Logistics and Supply Chain: Trick or Treat. *Hamburg International Conference of Logistics*, Vol. *Digitalization in Supply Chain Management and Logistics*, p. 1–18.

Hileman, G., Rauchs, M. (2017). *Global cryptocurrency benchmarking study* [interactive]. Access: https://www.jbs.cam.ac.uk/faculty-research/centres/alternative-finance/publications/global-cryptocurrency/#.Xi_asNjgodW [accessed 2020-02-02].

IBM. (2018). *Top Five Blockchain Benefits Transforming Your Industry* [interactive]. Access: https://www.ibm.com/blogs/blockchain/2018/02/top-five-blockchain-benefits-transforming-your-industry [accessed 2020-02-09].

PMI. (2014). *PMI's pulse of the Profession: The High Costs of Low Perfomance* [interactive]. Access: https://www.pmi.org/learning/thought-leadership/pulse/the-high-cost-of-low-performance-2014 [accessed 2020-02-07].

Ip, C. (2020). *GDPR has led to $126 million in fines over data privacy* [interactive]. Access: https://www.gdpr.associates/gdpr-has-led-to-126-million-in-fines-over-data-privacy/ [accessed 2020-02-10].

Kersten, W. M., Seiter, B., von See, B., Hackius, N., Maurer, T. (2017). *Trends and Strategies in Logistics and Supply Chain Management–Digital Transformation Opportunities.* Bremen: DVV Media Group GmbH.

Kiviat, T. (2015). Beyond Bitcoin: Issues in Regulating Blockchain Transactions. *Duke Law Journal*, No. 65, p. 569–608.

Lee, H., Sung, K., Lee, K., Lee, J., Min, S. (2018). Economic Analysis of Blockchain Technology on Digital Platform Market. *IEEE 23rd Pacific Rim International Symposium on Dependable Computing*, Vol. 1, p. 94–103. Doi: 10.1109/PRDC.2018.00020.

Litke, A., Anagnostopoulos, D., Varvarigou, T. (2019). Blockchains for Supply Chain Management: Architectural Elements and Challenges Towards a Global Scale Deployment. *Logistics*, Vol. 3 (1), No. 5, p. 1–17. Doi: 10.3390/logistics3010005.

Mattila, J., Seppälä, T. (2015). Blockchains as a Path to a Network of Systems – An Emerging New Trend of the Digital Platforms in Industry and Society. *ETLA Reports*, Vol. 45, p. 1–17.

Mattila, J., Seppälä, T., Holmström, J. (2016). Product-centric Information Management: A Case Study of a Shared Platform with Blockchain. *Industry Studies Association Conference*, Vol. 1, p. 1–18.

MHI. (2020). *MHI 2020 Annual Industry Report. Embracing the Digital Mindset* [interactive]. Access: https://www.mhi.org/publications/report [accessed 2020-02-18].

Nakamoto, S. (2008). *Bitcoin: A Peer-to-Peer Electronic Cash System* [interactive]. Access: https://bitcoin.org/en/bitcoin-paper [accessed 2020-01-17].

Omohundro, S. (2014). *Cryptocurrencies, Smart Contracts, and Artificial Intelligence* [interactive]. Access: https://steveomohundro.com/2015/03/31/national-association-for-business-economics-talk-cryptocurrencies-and-smart-contracts/ [accessed 2020-02-07].

Gartner. (2017). *Top Trends in the Gartner Hype Cycle for Emerging Technologies* [interactive]. Access: https://www.gartner.com/smarterwithgartner/top-trends-in-the-gartner-hype-cycle-for-emergingtechnologies-2017/ [accessed 2020-01-14].

Perez, Y. (2015). *Santander – Blockchain tech can save banks 20 billion a year* [interactive]. Access: https://www.coindesk.com/santander-blockchain-tech-can-save-banks-20-billion-a-year [accessed 2020-02-24].

Peters, G., Panayi, E. (2015). *Understanding Modern Banking Ledgers through Blockchain Technologies: Future of Transaction Processing and Smart Contracts on the Internet of Money* [interactive]. Access: https://arxiv.org/pdf/1511.05740v1.pdf [accessed 2020-02-04].

Pw, C. (2018). *Pulling Fraud out of the Shadows, Global Economic Crime and Fraud Survey* [interactive]. Access: https://www.pwc.com/gx/en/forensics/global-economic-crime-and-fraud-survey-2018.pdf [accessed 2020-02-17].

Robinson, A. (2016). *What is Blockchain Technology, and What Is Its Potential Impact on the Supply Chain?* [interactive]. Access: https://cerasis.com/blockchain-technology/ [accessed 2020-02-01].

Siciliano, R. (2019). *Identify theft crimes by numbers* [interactive]. Access: https://www.thebalance.com/identity-theft-crimes-by-the-numbers-4157714 [accessed 2020-02-16].

Sophiatx. (2017). *Blockchain based invoising* [interactive]. Access: https://www.sophiatx.com/storage/web/SophiaTX-eInvoicing-Use-Case.pdf [accessed 2020-02-05].

Tijan, E., Aksentijevic, S., Ivanic, K., Jardas, M. (2019). Blockchain Technology Implementation in Logistics. *Sustainability*, Vol. 11, No. 4, p. 1–13. Doi:10.3390/su11041185 352-375.

Wood, G. (2014). *Ethereum: A Secure Decentralized Transaction Ledger* [interactive]. Access: http://gavwood. com/paper.pdf 2017 [accessed 2020-01-17].

Zhao, J., Fan, S. Y. (2016). Overview of Business Innovations and Research Opportunities in Blockchain and Introduction to the Special Issue. *Financial Innovation*, Vol. 2, No. 28, p. 1–7. Doi: 10.1186/s40854-016-0049-2.

Zheng, Z., Xie, S., Dai, H., Chen, X. (2017). Blockchain Challenges and Opportunities: A Survey. *International Journal of Electric and Hybrid Vehicles*, Vol. 14, No. 4, p. 352–375. Doi: 10.1504/IJWGS.2018.095647.

"BLOCKCHAIN" TECHNOLOGIJOS TAIKYMO ATLIEKANT E.PIRKIMUS EKONOMINIAI PRIVALUMAI

Jurij Matyškevič, Inna Kremer-Matyškevič
„DXC Technology", Mykolo Romerio universitetas (Lietuva)

Santrauka

Straipsnyje aptariami „blockchain" technologijos taikymo atliekant e.pirkimus ekonominiai privalumai. Kadangi e.pirkimų procesą sudaro keletas etapų (pirkimo poreikio nustatymas / reikalavimų rinkimas, tiekėjų atranka, sutarčių derinimas, sudarymas ir vykdymas, mokėjimai, prekių tiekimas ir atsargų valdymas), straipsnyje analizuojama potenciali ir specifinė „blockchain" taikymo nauda kiekviename etape. Paaiškinamos šios technologijos diegimo prielaidos ir sąlygos.

„Blockchain" iš esmės yra decentralizuotas, saugus, skaidrus veiksmų fiksavimo registras, kurį galima sėkmingai taikyti ūkinėje veikloje – finansų ir teisės srityse. Ši technologija skaido informaciją į blokus ir šiuos blokus saugo daugelyje sujungto tinklo elementų – kompiuterių. Kiekvienas blokas, be prasminės informacijos, saugo ir tarnybinę / techninę – tam tikra matematinį algoritmą, kurio dėka paskiri blokai gali sudaryti loginę seką (šį principą atskleidžia ir pats pavadinimas: angl. *Block* – blokas, *Chain* – grandinė). Pagrindiniai šios technologijos privalumai yra decentralizacija (nėra jokios centrinės įstaigos, kuri valdytų šį registrą, jis paremtas savivaldos principu), skaidrumas ir viešumas (visi mato tą pačią informaciją tuo pačiu metu, įskaitant visus kitos šalies pakeitimus), saugumas (įsilaužti ir kokio nors bloko pakeisti neįmanoma, nes reikėtų įsilaužti į tą patį bloką visuose tinklo elementuose).

Nustatant pirkimo poreikį analizės etape svarbu tinkamai valdyti (rinkti ir fiksuoti) komunikaciją tarp įvairių suinteresuotų įstaigos padalinių (tiekimo, rinkodaros, pardavimo, finansų) ir greitai reaguoti į prioritetų pokyčius, tai gali būti veiksmingai tvarkoma „blockchain" registro pagrindu.

Atrenkant tiekėjus „blockchain" gali užtikrinti jų patikimumą ir sudaryti sąlygas atrankos procedūrose dalyvauti plačiam tiekėjų ratui, taip didinant galimybę surasti geriausią kainos ir kokybės santykį.

Derinant ir vykdant sutartį „blockchain" gali būti viena pagrindinių technologijų, užtikrinančių išmaniosios sutarties (angl. *smart contract*) konceptą, t. y. sutarties, kuri gali vykdyti savo sąlygas (sąskaitų išrašymo, mokėjimo ir t. t.) automatiškai – pagal iš anksto suprogramuotus trigerius, vis dėlto kilus nestandartinei situacijai, prireiks žmogaus įsikišimo.

Mokėjimo sritis su „blockchain" sąveikauja labiausiai, nes ši technologija atsirado kaip kriptovaliutų (konkrečiai bitkoino) pagrindinė technologija ir šiandien plačiai taikoma dėl savo saugumo ir decentralizacijos savybių.

„Blockchain" pritaikymas prekių tiekimo ir atsargų valdymo procesams arba logistikai šiandien yra plačiausiai nagrinėjama sritis, nes yra perspektyvi. Globalizacijos sąlygomis logistikos srautai yra didžiuliai, taikant „blockchain" galima juos suvaldyti. Tai efektyvus ir nebrangus sprendimas ypač šalinant žmonių klaidas, vykdant sukčiavimo prevenciją ir t. t. Veiksmingiausia „blockchain" būtų taikyti kartu su kita technologija – IoT (angl. *Internet of Things*).

PAGRINDINIAI ŽODŽIAI: *„blockchain"*, *e.pirkimai*, *tiekimo grandinė*, *technologijos taikymas*.

JEL KLASIFIKACIJA: O31, O32.

Gauta: 2020-03-20

Priimta: 2020-04-09

Pasirašyta spaudai: 2020-04-10