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BLOCKCHAIN TECHNOLOGY AND ITS IMPACT ON FINANCIAL AND SHIPPING SERVICES

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Introduction. Blockchain technology is becoming one of the main drivers of innovation in the global economy. Its adoption will have a huge impact on how businesses and governments operate and on the way people organize their everyday lives. Financial services industry is the one experiencing the biggest impact of the blockchain disruption so far, while financial institutions are among the first adopters of the technology. At the same time, being a relatively traditional industry, shipping has not yet seen many use cases with blockchain, but the technology is able to change this industry dramatically.

Aim and tasks. As the industries of finance and shipping have huge potential in the blockchain space and often interact, determining how the blockchain technology adoption can influence the industries of finance and shipping in the future was the main purpose of this article.

Research results. To fulfill this purpose, it was important to describe the origins of the blockchain technology, its main characteristics, functioning principles and consensus algorithms. Supported by the recent hype, cryptocurrencies are the biggest use case for blockchain so far, therefore, the article analyzes the largest of them, including Bitcoin, Ethereum and some others, as well as the cryptocurrency market as a whole. The level of worldwide adoption of blockchain and the overall market size are defined further in the article. Various applications in finance are also mentioned, paying particular attention to the insurance industry. Based on this information, the key areas in which blockchain can disrupt finance and insurance are identified. As the number of blockchain companies increases rapidly, the two main fundraising channels for such companies, venture capital and initial coin offering, are analyzed and compared. The ways in which blockchain may impact the shipping services industry are identified further.

Conclusion. Afterwards, the article describes a number of blockchain consortia formed by public institutions and private entities to research and test possible applications of the technology across various industries and countries. While the potential of blockchain is still largely undiscovered, all the gathered information and performed research help to make a conclusion that the blockchain technology will have a big impact on many different industries, including financial and shipping services. The coming years will definitely see an exponentially growing interest in blockchain in academic and business fields, as the technology becomes more and more mainstream.

Keywords: smart contracts, distributed ledger technology, Bitcoin, Ethereum, cryptocurrency, ICO, fintech.

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ТЕХНОЛОГІЯ БЛОКЧЕЙН І ЇЇ ВПЛИВ НА ФІНАНСОВІ ПОСЛУГИ ТА ПОСЛУГИ МОРСЬКИХ ПЕРЕВЕЗЕНЬ

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Проблема. Технологія блокчейн стає однією із головних рушійних сил інновацій в глобальній економіці. Її впровадження матиме величезний вплив на те як діють підприємства та уряди і на те як люди організовують своє повсякденне життя. Індустрія фінансових послуг на даний момент зазнає найбільшого впливу блокчейн-революції, а фінансові інституції є одними з найперших користувачів технології. У той же час, сфера морських перевезень, як доволі традиційна індустрія, поки що не має багато прикладів застосування блокчейну, але ця технологія здатна суттєво змінити цю галузь.

Мета та завдання. Метою статті є визначення впливу блокчейн-технології на сферу морських перевезень та фінансових послуг.

Результати. Задля втілення цієї мети було важливо описати походження технології блокчейн, її головні характеристики, принципи функціонування та алгоритми консенсусу. На фоні існуючого ажіотажу, криптовалюти є найпоширенішим прикладом застосування блокчейну на сьогодні, тому в статті аналізуються найбільші з них, в тому числі Біткоін та Ефіріум, а також криптовалютний ринок в цілому. Далі визначено рівень розповсюдженості блокчейну у всьому світі та загальний розмір ринку. Також згадуються різні приклади застосування у фінансах, особливої уваги приділено страховій галузі. Виходячи з цієї інформації, визначено основні сфери, в яких блокчейн може реорганізувати фінанси та страхування. Оскільки кількість блокчейн-компаній швидко зростає, проаналізовано та порівняно два основних канали збору коштів для таких компаній, включаючи венчурний капітал та первинну пропозицію монет. Далі визначено шляхи, якими блокчейн може вплинути на галузь морських перевезень. Також в статті описується низка консорціумів, сформованих державними установами та приватними організаціями для дослідження та тестування можливих застосувань технології поміж різних галузей та країн.

Висновки. У той час як потенціал блокчейну ще є доволі нерозкритим, вся зібрана інформація та проведені дослідження допомагають зробити висновок, що технологія блокчейн матиме великий вплив на багато різних індустрій, у тому числі на фінансові послуги та послуги морських перевезень. Наступні роки однозначно покажуть експонентне зростання зацікавленості блокчейном у академічних та бізнесових колах, адже технологія ставатиме все більш загальноприйнятою.

Ключові слова: смарт контракти, технологія розподіленого реєстру, Біткоін, Ефіріум, криптовалюта, первинна пропозиція монет, фінтех.

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Introduction. Blockchain is a technology that allows reconciling databases among different parties that have no trust to each other. It has the potential to significantly reduce the society's need for banks, governments and many other institutions, or even get rid of them in some cases, bringing more transparency, fairness and justice to the world. With blockchain, individuals and businesses can exchange any kind of information almost instantly and with no participation from third parties. Among many industries that blockchain will have big impact on, financial and shipping services are the ones that will be largely influenced.

Analysis of recent research. Blockchain has been the topic of research for a number of authors, including A. Antonopoulos, M. Swan, K. Bheemaiah, D. Drescher and others. The existing researches usually do not deeply investigate how blockchain can impact particularly the industries of financial or shipping services.

Aim and tasks. As blockchain is still at its infancy, it is poorly covered in scientific literature. Moreover, its impetuous development makes any related research outdated quite fast. While financial services is by far the industry that experienced the biggest impact of blockchain, it still has a very low level of adoption. Shipping services started experimenting with blockchain only recently, so there is a lot of room for research.

Main results. The blockchain technology is most known for underpinning the protocol of Bitcoin, the first decentralized cryptocurrency. As a technology, it is special for several reasons. Besides the fact that it works only on adding data to the newly generated blocks of information in the chain, it also stores the entire history of changes made to this chain, uses advanced cryptography to ensure the invariability and is stored by each participant of the network. Such database architecture allows all users of the system, i.e. nodes, work together to reach a consensus on the valid state of a shared data resource. Three main types of nodes in blockchain are usually distinguished. Miners validate new blocks of transactions in exchange for the blockchain's native tokens, which are also called cryptocurrencies or cryptocoins. Full nodes maintain the entire blockchain and propagate new entries, while the end users of blockchain usually access it by connecting to a full node.

In order to agree changes, i.e. new blocks, different consensus algorithms are used. The most common of them is proof-of-work (PoW), used by the Bitcoin's blockchain. PoW protocol is based on two principles: it ensures that each next block in the blockchain is the only version of truth and it keeps powerful attackers from manipulating the system. In PoW, miners compete with each other to add the next block of transactions to the chain by trying to solve very complex cryptographic puzzles. The miner, who solves the puzzle first, adds the block to the chain and gets a reward in the form of newly created native cryptocoins, like Bitcoin. The largest concerns about PoW are based on the fact that it needs a huge amount of computational power, what substantially increases energy consumption costs of miners. Recent estimates suggest that if the use of computational power for mining Bitcoin increases with the current pace, by 2020 it will use all the electricity produced around the world.

Proof-of-stake (PoS) is the second most popular consensus protocol after PoW. Unlike in PoW, instead of buying very expensive computer equipment to compete in a mining race, miners of PoS invest in the coins of the system. Precisely speaking, the term "miners" should be used with regard to PoW only, while the rest of consensus protocols are run by validators. However, nowadays the terms "mining" and "miner" are usually used to describe the process of validating blocks in all cryptocurrencies, and this article follows this trend. Mining does not exactly describe the PoS protocol because there is no process of coin creation. Instead, all the cryptocoins exist from day one, and miners, also called stakeholders, are paid strictly in transaction fees. The more tokens a miner owns, the more chances it has to be chosen to create the next block. Peercoin was the first cryptocurrency to implement PoS. Ethereum, which is currently the second largest cryptocurrency by market cap after Bitcoin, is planning to change its PoW to PoS in 2018.

Other consensus protocols include proof-of-importance, proof-of-DDoS, proof-of-burn, proof-of-activity, proof-of-capacity, hybrids of

different "proofs", etc. As understanding those is not crucial for this article, it makes no sense to describe them, while comparing different protocols would require a separate research paper.

Sometimes a term "distributed ledger technology" (DLT) is used to designate the blockchain technology. The DLT term was introduced by regulators, when they started researching and testing blockchain, to distinguish from an ambiguous reputation of the Bitcoin's blockchain. There are authors who even distinguish DLT and blockchain, particularly because they use the term "blockchain" to define PoW consensus protocols only. The majority of academic and business fields do not see difference in DLT and blockchain, and as the author of this article distinguishes the reputation of blockchain and reputation of those using it, this article will utilize only the term "blockchain". At the end, what matters is the technology, its principles and use cases, but not how it is called.

Depending on who has the right to participate in the network, blockchains are generally divided into private, or permissioned, and public, or permissionless. Those willing to connect to a private blockchain require an invitation or validation from the network operators. Private blockchains are generally used in intracorporate and interbusiness solutions. Public blockchains are open to anyone who wants to participate. All the biggest cryptocurrencies run on public blockchains.

Cryptocurrencies have been the first and the main use case for blockchain so far. As already mentioned, blockchain started from Bitcoin, which leaves behind the rest of cryptocurrencies by market capitalization and the level of market adoption.

The most advanced and the most famous application of blockchain is Bitcoin, the cryptocurrency that was the first to introduce blockchain. In 2008, a person or a group of people under nickname "Satoshi Nakamoto" published a paper called "Bitcoin: A Peer-to-Peer Electronic Cash System" [1].. Since that time, Bitcoin became a true religion. At the beginning, it was interesting only for tech geeks, then it came to financiers, speculators, anarchists, etc. The decentralized nature of Bitcoin and, therefore, its independence from central banks and monetary authorities is what made it popular initially. Satoshi Nakamoto released the version 0.1 of Bitcoin software on Sourceforge on 9th January 2009, and since that time, for more than eight years, the Bitcoin network has been running without interruption.

At first seen by governments as a threat, today Bitcoin is becoming wider and wider adopted around the world. Bitcoin's historically highest market cap of $335 billion was reached on 17th December 2017, when the price of one Bitcoin on some cryptoexchanges passed $20 thousand [2].

Bitcoin has three main areas of problems which include:

– Privacy, as while many think that Bitcoin is anonymous, in fact, it is pseudonymous. Even though a peer's identity is not directly disclosed, its public key is open to everyone. Therefore, by analyzing this peer's behavior, it is possible to identify a unit behind this digital identity [3].

– Scalability, as today Bitcoin transactions are expensive and slow, what is a significant obstacle for performing micropayments and instant transactions. With an average transaction size of 240 bytes, less than seven Bitcoin transactions are made each second. Comparing to 115 by PayPal and 2 thousand by VISA, which in theory can perform 56 thousand transactions per second, this number is very low. At the same time, an average speed of one transaction is 10 minutes with a maximum one-megabyte block size. Some Bitcoin enthusiasts and skeptics are afraid that in the future, the storage problem might also occur, as at very high transaction rates each block can be over half a gigabyte in size.

– Price volatility is seen by some famous economists as too risky for the future of Bitcoin. In his opinion, the high volatility of Bitcoin's value means that it does not function well as a storage of value, and that is the reason why Bitcoin has not become a real unit of account yet. High volatility also makes it risky to sign long-term contracts on Bitcoin. At the same time, Bitcoin's inelastic supply, in the future, maximum of nearly 21 million Bitcoins, and a relatively small market cap make transfers of huge amounts unreliable.

Ethereum is the second largest cryptocurrency by market cap, the highest of $74 billion was reached on 18th December 2017 [2]. Ethereum is a permissionless blockchain-based distributed computing platform that enables functionality for smart contracts, self-fulfilling digital P2P contracts. It provides a decentralized virtual machine that can execute the code of such contracts using a token called ether. Ethereum was initially created in late 2013 by Vitalik Buterin, a cryptocurrency researcher and programmer from Canada. Ethereum network's development was funded by an online crowdsale in the summer of 2014. Its code is developed by Ethereum Foundation. Etherium's high value is explained primarily by the fact the majority of initial coin offerings (ICOs), an analogue of initial public offering (IPO), run on Ethereum, while 2017 has seen the largest amount of ICOs so far.

Besides Bitcoin and Ethereum, other largest cryptocurrencies by market capitalization include Bitcoin Cash, IOTA, Ripple and Litecoin. Until 2017, Bitcoin was dominating the cryptocurrencies market with a huge advantage, usually reaching over 90% of the total market capitalization of all cryptocurrencies. However, since the start of the year, many other cryptocoins have been growing in valuation dramatically. The most significant spikes happened in May and June 2017, when Bitcoin's total valuation went below the valuation of a total of all other cryptocurrencies for the first time in history, and more recently, when the total market cap of all cryptocurrencies reached its peak of $605 billion on 18th December 2017 [2].

For several years, European authorities have been working on how to regulate the usage of cryptocurrencies. Even though it was clear that cryptocurrencies' effect on financial stability in the EU was negligible at the time, European Parliament understood that this could change later, especially if cryptocurrencies' usage in regular payments would substantially increase, if they would integrate to a larger extent into the real economy or if nothing would be done to increase their stability.

As a result, two years ago the European Parliament adopted the 4th Anti-Money Laundering (AML) Directive to regulate the growing cryptocurrency market further. The Directive had to be implemented by all the Member States by 26th June 2017. While the European Central Bank (ECB) preferred the legislation to be stricter, the Directive brought cryptocurrency service providers under existing AML and counter-terrorist financing laws. From this date on, all the cryptocurrency wallet and exchange providers operating in the EU are obliged to conduct a proper due diligence on their clients and to detect, report and disrupt any suspicious activities [4].

In addition to the above-mentioned European Directive, the European Parliament is working on another Directive to allow financial regulators in the EU collect more information on cryptocurrency users. According to the draft version, published in March 2017, the Committee on Economic and Monetary Affairs suggests creating a database that will link all the wallet addresses and particular identities of these wallets' owners.

One of the most famous books on blockchain, written by Melanie Swan, suggests breaking down different types of existing and potential activities in the blockchain environment into three categories: Blockchain 1.0, 2.0, and 3.0. Blockchain 1.0 underlies currency, the initial use case of the technology. It includes deployment of cryptocurrencies, such as value transfers, remittance and digital payment systems. Contracts are the base for Blockchain 2.0. According to the author's categorization, it consists of the complete set of economic and financial applications of the technology that are more extensive than simple currency transactions, such as stocks, bonds, mortgages, futures, titles, smart property and smart contracts. Blockchain 3.0 includes the rest of possible blockchain applications that go beyond currency, economics and finance and reach governments, health, culture, science, literacy, etc [5].

So far, use cases of blockchain in finance have been the most notable, as financial institutions are the most interested in quickly integrating blockchain solutions into their everyday operations. According to 55% of executives from the financial services industry, the most likely blockchain use case is in payments infrastructure. Other most popular use cases among the respondents include fund

transfer infrastructure and digital identity management, 50% and 46% respectively [6].

Nevertheless, academic and business fields usually see capital markets as the second most relevant field of blockchain adoption after payments, with applications focused on digital issuance, transfer and management of different capital markets' asset classes like bonds, private securities, swaps, OTC derivatives, etc. However, while blockchain solutions in the field of payments are likely to be the first ones widely adopted by financial institutions, capital markets implementation will probably take three to five years. The rest of blockchain applications like employee reward solutions, token-based royalty calculation, identity management solutions, etc., are likely to be adopted by 2020.

By switching clearing and settlement of financial markets to blockchains, the banks expect to save on their costly back office operations that process trades and keep records up-to-date. The quicker settlement should also free up funds that banks keep against trading risk. Total savings from using blockchain technology in payments, securities trading and regulatory compliance could reach $15 - $20 billion annually by the year 2022.

Regarding cross-border fiat currency transactions, the most advances are shown by a London-based blockchain startup Circle. Recently it started to offer cost-free cross-border payments to its customers in the US, the UK and a dozen of other countries in Europe. At the same time, these transactions are sent and received instantly, what is a huge advancement for the market.

The main blockchain applications specific to the insurance industry are enhanced claims processing and P2P insurance, that are likely to be widely adopted within the next three years. These and other applications can use blockchain to increase efficiency, particularly by automating identity management. Blockchain will help address the key concern that insurers see when providing microinsurance in emerging economies – the lack of reliable identity validation among population.

Another significant enhancement of insurers' business models will be brought by smart contracts, which, together with real-time data capture and recording, can automate claims settlement. Outsiders may be the first to create initial insurance applications but eventually, if the real rewards arrive, insurance companies are likely to acquire these insurance startups, also called insurtechs, or adapt their models and start transforming themselves [7].

So far, four key areas in which blockchain is likely to disrupt the insurance industry have been identified:

–Increased back-end efficiency and security due to no need for a central authority, no data duplication and processing delays, low transaction costs. An insurtech called Chain is forming a decentralized insurance market with the use of smart contracts in communications and transactions.

–Disintermediation of not too complex coverages thanks to a decentralized network of insurance providers, e.g., auto insurance and mass-market products.

–Improved pricing model is being reached by increased risk transparency, as customers voluntarily share more and more relevant information through wearables and other IoT devices.

–New and newly discovered types of insurance. Microinsurance will advance, as blockchain will help to overcome some existing hurdles like lack of reliable data, unreliable identity validation in emerging countries, large acquisition and administration costs associated with low customer loyalty and high volume of policy cancellations. P2P insurance providers like Lemonade, Friendsurance and TongJuBao use blockchain to increase transparency and reinforce the decentralized nature of P2P products.

Findings made in the Global Fintech Report 2017 by PwC prove that blockchain is quickly becoming a common element of business processes in finance. 55% of the questioned financial executives stated they were planning to make blockchain part of their production systems or processes by 2018, and 77% – by 2020. However, by the time the research by PwC was published, only a quarter of respondents saw themselves as very or extremely familiar with the technology. Out of all the executives, the most familiar are the ones located in North America – 41% of respondents [6].

When speaking about fundraising for blockchain companies, venture capital (VC) and ICO are the two dominating sources. Before 2017, VC was the most common way for startup companies and small businesses to get investment, as they usually have no access to capital markets. Venture capitalists consider such risky investments when they see long-term growth potential in these companies. According to KPMG, VC investment in blockchain companies peaked in 2016 at $544 million across 132 deals [8]. Other sources come up with different numbers for 2016 – $496 million from CoinDesk and $450 from PwC [9]. This discrepancy occurs due to different calculation approaches.

It is notable that the average deal value has benn steadily increasing from $1.8 million in 2013 to $4.1 million in 2016, what is explained by the more selective nature of investments [8]. In 2017, corporate investors cooled down a bit and shifted from direct investment in blockchain providers rather to supporting projects based on the technology. 2016 was the year of the highest blockchain hype so far, so investors are not sure that blockchain is able to live up to this hype. As a result, the first half of 2017 marked VC investment in blockchain slow down. By the end of the year, more robust business cases using blockchain are likely to attract the main interest of venture investors, expanding further into insurtech and asset management sectors.

Another way for a blockchain project to attract investment is through an ICO, pre-selling of its own cryptocurrency. Its value is directly linked to the number of future active users and can change exponentially depending on token issue limitations and on varying demand. Basically, an ICO is an analog of IPO in equity markets with one large difference – ICOs are poorly regulated. So far, only Singapore and Switzerland offer legal frameworks, so ICOs held in other countries usually operate somewhere in a gray area [10].

The research on blockchain ICOs by CoinDesk from March 2017 concluded that in 2016, $236 million was invested in blockchain companies through ICOs, less than a half of VC funding. Notably, CoinDesk brings a different number to that of KPMG – $496 million [9]. However, the year 2017 has shown an incredible rise of ICOs, which outrun VC funding and already totaled to more than $3 billion. The Bancor protocol, which provides built-in price discovery and a liquidity mechanism for tokens on smart contract blockchains, alone has risen $147 million through an ICO in June 2017.

Many experts believe that the ICO bubble might burst. Such expectations are supported by the aforementioned research by Coin Desk, which asked many cryptoinvestors about their views on ICOs. 76% of respondents cited speculation or investment as their primary motivations to invest in ICOs, while only 28% of investors would consider allocating over 10% of their portfolio to ICOs. Just over a quarter of respondents agreed that ICO issuers could have raised capital through traditional funding, what only confirms the idea that the majority of ICO projects have very questionable background and perspectives. Cryptoinvestment is seen as a risky business overall, and ICO is one of the riskiest sides of this business [9].

The already mentioned European Directive restricts ICOs held in the EU to be fully registered in the respective jurisdictions. Everyone who accepts cryptocurrencies needs to conduct a proper KYC procedure [4]. However, not all the governments find it reasonable to regulate ICOs. Australia's leading securities regulation body believes that cryptocurrencies issued by central banks could potentially limit illegal usage of Bitcoin and other dominating cryptocoins, thus helping to fight black economy and money laundering.

Comparing VC and ICO ways of funding shows that they are suitable for different cases of fundraising. Venture capitalists usually invest “smart money”, bringing knowledge, expertise and networking together with funds. At the same time, they always do a profound research of a project they are supporting, what signals to the market that this project deserves credibility. For the same reason, small companies, especially at an early stage, see it easier to raise up to $20 - $30 million through an ICO, as they have to deal with a number of smaller investors instead of one or two large ones. ICO token sale also brings certain publicity and free marketing with it, what is good for almost any business. It also makes

sense to mention that if a project's goal is fraud, persuading a large number of inexperienced ICO investors is much easier than a few solid VC firms. Unfortunately, irresponsible businessmen are attracted by the ICO market as long as there are no legal consequences for them failing their businesses.

It is ironic, that the system, that was once created as a decentralized libertarian counterweight to centralized authorities, is expected to be widely adopted by governments worldwide for their financial systems, election frameworks, land registries, identity management, healthcare records and other purposes. Talking about the ways blockchain will improve public management, the UK Government Office for Science mentions reduced cost of operations, greater transparency of transactions between government agencies and individuals, greater financial inclusion of citizens currently on the fringes of the financial system, reduced costs of protecting citizens' data, protection of critical infrastructure, reduced market friction, promotion of innovation and economic growth possibilities for small and medium-sized enterprises [11].

There is no surprise that the earliest country-level adopters are the European ex-Soviet republics. When there are no or poor legacy systems, it is easier for young countries to build truly digital societies from scratch. Estonia, which is well-known as one of the most internet-friendly countries and a pioneer in e-government, has already used blockchain-like technologies for health records and shared government database system. The US-based BitFury Group partners with the Georgian government to store its records on blockchain with a potential to bring the entire government infrastructure to blockchain. As a result, Georgia has lately moved its land registry onto blockchain with over 160 thousand registrations already processed.

Ukraine, which is trying to become one of the world's leading blockchain nations, also signed a memorandum of understanding with BitFury to address the historical distrust of government in the country. The adoption will also start with land registries. At the same time, Deloitte is helping the Ukrainian government to bring most of the existing document flows on blockchain to protect documentation from any fraudulent manipulations, while the National Bank of Ukraine considers launching a blockchain-based national currency under its Cashless Economy strategy [12].

Other examples of government adopters include Norway, which considers issuing their own national cryptocurrency, Sweden, which is also testing a land registry on blockchain, Dubai, that want all its government systems to run on blockchain by 2020 and many others all around the globe.

The US authorities also consider adopting blockchain across various fields, but especially in the financial system. In this way, cross-border payments and the post-trade clearing and settlement of securities are identified as the main use cases to address operational and financial frictions around existing services. However, as the technology still is believed to be in its infancy, the related challenges for development and adoption of blockchain include technological hurdles, legal constraints, risk management considerations and some other issues related to the existing business cases [13].

At the same time, the advancements are not that rapid, as some governments are more hesitant about blockchain. For example, Bank of England recently decided not to put the technology into the core of its system of the Real-Time Gross Settlement, the heart of the UK payments framework. Such decision was based on research results stating that blockchain was not sufficiently mature to provide the required highest levels of robustness for the system. However, the new settlement system will have the functionality to interface with other blockchains when needed [14].

Shipping services is another industry where blockchain can have a huge impact. Despite the recent technological progress, shipping is still quite a conservative industry and heavily depends on paper documents and obsolete IT systems. The majority of shipping transactions include a huge number of papers that often pass through a big number of parties involved, what can be so time-consuming that the bills of lading often arrive at the discharge ports after the vessels with cargo. As a secure distributed public ledger free of third parties, the blockchain technology will help shipping

improve these inefficient processes and revolutionize the way trade is performed. With the use of advanced cryptography, all the related parties will be able to exchange and store information instantly and securely. In this manner, smart contracts will have a particular impact on shipping. Smart contracts software will include bill of lading and charter-party terms and conditions that could be changed only in case of consensus by all the parties involved. Smart contracts are able to include all the data required for shipping, from a contract being published by an owner or a charterer to the sequence of shipping actions and automated calculations. The technology will also reduce entry barriers to the market for newcomers, thus making the shipping services industry more competitive.

Blockchain will bring various improvements to the existing shipping value chain. The exchange of information will be instantly executed and updated in real time, automating a lot of tasks that are currently done manually. As the information will be stored on blockchain, each party involved will have complete or partial access to this information, depending on the possession of required access keys. This will give full transparency to the market and will reduce the counter-party risk. As all the information on the blockchain will be encrypted, its exchange will be more secure than nowadays. Taking a real case from June 2017, Maersk lost $300 million as one of the victims of the global ransomware attack, what would not be possible with the use of blockchain.

Last but not least, blockchain will noticeably save shipping costs, which are currently largely related to documentation, procedural delays, discrepancies or errors. Proving that the large part of transactions in shipping are related to document processing and administration, Maersk performed a research in 2014 and found out that a simple shipment of refrigerated goods from East Africa to Europe had to pass about 30 people and organizations, including more than 200 various communications among them. Marine Transport International estimates that the blockchain technology could save $300 per container in terms of labor and processing associated documents. For one ultra large container ship, which carries up to 18 thousand containers, the savings may reach $5.4 million.

Wider adoption of the blockchain technology in insurance, what was previously discussed in this article, will have a big impact on the shipping services industry as well, what will ensure transparency across an interconnected network of clients, brokers, insurers and other third parties. Further application of blockchain in shipping is also in line with the automated ships progress. Run by Rolls-Royce, AAWA project looks the most promising in this field. According to its roadmap, the first remotely operated local vessel will be in operation by 2020, the first remotely operated autonomous vessel in international waters will be in line by 2025, while the first ocean-going vessels are expected by 2030.

A number of partnerships on implementing blockchain in the shipping services industry have already taken place. Earlier in 2017, Maersk and IBM revealed a supply chain process solution that helps manage and track paper trail of tens of millions of shipping containers around the globe to promote transparency and the highly secure exchange of information among trading partners. When adopted at scale, the solution promises to save the industry billions of dollars. This partnership is reaching even further, as IBM recently signed a Memorandum of Understanding with the two of Singapore's key traders, ocean shipping carrier Pacific International Lines and port group PSA International. With the use of blockchain, Maersk's supply chain solutions company Damco also shipped flowers from Kenya, oranges from California and pineapples from Colombia to the Port of Rotterdam. The latter has already formed its own logistics consortium that is aimed at testing blockchain for exchange of information. Similarly, neighboring Port of Antwerp is partnering with the tech firm T-mining to work on a pilot project using blockchain to make container handling at the port more secure and efficient. Taking into account all these advancements in shipping, it seems that a formation of an industry-wide consortium, that will include all the largest players, is only a matter of time.

As blockchain adoption is permanently advancing, governments and businesses realize that sometimes it makes more sense to develop conjoint solutions and researches. In the past two years, a number of consortia around the world were formed to apply blockchain across various fields. The challenges a consortium approach faces when dealing with blockchain are already clear, as there can be tensions among participants over control of product development, intellectual property ownership and the way to meet specific business needs of a diverse group of participants.

R3 CEV, or simply R3, is a blockchain company that leads a consortium of over 70 biggest world players in the financial services industry to research and develop blockchain solutions in the financial sector. David Rutter, a former senior executive at electronic broker ICAP, established the company in 2014 in New York. In September 2015, R3 formed a blockchain consortium together with nine financial giants: Goldman Sachs, J.P. Morgan Chase, BBVA, Barclays, UBS, Credit Suisse, Royal Bank of Scotland, State Street and Commonwealth Bank of Australia. Since that time, the list of participants of R3 consortium exceeded 70 names.

David Rutter admits that the companies participating in R3 want to build blockchain applications to form a major part of banks' operating systems as many of those have obsolete legacy IT systems that were integrated during a wave of mergers in the late 1990s and early 2000s. The consortium's joint efforts have created a public blockchain called Corda, which is focused on dealing with the financial world in handling complex transactions and restricting access to transaction data. The aim of Corda is to provide a platform with common services to make sure that any services built on top of it are compatible with the IT systems of participants involved.

Even though the R3 project looks very promising, not everybody agrees with the chosen approach. At the end of 2016, three of the major participants, Goldman Sachs, Banco Santander and Morgan Stanley, withdrew from R3. The reasons for their leave included disputes over terms of a prospective fundraising deal, competing interests and the outsized number of participants, what made the negotiations too difficult. Despite this, in May 2017, R3 informed the media that it had raised $107 million of funding for Corda. Even though it was the largest amount of venture capital invested in blockchain, the initial target of $200 million was not reached.

R3 is a member of another consortium, Hyperledger, a collaborative project of open-source cross-industry blockchains and related tools, which was started in December 2015 by the Linux Foundation. The project aims to bring together some independent efforts to develop open protocols and standards by providing a modular framework that supports different components for different uses, including a variety of blockchains with their own consensus and storage models, identity management services, access controls and contracts. The above-mentioned solution for shipping from Maersk and IBM was developed under their partnership in Hyperledger. The founding members include: IBM, Intel, JP Morgan, R3, Accenture, Airbus, CME Group, Deutsche Boerse Group, Digital Asset, DTCC, Fujitsu, Hitachi and Wanda Group.

Another consortium example is Enterprise Ethereum Alliance, a non-profit organization with over 116 members connecting enterprises, startups, academics and technology vendors with Ethereum. It was launched in February 2017, aimed at defining enterprise-grade software able to handle the most complicated, highly demanding applications at the speed of business. J.P. Morgan Chase, CME Group, BNY Mellon and other large multinationals are among the founding members, with Microsoft being the leading technology provider.

Hyperledger and Enterprise Ethereum Alliance, which are primarily powered by IBM and Microsoft respectively, in some sense embody the confrontation between private and public blockchains. The two tech giants challenge in building a business-friendly blockchain-as-a-service (BaaS) platform. While IBM's blockchain offers a commercial set of cloud services to help clients create and run both public and private blockchain networks, Microsoft's Azure cloud-computing platform lets its users to use primarily public BaaS modules. As IBM mostly does not interact with public blockchains, its BaaS service is based on

Hyperledger's Fabric code, to which IBM was the main contributor. Fabric is governed by Hyperledger's steering committee, where IBM holds one of the leading positions. This committee has the right to make changes to Fabric, but only with a consent from the IBM side. On the other side, Microsoft's BaaS, while supporting a number of private blockchain protocols, prefers to work with Ethereum blockchain. Azure was launched at the Ethereum Event in 2015, and most of its partnerships are with Ethereum-based startups. As mentioned earlier, Ethereum code is maintained by Ethereum Foundation, where Microsoft has no seat, so the Foundation can at any time decide to fork the blockchain without even asking Microsoft, what is a big risk factor for the latter. Therefore, the main difference in IBM's and Microsoft's approaches is in code governance, and the position of Microsoft does not seem to be the winning one at the moment.

At the same time, Hyperledger and Enterprise Ethereum Alliance are associate members of the Blockchain Research Institute, a syndicated research group of governments, tech companies and blockchain startups. Initiated by Don and Alex Tapscott, it was founded as a non-profit organization in Toronto earlier in 2017. The founding members list includes Accenture, IBM, SAP, NASDAQ, Pepsico, the Province of Ontario and some others. The group is focusing on academic analysis of the impacts of blockchain on a number of industries like energy, media, technology, government and healthcare.

Insurance is also represented by its industry-specific consortium. In October 2016, five of the largest insurance and reinsurance companies in the world, Allianz, Aegon, Swiss Re, Munich Re and Zurich, launched the so-called Blockchain Insurance Industry Initiative, or B3i. With the recently joined 10 additional members from Asia, Europe and Americas, B3i initiative will explore the ability of blockchain to improve efficiencies in the data exchange among reinsurance and insurance companies. Aiming to further modernize the insurance industry and innovate the way to serve customers, B3i is likely to launch a pilot project later in 2017.

Another consortium of insurers was formed by nine large Chinese insurance companies. The consortium's blockchain system, controlled by Shanghai Insurance Exchange, should resolve credit problems and account settlements among the insurers, as well as automatically reconcile processes related to insurance claims, premiums and commissions.

Chinese giants like Alibaba Group, ZTE and China Unicom, along with China's Ministry of Industry and Information Technology, launched another initiative back in March. The group of companies will develop blockchain solutions for the Internet of Things (IoT). They believe that this will help overcome many existing obstacles that slow down the advancement of IoT, including high costs and centralized nature of connection, low scalability and network vulnerability. With blockchain, the group expects to bring higher trust, cryptographic security, lower costs and increased speed of operations for the IoT industry.

Another blockchain consortium with Alibaba Group among its founders was introduced earlier in 2017 to tackle fraud in food supply chain in Asia-Pacific. As the recent research concludes, this problem costs the industry $40 billion per year globally. Besides Alibaba, the consortium also includes Fonterra, a dairy cooperative from New Zealand, vitamin supplier Blackmores, PwC, Australian Post and New Zealand Post. The consortium's goal is to create a framework to fight food fraud risk through improving food trust practices and integrity across the entire supply chain of food products traded through the Alibaba platform.

One more recently announced consortium is related mainly to logistics and comes from Korea. Lead by Samsung SDS, which is already a member of Enterprise Ethereum Alliance, the consortium brings together the Korea Customs Service, Ministry of Oceans and Fisheries, Hyundai Merchant Marine, IBM Korea and Ktnet. The solution is presented as an enterprise-grade blockchain platform Nexledger, which will help manage and make impossible to manipulate the entire supply chain from history of manufacturing and storage to transportation and online-tracking of cargo. The members will try to apply this blockchain solution to the entire logistics process for all export and import operations. At the same time, cooperative research on

technical and regulatory challenges for the technology will also be performed.

While industry-specific consortia dominate the market by far, some country-oriented consortia have also been formed. They include the State Bank of India's National Bank Blockchain Consortium, Russia Blockchain Consortium, The Global Blockchain Council in Dubai, Financial Blockchain Shenzhen Consortium, ChinaLedger in China, Blockchain Collaborative Consortium in Japan and Luxembourg-based Fundchain.

The fact that India, China, UAE, Japan, Russia and other states have all established country-specific consortia, shows how important blockchain is for governments. Essentially, if blockchain really becomes the new internet, as many expect, countries like India, China, UAE, Japan and Russia do not want the US dominate it in a similar way the country does with internet.

Conclusions and further research. While the potential of blockchain is still largely undiscovered, it is already clear that it will have huge impact on various processes in everyday processes. This article analyzed the biggest applications of the technology so far, including cryptocurrencies, use cases in finance, shipping and public management. Based on all the information gathered, it is possible to make a conclusion that the blockchain technology will have a big impact on financial and shipping services. The coming years will definitely see the growing interest in blockchain in academic fields, as the technology becomes more and more mainstream. Further research is needed to understand how it will influence not only financial and shipping services but many other industries as well, as with more use cases there will be more solid data for more accurate researches.

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