Acta Catallactics

časopis za ekonomska i opšta društvena pitanja

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Iskreno se nadamo da će se časopis ostvariti vlastitu misiju i doprinjeti boljem razumijevanju ekonomskih i opštih društvenih pitanja.

Svako dobro,
Admir Čavalić, MA,
glavni i odgovorni urednik

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Sadržaj

CRYPTOCURRENCIES AND THEIR IMPLEMENTATION IN EVERYDAY LIFE[1]

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Abstract

The growth of cryptocurrencies poses a threat to the traditional financial system since blockchain technology can be used more efficiently than implementing a traditional one. Cryptocurrencies are now used in food, beverage, and online shopping, but they are also responsible for developing new fields of work and creating new jobs. When they came into existence, society was not introduced to or educated about this type of currency. Although information about cryptocurrencies today are available, people are still skeptical about their usage. For this reason, many researchers have taken a closer look at this particular area of finance. In comparison, fiat money is more secure because a person has "full" control over it, but since third parties are involved, people are leaning towards cryptocurrencies because of their efficiency and lower cost. Although cryptocurrencies have many advantages, there are also disadvantages of this type of currency, such as the fact that there is no central body that controls its development. The use of cryptocurrencies has proven to be both extremely promising and problematic. The lack of regulation creates significant risks (i.e., financial instability, market manipulation and financial crime). Therefore, the main subject of this paper is the (mass) adoption of cryptocurrencies in today's society and everyday life. Also, historical overview and future perspectives of this particular currency concept are tackled in the paper. In conclusion, new regulations must be created to make better use of cryptocurrency opportunities (especially to protect consumers and investors) and limit the risks.

Key words: Cryptocurrencies, Blockchain Technology, Mass Adoption and Implementation, Future Perspective, Regulations.

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1. Introduction

The rapid development of technology in recent years has brought many changes to the economy, society and the environment. It can be said that technology is present everywhere and therefore has become an irreplaceable part of life. The development of the Internet and its use have become an everyday routine, without which the world would not function as it used to, and it is especially important for the young population growing up in the modern world. With the development of Internet technology, selling over the Internet (i.e., e-commerce), which involves various ways of virtual payment, is becoming more and more common. Credit cards are well known as virtual payment methods, and cryptocurrencies are also becoming more popular recently.

Cryptocurrencies are digital money created only in digital form and serve as a digital medium of exchange. They are not supervised by the central bank. Today, there are more than 19 thousand cryptocurrencies on the market, and the most famous is Bitcoin. The advantage of Bitcoin is that it is a fully decentralized currency that is not controlled by any institution. Although its creation dates back more than ten years (i.e., in 2009), cryptocurrencies and blockchain technology are instruments that are still not massively adopted. More precisely, the question is not if global adoption of cryptocurrency will happen, but when it will happen. The exact timeline is tricky to pin down; mass adoption could take place in 2 years, 5 years, 10 years, or more. However, the point is that it will happen, and there are objective benefits to learning about cryptocurrency before mass adoption comes. Understanding cryptocurrency earlier rather than later can provide a smoother transition for all individuals.

The purpose of this paper is to become familiar with cryptocurrencies from their inception to the present day, determine the use of cryptocurrencies in the modern world, and consider the potential future perspectives of cryptocurrencies. Ultimately, cryptocurrencies and their everyday life usage (i.e., examples and obstacles) are the main topic of this paper. Therefore, the aim of this paper is to find out how cryptocurrencies are used in everyday life and what are the future prospects of this concept. This paper is divided into five parts. After the introductory remarks follows the section on history and evolution of cryptocurrencies. The third part discusses the use of cryptocurrencies in everyday life. The fourth part presents future perspectives regarding cryptocurrencies while main research findings ae presented in the conclusion.

2. History and evolution of cryptocurrencies: an overview

It is impossible to imagine the world today without money. It is also impossible to imagine the world thousands of years ago without some form of money as we know it today. According to archaeological findings, the use of money in the form of coins, beads, precious metals, amber or various other forms dates back 40,000 years in human history and testifies to the importance of these units of value developed through human interaction and exchange. These units of value, as we can simply call them, have been developed by mankind from a variety of natural materials into coins and even into digital and virtual forms such as cryptocurrencies that we have today.

2. 1. History of cryptocurrencies

Cryptocurrencies are virtual currencies and this type of currency is created, transmitted and received through the so-called blockchain technology. The main purpose of cryptocurrencies is that they include a peer-to-peer mechanism, effectively eliminating, for example, financial institutions that act as "middlemen" in the payment process (Härdle, Harvey and Reule, 2020). The idea of a currency that could be delivered without centralized institutions and in an anonymous manner was first mentioned in the 1980s. American cryptographer David Chaum introduced Digicash, an anonymous electronic cryptocurrency, in 1995. It was an early example of a cryptographic electronic payment that required user software to withdraw from a bank and certain encryption keys to transmit to a recipient (Dorn, 1997).

In 1998, Nick Szabo developed Bit Gold, which is generally considered a direct precursor to Bitcoin. Cryptographic puzzles required participants to use their computers to solve the puzzles, and those who managed to do so received a reward. When Chaum and Szabo's ideas are combined, the result is something that looks like Bitcoin. However, without the help of a central authority, Szabo was unable to solve the double spending problem, which was still puzzling at the time. Therefore, it took another ten years for the story of Bitcoin and other cryptocurrencies to begin when an unknown author or authors under the name Satoshi Nakamoto wrote a white paper titled "Bitcoin - A Peer to Peer Electronic Cash System" on October 31, 2008. This paper explained how the Bitcoin blockchain network worked (Nakamoto, 2008). On August 18, 2008, they officially started working on the Bitcoin project after Satoshi Nakamoto acquired Bitcoin.org. Six months later, on January 3, 2009, Satoshi Nakamoto mined the first block of the Bitcoin network and thus began the history of Bitcoin. In the first months of its existence, Bitcoin had virtually no value. In April 2010, when they were first traded, one Bitcoin was worth only about 14 cents. In May 2010, a pizza was purchased using Bitcoin, and by early November 2010, the value had risen to 36 cents before settling at about 29 cents. Bitcoin proved that it had real value despite its current low value. In February 2011, it peaked at $1.06 before falling back to about 87 cents. In the spring of 2012, the price jumped, due in part to a Forbes article about the brand new "cryptocurrency". Between early April and the end of May 2012, the price of one Bitcoin rose from 86 cents to $8.89 (Jones, 2022; Buterin, Ribarić and Savić, 2015). When Bitcoin was mentioned on June 1st, 2012 in an article about the currency's popularity in the online drug-dealing community, the price tripled in a week to nearly $27. Bitcoins in circulation at that time had a market value of about $130 million. Bitcoin value increased dramatically in 2012, and in September of that year, the Bitcoin Foundation was established to promote Bitcoin's growth and (mass) adoption (Jones, 2022).

Since January 2016, the price of Bitcoin has increased rapidly every year. In July 2017, a software update for Bitcoin was approved to support the Lightning Network and improve scalability. A week after the upgrade went into effect in August, Bitcoin was selling for about $2,700, and by December 17th, 2017, it had climbed to a record high of nearly $20,000. In the period between 2016 and 2018, Ethereum, a brand new blockchain initiative, was the second most popular cryptocurrency on the market. Ethereum introduced smart contracts to the world of cryptocurrencies by creating a variety of potential use cases and fostering the creation of more than 200,000 unique projects, all connected to the Ethereum blockchain. Most of these projects have their own cryptocurrency, each with

unique goals that often diverge from those of Bitcoin. Later, as the cryptocurrency market grew and expanded, new blockchains, including Cardano and Tezos, began to compete with Ethereum (Jones, 2022).

In the future, there will be a battle between regulation and anonymity. Governments (will) want to control the functioning of cryptocurrencies due to (some) associations with terrorist activities. On the other hand, the main goal of cryptocurrencies is to ensure the anonymity of users. According to Arora (2022), cryptocurrencies will account for almost 25% of all national currencies by 2030, which means that a significant portion of the world's population will begin to trust cryptocurrencies as a means of payment. Cryptocurrencies will continue to be volatile, meaning that prices will fluctuate as they have in recent years, and they will become more widely accepted by businesses and customers (Akhmatov and Roienko, 2020).

2. 2. Development and evolution of cryptocurrencies

The world's first decentralized money (i.e., Bitcoin), as previously mentioned, was created in 2009 and marked the beginning of cryptocurrencies. Since then, the value of cryptocurrencies has increased and they are referred to as "digital gold" by their users. The basic idea behind cryptocurrencies was to create a secure and anonymous mechanism to transfer money from one person to another. Cryptocurrency, or crypto for short, is a digital currency that serves as a medium of exchange. To verify and secure transactions, cryptocurrencies use cryptography. Cryptography is also used in controlling the formation of new units of a particular digital currency. By using cryptographic protocols, which are extremely complex code systems that encrypt important data transfers, cryptocurrencies secure their units of exchange. These protocols are created by cryptocurrency developers using advanced mathematical and computer concepts, making them nearly impossible to hack, copy or even counterfeit. In addition, these protocols protect the identity of Bitcoin users, making it more difficult to link transactions and money flows to specific individuals or groups (Martucci, 2022). Most cryptocurrencies operate without government or central bank backing. Cryptocurrencies differ from fiat currencies such as the British pound or the U.S. dollar because cryptocurrencies are not issued by a central authority. Instead of relying on government guarantees, cryptocurrencies are backed by a decentralized technology called blockchain. A large number of cryptocurrencies are created on blockchain technology, which is a distributed ledger operated by a distributed computer network (Frankenfield, 2022a; Androutsellis-Theotokis and Spinellis, 2004).

Blockchain is the core technology of cryptocurrency, and its goal, according to its founders, was to provide banks with an alternative to protect themselves from the new financial crisis. Blockchain is considered to have the most important advantage of decentralization. It uses techniques such as data encryption, time stamping, distributed consensus algorithms, and economic incentive mechanisms to enable disintermediated peer-to-peer (P2P) exchange, coordination, and collaboration in distributed systems without trust, respect, and centralized control between individuals. In addition, blockchain has the potential to provide a new solution to long-standing problems such as high operational costs, limited efficiency, and potential security risks associated with data storage in existing centralized systems. After the mainframe, the PC, the Internet, and mobile/social networks,

blockchain is widely regarded as the fifth breakthrough computing paradigm. Blockchain is the next generation of cloud computing, and it is predicted to drastically change human and organizational behavior and enable the transition from today's Internet of information to the future Internet of value (Yuan and Wang, 2018).

According to Yuan and Wang (2018), blockchain is a shared ledger, a distributed shared ledger where blockchain data is recorded, verified, stored, maintained, and transmitted using a distributed architecture and mutual trust is established between distributed nodes through mathematical algorithms rather than centralized third-party authorities. It consists of a series of sequential numbers that move up in sequence after each transaction. Each account also has a unique number consisting only of binary digits associated with ownership and contracts, ensuring the highest level of privacy for cryptocurrency users. Therefore, these codes are updated after each transaction, and the data is stored on the blockchain in the form of chained time block tags. Numerous forms of economic incentive schemes aim to increase the number of blockchain miners and encourage these miners to participate in the blockchain by verifying data in the distributed shared ledger.

Cryptocurrencies are called virtual tokens because they exist only on the Internet and do not exist in the form of coins or a stack of banknotes. The value of virtual tokens is determined by market forces generated by people who want to buy or sell these tokens. Mining is a method of generating cryptocurrencies by solving complex mathematical problems using computer computing power in exchange for coins. Users can also buy currencies from brokers, which they can then store and spend using encrypted wallets (Frankenfield, 2022a). The proof-of-work (PoW) or proof-of-stake (PoS) consensus methods are commonly used in blockchains. The PoW is managed by miners, who often allocate specific computing devices to the process. The PoS is therefore powered by staking. The staking system distributes rewards to support the operation of the network by storing assets in specific, designated wallets. A number of PoS assets also support masternodes, which often require a certain number of coins and represent a more complex staking process (Frankenfiled, 2022b).

There are two categories to identify different types of cryptocurrencies; the first category is cryptocurrencies, which include Bitcoin and altcoins, and the second category is tokens. Coins are created on their own blockchain and are meant to be used as a form of currency. Any cryptocurrency based on a blockchain that is not Bitcoin is referred to as an altcoin. The name Altcoin was created as a synonym for "alternative to Bitcoin" and the vast majority of Altcoins were developed to improve upon Bitcoin in some way. Altcoins include, for example, Ethereum (ETH), Litecoin (LTC), and USD Coin (USDC). Some cryptocurrencies like Bitcoin have a limited supply of coins, which helps drive demand and increase their perceived value. For example, the creator of Bitcoin has stipulated that the maximum supply of Bitcoin is 21 million in total (Frankenfield, 2022c). Furthermore, Stablecoins are digital currencies whose value is linked to fiat currencies or items of value such as gold. Stablecoins, which are typically pegged one-to-one to the US dollar, allow consumers to sell into an asset that has the same value as a national currency, but can still be transacted and held in a crypto-like manner (Hayes, 2022).

Tokens are developed on an existing blockchain and are programmable assets that enable the creation and execution of certain smart contracts. These contracts can be used to establish ownership of assets outside of the blockchain network. Tokens can be sent

and received and can be used to represent units of value such as coins, money, digital assets, and electricity (Frankenfield, 2022d). In addition, the non-fungible tokens (NFTs), are a type of cryptocurrency that denotes a unique asset that cannot be duplicated. The Bitcoin is fungible (token), meaning that when it is exchanged for another, it becomes the exact same asset. Therefore, a one-time trading card cannot be reproduced. This is evident when a one-time trading card is exchanged for another card and becomes something completely different (Sharma, 2022a).

3. The use of cryptocurrencies in everyday life: examples and obstacles

According to Bunjaku, Gjogieva-Trajkovska and Miteva-Kacarski (2017), there are many benefits that the use of cryptocurrencies (i.e., Bitcoin) can bring to society in the future. The first is that Bitcoin uses the same technology that is used in online banking (the only difference of online banking is the disclosure of information about the users). The second advantage is that there is no inflation in the cryptocurrency market as the maximum number of coins is strictly limited to 21 million Bitcoins. The third advantage is that it is a peer-to-peer network (information exchange takes place between two or three clients with no master server and each client stores records of the transactions performed). The fourth advantage of using cryptocurrencies is that they have unlimited possibilities of transaction. In addition, payments made in this system are actually impossible to cancel (the coins cannot be counterfeited, copied or spent twice). Another advantage is that Bitcoin transaction costs are low (the Bitcoin works like physical cash that combines the functions of electronic commerce). Decentralization means that the network is equally distributed among all participants (there is no central authority that dictates the development and price of the cryptocurrency). Moreover, Bitcoin is a currency that is easy to use. Another advantage of introducing it in everyday life is the fact that all the transactions that are done with cryptocurrencies are anonymous, transparent and fast. Another reason why this currency was introduced is the fact that only the owner who has protected his wallet can use it. There is less or no chance of fraud and customers can manage their own transactions.

3. 1. Everyday life examples of cryptocurrency usage

The easiest way to buy something with Bitcoin is to use a crypto-debit card. These cards already have a Bitcoin value stored on them. When someone pays for products or services with Bitcoin, the retailer receives that payment in fiat (i.e., real) money. A car dealership named Bitcars can be used as an example of purchasing products and services with Bitcoin currency. The list covers a range of premium cars and old-timers for the crypto community and includes some luxury cars like Lamborghini and the dealership actually receives Bitcoin payments for its products. Not only do they accept Bitcoin, but they state in the product description that they accept any type of cryptocurrency. Technology and e-commerce products are the following ones that can be purchased with cryptocurrencies. There are several companies that currently accept Bitcoin, such as Microsoft. Microsoft currently accepts Bitcoin as a payment method on its online store, but not on its

Xbox platform. Even though they accept Bitcoin as payment, they do not accept advertising related to cryptocurrencies or other content related to Bitcoin. Overstock is an online retail platform that sells a wide range of goods, and they were the first to accept Bitcoin as a possible payment method. Another example of e-commerce sites is Shopify and Rakuten. Even though some small businesses have decided to accept Bitcoin as a payment method, some big companies are still skeptical about Bitcoin. For example, Amazon, still does not give online shoppers the option to purchase products with cryptocurrencies, especially Bitcoin. (Ross, 2021). At E-bay, there were rumors that they are among those accepting cryptocurrencies as payment. While attending an event about cryptocurrencies, E-bay brought banners confirming that the company wants to enter the business with Bitcoin. In 2021, the company commented to Reuters, saying it was looking into the future of all forms of payment, including cryptocurrencies, and was interested in the NFT market. Meanwhile, PayPal, which was once an eBay subsidiary, now allows customers to buy, sell, and hold cryptocurrency in their accounts (Sharma, 2022b). Another type of product that can be purchased with Bitcoin is jewelry and expensive goods. The online luxury retailer BitDials offers Rolex, Patek Philippe and other high-end watches in exchange for Bitcoin and other cryptocurrencies. Even luxury watchmaker Franck Muller has produced a watch that is studded with gold and even diamonds. This piece of jewelry had a QR code with the Bitcoin genesis block. Some other jewelry stores have partnered with payment processors to facilitate crypto-based purchases from their stores (Sharma, 2022b). Cryptocurrency media outlets generally accept Bitcoin for subscriptions or other services. Among mainstream media, the Chicago Sun-Times was the first major publication to accept Bitcoin on its platform in 2014. That same year, magazine publisher Time Inc. began accepting cryptocurrencies for digital subscriptions. In 2019, the magazine publisher entered into a new cryptocurrency partnership with Crypto.com (Sharma, 2022b). For the most part, the insurance industry has been reluctant to adopt cryptocurrencies. But things are starting to change. While life insurance is still taboo, insurance providers have begun accepting premium payments with Bitcoin for other products in their portfolios. In April 2021, for example, Swiss insurer AXA announced that it was accepting Bitcoin as a payment method for all of its insurance lines, with the exception of life insurance (due to regulatory issues). Metromile, an agency that sells "pay-per-mile" auto insurance, also accepts Bitcoin for premium payments (Sharma, 2022b).

According to Lecarme (2021), there are five practical ways to use of cryptocurrencies in ordinary life. The first use is the use of cryptocurrencies as a means of payment when shopping online. This has already been discussed, but types of products that can be also purchased with cryptocurrencies include the following: a villa in the Swiss Alps; porn, gaming and gambling; pay taxes in Miami and a corona test in New York. The second use of Bitcoin is as an investment tool. Bitcoin has proven to be the best performing asset over the last decade (even though this statement is true, people are still scared to move their fiat money into Bitcoin). The third way to use Bitcoin is in the transaction of value. When sending money through a bank, this process can take days and banks charge fees for it. With Bitcoin, this transaction is much faster and more secure. The fourth way to use Bitcoin is as a store of value for other (newer) cryptocurrencies. The reason for this is that store of value function of Bitcoin is now indirect, and not felt by people in their ordinary lives. With fiat money, you can touch and feel it, which is not the case here. However, it is only possible to get into almost all crypto exchanges with Bitcoin. Many other cryptocurrencies are expressed in the strength and the value of the daily fluctuating price of Bitcoin.

This makes Bitcoin the reserve currency for all other cryptocurrencies. And fifth, Bitcoin needs to be integrated as a means of payment. Even though Bitcoin has been established as a new cryptocurrency for years, the Internet is an unreliable place where there can also be many scams and frauds. In this way, people can scam other people by tricking them into "investing" in Bitcoin. Even if it is not a scam, people are still skeptical and afraid of this kind of investment (i.e., Bitcoin Circuit has been accused of fraud even though it is a legal software for mining Bitcoin - this platform is less risky and safer for its participants).

According to Zafar (2021), cryptocurrencies are becoming an increasingly common payment instrument in real life, as more than 18,000 worldwide registered organizations accept cryptocurrency as a payment. Companies such as Booking, Coca-Cola, PayPal, KFC, BMW and many others are ready to accept payments in Bitcoins now. And every year the adoption of digital currencies will only increase. It is estimated that the number of crypto wallet holders will increase to 300 million by 2030 and the number of businesses supporting crypto payments will increase to 25 thousand. The retail and e-commerce will be the main sectors accepting cryptocurrency as a payment instrument. This market accounts for almost 40% of all crypto payments in the world. The sector of premium goods (jewelry, yachts, planes, real estate), cross-border payments, also gaming and gambling circuits will take the lead as well.

According to Faris (2022), you can also buy furniture with Bitcoin. The company Overstock offers the possibility to buy furniture using Bitcoin currency. In the US, you can even buy pizza with Bitcoin currency at Domino's Pizza. Subway is a fast food restaurant that offers the possibility to buy its products with Bitcoin currency as well. In the last decade, many branches of this restaurant have announced Bitcoin acceptance. Again, in the US, customers can even buy socks with cryptocurrencies at MtSocks. Due to the processing fees that come with smaller purchases, there aren't many opportunities to buy candy using your Bitcoins. But one manufacturer came up with a Bitcoin-enabled candy dispenser called SweetBit. Buying event tickets online using cryptocurrencies is also a possibility (i.e, the Dallas Mavericks not only allow Bitcoin payments, but one also gets a discount on fan merchandise if tickets are paid this way; the Miami Dolphins accept both Bitcoin and Litecoin; Manhattan residents can buy concert tickets with Bitcoins through a local company called Blockparty). Bitcoins can also be used when going on vacation. There are several airlines that now accept Bitcoin payments, including CheapAir. An increasing number of hotels are accepting Bitcoin, including The Kessler Group, a U.S. based luxury hotel chain. Also, in Las Vegas, Bitcoin ATMs are located throughout the city, and hotels like The D and Golden Gate accept Bitcoins as payment. Another line of products that can be purchased with Bitcoin are electronic devices (i.e., Newegg sells electronic devices that can be purchased with Bitcoin - everything from gaming chairs to drones). Hard to believe, but at least a couple of funeral service providers now accept Bitcoin as a form of payment. The first one in the U.S. was St. Paul, Minnesota's Crescent Tide Funeral and Cremation Services, which started accepting Bitcoins in 2014. Movie tickets, works of art, frappuccino or even a college tuition can be nowadays purchased with Bitcoins.

3. 2. Obstacles in cryptocurrency implementation

Even though cryptocurrencies are currently trending and their modern approach can change payment methods and improve the standard of living in society, there are also some disadvantages of cryptocurrencies that need to be taken into account. If these problems are not solved, there is a possibility that cryptocurrencies will not "come alive" as a (official) means of payment. Ivanschenko (2016) lists several disadvantages of using cryptocurrencies: a) cryptocurrencies have high / strong volatility as their value actually depends on government declarations (this volatility can cause problems, but only in the short term). There are also major risks associated with investing in cryptocurrencies, and these risks need to be considered in the medium and long term (many of these risks involve cryptocurrencies being used for money laundering, terrorism, or other types of illegal activities). Even though decentralization brings many benefits, it can also pose a risk to its use because there is no centralized authority that controls the development of cryptocurrencies.

According to Ivanschenko (2016), the use of cryptocurrencies will reduce the cost of transactions and boost trade and the (global) economy. However, pessimism surrounding cryptocurrencies remains the major obstacle and a potential problem in the future – if consumers do not feel like buying products with Bitcoin, it is unlikely that companies will introduce this payment method into their business. Ivanschenko (2016) explains that although cryptocurrencies have many advantages and huge potential for development, there are also risks associated with the use of this type of currency. Besides pessimism towards cryptocurrencies and the fact that there is no central body that controls them, the risk and also an obstacle in their implementation is that they are not suitable for all types of payments. This obstacle lies in the fact that Bitcoin payments are not timely. Even if payments are made within ten minutes, it is always suggested that customers wait a few more rounds of verification until the transaction is completed. This can sometimes take an hour, making Bitcoin a not-so-reliable payment source. For card payments, which are also not real-time because the money is not credited to the payee's account until one or more days later, this problem is solved by reserving the money in the payer's account and guaranteeing payment to the payee (Segendorf, 2014).

Bitcoin, which does not have a central issuer or verification process, cannot do this. However, individual payment service providers can guarantee Bitcoin payments to their customers. However, it is difficult to find a guarantee that supports the decentralized use of Bitcoin without central participants. Credibility issues of a technical nature are also an obstacle. The way Bitcoin works is based on miners verifying transactions. The incentive for this is mainly that new Bitcoins are allocated to the miners. However, this incentive could be eroded, which could undermine trust in the virtual currency. Another obstacle is the cap on the number of Bitcoins (i.e., 21 million). The fundamental problem is that virtual currencies can be easily recreated. If 21 million Bitcoins can suddenly become 42 million, each Bitcoin would also be worth less. Maintaining a cap of 21 million Bitcoins is therefore important to maintain the credibility of Bitcoin's future value. Another reason why miners' incentives could be undermined is that the exchange rate could fall, which would reduce the value of the reward. In addition, computing power and electricity could become too expensive. Another potential problem is that the length of the blockchain is constantly increasing. Currently (as of July 2022), it is over 418 gigabytes (de Best, 2022).

The Bitcoin network assumes that there are a large number of nodes on whose computers the entire blockchain is stored. This makes the network robust. The incentive to manage such a "full" node has decreased, and the number of such nodes appears to be decreasing. In other words, it appears that Bitcoin is becoming increasingly centralized and thus less robust. If the incentives for miners disappear, decentralized verification of transactions will no longer be possible, and Bitcoin will no longer be usable (Segendorf, 2014). Some other virtual currencies can replace Bitcoin, which is an obstacle that limits the use of Bitcoin in daily life. Even though cryptocurrencies are publicly visible and available and Bitcoin is the largest cryptocurrency, for example, there is a possibility that many new cryptocurrencies will emerge and Bitcoin will become a thing of the past. According to Kharpal (2022), there are more than 19,000 cryptocurrencies and dozens of blockchain platforms that exist today.

There are two effects that can have a major impact on the market and that can either create opportunities or barriers to the adoption of cryptocurrencies: 1) the reinforcement effect is the result of the one-sided network effects present in the currency adoption process (as Bitcoin becomes more popular, more people would believe that it will win the "winner-take-all" race against other cryptocurrencies - with this expectation, the demand will further increase); 2) the substitution effect is the result of speculative dynamics that led to cryptocurrencies being treated as financial assets (as Bitcoin becomes more popular and more expensive, people fear that it may be overvalued, or too volatile, and look for an alternative cryptocurrency investment). According to Gandal and Halaburda (2014), in the context of currency competition and competition between exchanges, the so-called network effects play an important role. Positive network effects are present when the value of a product or service increases with the number of users. A currency is more useful as more people adopt it. An exchange is more liquid when there are more buyers and sellers. In such an environment one might expect a "winner-take-all" dynamics and convergence to one dominant player. The more popular the currency the more easily it can attract new users. Similarly, the larger exchange will be more attractive to new buyers and sellers. Therefore, the larger competitor will grow even larger, eventually dominating the whole market. However, Gandal and Halaburda (2014) do not see a clear "winner-take-all" dynamic in the cryptocurrency market.

4. The future of cryptocurrencies

According to Segendorf (2014), Bitcoin is (or should be) the answer to all the problems caused by the traditional monetary system. Although Bitcoin is a promising way of payment, Segendorf (2014) believes that it serves as a kind of savings since the use of Bitcoin for payments is low in terms of mass (not to say, global) adoption. For this cryptocurrency to become more attractive than fiat money, it needs to be used for more purposes rather than just this one. Critics see only risks in cryptocurrencies, while others see great potential. The future of cryptocurrencies is not so clear yet, as there are many obstacles for their implementation. Cryptocurrencies have the potential to benefit everyone, not only customers but also businesses. There are more opportunities for financial inclusion, ownership and power but at a lower cost. There is also greater access to the market. On a policy level, investing in blockchain offers the opportunity to in-

crease the capacity of e-government and develop a digital society. This can also have the potential to strengthen democracy, human rights, the rule of law, and anti-corruption initiatives. The incredible potential for developing the economy is exactly what makes blockchain difficult to adapt and use. China, for example, is trying to crypto its own currency, but decentralization is failing just as it did with Bitcoin[5]. Russia is trying to reduce its dependence on the U.S. dollar, but is also sceptical of cryptocurrencies.[6] In the West, there is a growing concern about the large environmental footprint that cryptocurrencies cause.[7] Even though cryptocurrencies have great potential, they are still a risky investment (Segendorf, 2014).

According to Segendorf (2014), there are three types of benefits that Bitcoin can bring to society as a whole if implemented properly. The first is that payments in Bitcoin can be free, unlike other traditional payment methods. Bitcoin can also lead to savings and create a more efficient payment system. Second, over time, a virtual currency like Bitcoin can contribute to a more robust payment system that removes barriers in traditional financial structures. Finally, it is beneficial if innovation of new payment services and other financial services develops around Bitcoin. For example, Ripple has tremendous potential to benefit the society. The primary goal of Ripple is to provide a more efficient means of transmitting currency across national borders. In the banking sector, this means reducing costs and transaction time by eliminating the intermediaries. There are legal challenges that need to be resolved to make it ready for future use. Since XRP[8] (i.e., a cryptocurrency issued by the Ripple network) has a large community and loyal shareholders, this means

5 The People's Bank of China argues that its ban on cryptocurrencies is designed to curb financial crime and prevent economic instability. However, China's ban on cryptocurrencies comes amid concerns that cryptocurrencies facilitate capital flight from Chinese markets by circumventing traditional restrictions. China's ban on cryptocurrencies is part of a new trend in Chinese economic policy toward greater government intervention, reflected in the "common prosperity" campaign (Shin, 2022).

6 However, during the war between Russia and Ukraine, Russia was able to use cryptocurrencies to mitigate the force of sanctions put in place. While cryptocurrency transactions are recorded on the underlying blockchain and are therefore transparent, new tools developed in Russia can help obscure the origin of such transactions. This would allow companies to trade with Russian entities without being detected. In addition, illicit funds have flowed into Russia through a dark web marketplace called Hydra, which is powered by cryptocurrency and reported more than $1 billion in revenue in 2020. The technology behind Hydra disguises the source of transactions and provides Russian users with a potential tool to move money outside the country's borders. However, Hydra is not yet large enough to handle the volume of transactions Russia would need to successfully circumvent sanctions. But other money laundering techniques, such as "nesting" in which an illicit marketplace embeds itself in a larger and legal structure to hide its activities, could also help (Flitter and Yaffe-Bellany, 2022).

7 It is estimated that Bitcoin alone consumes 131 TWh annually, which is equivalent to 0.29% of global energy production and 0.59% of global electricity production, ranking Bitcoin mining between Ukraine and Egypt in terms of electricity consumption (Kim, 2022).

8 Ripple can facilitate exchanges for a variety of fiat money, Bitcoin, and some other currencies. When a user makes a transaction on the network, a small amount of XRP is generated as a fee. XRP is a cryptocurrency that runs on the XRP ledger, a blockchain developed by Jed McCaleb, Arthur Britto, and David Schwartz. This blockchain technology works a little differently than other cryptocurrencies. This type of cryptocurrency system is centralized in some ways, as it contains unique node lists that users can choose to verify their transactions based on the participants they believe would be least likely to defraud them. In addition, Ripple can decide which validators update their ledgers, and Ripple decides who is allowed to maintain the interaction. Ripple also makes 6 validation codes. The XRP ledger has created over a hundred million tokens that are then publicly released. Ripple owns about 6% and is expected to help this cryptocurrency grow and become successful over time. Another 48% is held in reserve to be released to the market for further sales. There are several advantages of using this type of cryptocurrency. The first is the fact that this cryptocurrency can be transacted very quickly, usually in 2-5 seconds. Ripple has very low fees, and the cost of completing a transaction is only 0.0001 XRP, which is a small fraction of a penny. As mentioned earlier, Ripple also has a very versatile network that not only handles transactions with XRP, but is also used for fiat money, cryptocurrencies, etc. It is also used by large financial institutions that use these cryptocurrencies as a transaction platform (Rodeck and Schmidt, 2022; Reiff, 2022).

that XRP can become very successful and popular in the world (Rodeck and Schmidt, 2022; Reiff, 2022).

There are also some variables that can influence the emergence of Bitcoin: a) the growth of the share of digital purchases; b) customer acceptance of blockchain innovation in electronic billing, payment and banking systems; c) the emergence of Bitcoin (and also various other cryptocurrencies) such as niche cash; d) the impact of Bitcoin (or another cryptocurrency) as a specific niche cash in nations with a weak currency and the possibilities of regulatory dangers of Bitcoin usage in these nations. Bitcoin's technical breakthrough has ensured that this method of payment has a bright(er) future. Clearing purchases makes them even more attractive to customers because this type of payment is less expensive and more secure. According to Rahman and Dawood (2019), the increasing trend towards electronic payment systems is due to the fact that people are using cell phones, tablets, etc. more than ever before, making this type of payment simpler and easier to make. In addition, using computer power to "mine" money that can be used to purchase products and services is an attractive idea for "prospectors". The popularity of blockchain technology in the payment and settlement system is another reason why these authors predict a bright future for Bitcoin. Bitcoin has underlined the strength of blockchain technology. When governments realize the strength of blockchain technology, they will introduce this system into their banking system(s) because they will want a more cost-effective system to work with. Bitcoin represents an imaginative and technologically advanced alternative for an uncertain globalized future. If cryptocurrencies are properly regulated, they can face new challenges in the future (Rahman and Dawood, 2019). Until then, a lack of regulation will create substantial risks.[9]

According to Fauzi and Paiman (2020), cryptocurrencies are here to change the future of payment options. In order for cryptocurrencies to become part of everyday life, some issues need to be addressed. For example, if cryptocurrencies are to remain "alive" in society, security protocol(s) must be improved as well as the work on activity proofs, and knowledge management needs to be applied in order to make this system work. The benefits and advantages of cryptocurrencies need to be harnessed in a short period of time because cryptocurrencies are evolving every day and need to be managed accurately and appropriately. Knowledge of how this technology works is essential to control the negative effects of using cryptocurrencies in everyday activities. Expertise in this area must be utilized in the formulation of policies and regulations related to cryptocurrencies. Fauzi and Paiman (2020) also speculated that (globally) in the future cryptocurrencies will be used in cafes, restaurants, bars, marketplaces, online stores, and even hair and beauty salons. Also, they predicted that cryptocurrencies will become mainstream in this decade and their use will be accepted worldwide. E-commerce will develop rapidly with the use of cryptocurrencies and the most popular crypto areas will be: retail, gambling, gaming, food and beauty industry.

When discussing about the future of cryptocurrencies, it is also important to mention their volatility. The current state of cryptocurrencies (also referred to as the "perfect

9 In the EU, for example, people trading crypto assets do not fall under EU consumer protection rules and are often not well informed about the risks, which can cause them to lose money. The widespread use of crypto-assets without regulation could lead to financial instability, market manipulation, and financial crime. Because transactions are largely anonymous, cryptocurrencies are often used for criminal activity. In the wake of the Ukraine war, EU countries have restricted the trading of crypto assets for use in Russia or with a Russian entity. The technology also consumes large amounts of electricity, resulting in a high environmental impact.

storm of fear and panic") best explains why many people do not believe they will be a viable currency in the near future. What is meant by this? The Bitcoin price is at its lowest level since 2020, one of the largest cryptocurrency exchanges Coinbase has declined in value, more than $300 billion has been wiped out by a plunge in the price. Rising interest rates, inflation, and economic uncertainty caused by Russia's invasion of Ukraine have all contributed to the current situation. All of the aforementioned events led to a huge sell-off due to fear and panic, and some traders are comparing this collapse with the start of the 2008 financial crisis. Even though cryptocurrencies have usually recovered from major price drops, it still took several years to reach new highs in some cases. How long this decline will last, no one can say for sure (Yaffe-Bellany, Griffit and Livni, 2022).

While proponents tout cryptocurrencies as potentially viable investment alternatives, several prominent financial experts consider most coins, with the exception of Bitcoin and a few others, acceptable as anything but pure speculation. (Martucci, 2022). Just as the evolution of technology opens up new opportunities, so will new challenges. It is important that blockchain technology overcomes existing problems and challenges in order to maintain the trust of the many companies it has already gained, but also to attract new users who were previously skeptical.

5. Conclusion

There are differing and controversial opinions about the future of cryptocurrencies in general and Bitcoins in particular. While those who have a libertarian view of life are optimistic and welcome the cryptocurrency system, other authors, economists and scholars are not enthusiastic about the use of cryptocurrencies in the system of payments and financial transactions. The optimistic view of the use of cryptocurrencies is supported by the fact that they facilitate the transfer of money between two parties in a transaction; these transactions are facilitated by the use of public and private keys for security purposes. These money transfers are done with minimal processing fees, allowing users to avoid the high fees charged by most banks. In addition, many countries have started accepting Bitcoin as a valid currency. Especially countries that want to abolish cash are very open to cryptocurrencies. One argument that Bitcoin proponents make is the market capitalization of Bitcoin, Ethereum and other cryptocurrencies. They claim that the market for cryptocurrencies has become very large and powerful, so banning them would be too costly for any country. On the other hand, opponents of cryptocurrencies claim that cryptocurrencies are very volatile and can be used to launder money or finance illegal activities. In this regard, Bitcoin is not considered as a viable electronic currency - Bitcoins are illiquid and have high price volatility, the discounted present value of a Bitcoin is zero, this currency has no central issuer, and there is no financial or economic basis for its creation.

In the past, regulation of blockchain and cryptocurrencies has lagged behind, as regulators globally have found it difficult to regulate a technology that is borderless. As for crypto regulation, the EU is working on (new) rules to promote the potential of crypto-assets and mitigate the threats. To encourage the development and use of the technology behind cryptocurrencies, these rules aim to provide legal certainty, support innovation, protect consumers and investors, and ensure financial stability. The rules address transparency, disclosure, authorization, and monitoring of transactions. Companies that trade crypto

assets must better inform consumers about risks, costs, and fees. By regulating the public offering of crypto-assets, the regulations would ensure financial stability, while other measures address market manipulation, money laundering, terrorist financing, and other criminal activities. For truly global, coordinated action, countries and international organizations must work together, leveraging best practices and lessons learned from each other. In addition to risk assessments and the establishment of common standards, there is also an urgent need to leverage technology itself to develop expedient and inclusive solutions through public-private collaboration.

The majority of people are still skeptical about the whole "cryptocurrency thing". Rightfully so, as we see prices "hit the floor" when cryptocurrencies enter the so-called "bear market", and as long as cryptocurrencies remain as volatile as it is today, it will be hard to see any faster progress in their (grater) mass adoption.

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A BLOCKCHAIN SYSTEM FOR HEALTHCARE

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Abstract

This paper analyses the impact of the digital transformation on the healthcare sector and investigates the opportunities of using blockchain technologies in the healthcare ecosystem. The main goal is the proposition of a blockchain system for healthcare that will improve the tracking of business transactions, real-time communication and data sharing between stakeholders. The proposed system will enable the recording of all data and transactions of healthcare providers, medical laboratories, academia, research institutes and laboratories, companies, health insurance companies and investors, government and state authorities, and patients. All stakeholders' transactions will be done using a blockchain network and all collected data will be stored in a cloud database. Patients will have a blockchain application that will enable managing electronic personal health record, electronic health records, medical reports, electronic prescriptions, health insurance data, and crowdsensing data. Using blockchain application, patients can interact with their doctors through online conversations and distributes their personal health data reports. This approach encourages telemedicine services and is suitable for monitoring patients' health status and online access to all their health data. For tracking patients' health status different crowdsensing applications can be used, such as monitoring heart rate, blood pressure, stress, etc. The proposed system could serve as a good basis for the adoption of blockchain for healthcare in different countries.

Key words*:* Digital Transformation, Blockchain, Healthcare, Crowdsensing.

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1. Introduction

Digital transformation has affected the improvement of e-business and stakeholder relationship management in healthcare sector and medical practice (Massaro, 2021). Healthcare sector has become increasingly technology focused. Innovative information and communication technologies such as web and mobile technologies, cloud computing, big data, blockchain, Internet of things, artificial intelligence, virtual and augmented reality have enabled the introduction of modern infrastructure and services in the healthcare ecosystem. The main aim of introducing these technologies in healthcare is to solve problem related to data management, transparency of business transactions, trust in data handling, security, privacy, scalability and interoperability issues (Kraus et al., 2021), stakeholder relationship management (hereinafter: xRM). Blockchain technology has the potential to help solve these problems and support the digital transformation of the healthcare sector impacting all healthcare stakeholders (Tandon et al., 2020; Massaro, 2021; Sharma et al., 2021).

This paper presents a blockchain system for healthcare that enables the tracking of business transactions in the healthcare sector, using secure, scalable, and distributed infrastructure, and real-time communication and data sharing between stakeholders. The proposed system could serve as a good basis for the adoption and implementation of blockchain services in the healthcare ecosystem in Serbia and other countries. The rest of the paper is organized as follows: section 2 gives the theoretical background on the digital transformation in the healthcare sector; section 3 analyses the possibilities of using blockchain technology in healthcare; section 4 presents the developed blockchain system for healthcare. Finally, we give conclusions and implications.

2. Digital transformation in the healthcare sector

Digital transformation significantly affected the healthcare sector. Healthcare 4.0 enabled the application of new e-business models and innovative digital technologies in healthcare such as blockchain, the internet of things (hereinafter: IoT), telemedicine, artificial intelligence (hereinafter: AI), cloud computing, big data (Kumari et al., 2018; Massaro, 2021; Cerchione et al., 2022). These emerging technologies changed the healthcare organizational processes, improved medical care services, health insurance problems, solving medical practice issues (Farouk et al., 2020; Kraus et al., 2021).

Healthcare ecosystems consist of different stakeholders such as (Secundo et al., n.d.; Massaro, 2021):

- providers of medical care services (physicians, professionals, nurses, healthcare workers),
- medical laboratories,
- academia,
- research institutes and laboratories,
- pharmaceutical industry,
- health insurance companies,

- public and private companies,
- government and state authorities,
- patients.

Innovative information technologies positively affected real-time communication and collaboration among different stakeholders, better productivity, lower business costs, and insight into business transactions, managing large data sets in real-time, faster detection and identification of diseases and supporting healthcare ecosystems (Massaro, 2021; Cerchione et al., 2022). For the patients, digital technologies are enabled approach to their medical data and to share them on request with healthcare providers and other participants in the healthcare ecosystem. Furthermore, patients can use telemedicine services for distance healthcare monitoring by health providers in order to reduce the time needed to visit health institutions and receive real-time information (Spanò et al., 2021).

Due to the exchange of large amounts of data in the healthcare ecosystem, it is necessary to provide an adequate IT infrastructure that would enable interoperability, reliability, and protection of health information from misuse (Hermes et al., 2020; Massaro, 2021). Because of the transparency and immutability of data, and managing an extensive distributed database to enhance medical records and enable safe medical data sharing (Cerchione et al., 2022), blockchain technology is recognized as an adequate solution to these problems in healthcare (Tandon et al., 2020; Massaro, 2021).

3. Blockchain in healthcare

Blockchain represents a method for storing data in a transparent, distributed, and immutable manner (Tapscott & Tapscott, 2016). It can be defined as a distributed database that contains all recorded transactions in chronological order (Centobelli et al., 2021; Cerchione et al., 2022). This distributed database is maintained by a network of verified participants and stores immutable blocks of data that can be shared securely without third-party intervention (Tapscott & Tapscott, 2016; Hölbl et al., 2018; Tandon et al., 2020). This concept of storing and sharing recorded data is suitable for the healthcare ecosystem where participants need to be registered members agreed to use a consensus protocol and defined rules. Data are preserved and recorded with cryptographic signatures and the use of consensus algorithms (Tandon et al., 2020).

Blockchain has the potential to improve the healthcare ecosystem (Sharma et al., 2021) to be based on trust, automation, and privacy. This could significantly affect on the clinical data exchange between patients, doctors, healthcare service providers, pharmacies, insurance companies, etc. Blockchain enables safer and more secure access to patients' medical data only by authorized healthcare entities, recording every visit to the healthcare institutions, recording clinical trials, using recipes, access to data related to health insurance, etc. (Farouk et al., 2020).

If the patient needs healthcare services abroad, doctors can request to approach his electronic health record (hereinafter: EHR). EHRs, may include all required information of a patient regarding medical history, diagnoses and treatments, laboratory results, and X-ray and MRI images (Sookhak et al., 2021). Blockchain should enable the integration

of electronic medical reports and create a distributed EHR ecosystem (Cerchione et al., 2022).

Medicalchain provides telemedicine services by enabling patients to communicate online with their doctors, distributes their medical reports, and share their real-time health data (Farouk et al., 2020). For enabling telemedicine services significant contributions have mobile and Internet of things technologies. Health IoT (hereinafter: HIoT) can enable monitoring patients' health using wearable sensors or devices. Usually, wearable devices (such as smart watches, smart bracelets, IoT-based wearable devices, etc.) enable real-time monitoring of temperature, heart rate, oxygen saturation, blood sugar, blood pressure, etc. (Rodic-Trmcic et al., 2018; Labus et al., 2021; Adere, 2022). All these data collected via wearable devices or sensors, can be tracked using smart healthcare mobile applications. This is so called crowdsensing concept (Staletić et al., 2020). Generated crowdsensing data from patient's wearable and mobile devices are stored in the cloud and can be added in the electronic personal health record (hereinafter: ePHR). These data patient can share with their doctors or healthcare workers and receive medical advices. In contrast with EHRs that healthcare providers maintain, ePHRs reflect patient-related health records and are handled by the patient (Cerchione et al., 2022).

All health data transactions between patients and doctors can be tracked using blockchain. Blockchain can be used for tracking data between patients and other stakeholders in the healthcare ecosystem. All transactions among all participants in the healthcare ecosystem become transparent because of using smart contracts. Smart contracts refer to a series of computer codes and protocols that can automatically execute and enforce an agreement when the specified conditions are met (Sookhak et al., 2021). They enable immutability and trustworthiness of blockchain transactions without intermediaries.

Blockchain can enable the global medical data exchange using interoperability. The application of interoperability in healthcare improves operational efficiency, eliminates frauds, reduces the time required for administrative business, medical errors and the duplication of clinical examinations, imaging, or laboratory analysis, (Cerchione et al., 2022).

4. Blockchain system for healthcare

In this article, we propose a blockchain system for healthcare that integrates various services for stakeholders in healthcare sector:

- **Healthcare providers**. Healthcare providers can be a person (physician, professional, healthcare worker, etc.) or entity (hospitals, urgent care clinics, health centres, etc.) that provides diagnostic, medical, surgical, or dental treatment, or chronic or rehabilitative care. Patient's data are tracked using electronic health record (EHR) system that is part of the providers' existing health information system (HIS). Standard data fields and patents' public IDs are transferred in the blockchain via APIs (Farouk et al., 2020). Healthcare providers can record in blockchain all patient's data related to medical check-ups, immunization dates, established diagnoses, radiology images, allergies, provided medical treatments, laboratory results, prescribed therapies, etc. All transactions between healthcare

providers and patients are validated and verified using smart contracts. Transactions are stored in the blockchain and contain patients' public ID. Besides recording patients' data and transactions, blockchain enables storing data related to healthcare provider's transactions with other stakeholders, finance data, data related to business strategies,

- **Medical laboratories**. Medical laboratories present a laboratory where patients can test their health. Test results are helping healthcare providers to establish a diagnosis and prescribe medical treatment. If the laboratory is in the scope of HIS this data will be automatically available to healthcare providers. In this way all data medical laboratories can record in the patient's EHR. All transactions between medical laboratories and healthcare providers will be recorded in the blockchain.
- **Academia, research institutes and laboratories**. These institutions have a significant role in introducing new medical treatments, diagnostics, medicines and medical equipment. Furthermore, academia contributes to introducing new innovative technologies that improve business among all stakeholders in the healthcare sector. Blockchain can be used for recording and sharing all these data among stakeholders in order to all be up to date with science and new practices.
- P**harmaceutical industry and pharmacies**. In the pharmaceutical industry blockchain can be used for tracking transactions through all supply chain, recording all data related to producing, storing, using medicines, certification, etc. All these data will be available to stakeholders via blokchain system. Besides data related to medicines, using blockchain system pharmacies can check patients' prescriptions and record transactions about purchased or given drugs on prescription.
- **Companies and investors**. Different types of companies such as corporations, nonprofit companies, startups, individual investors etc. can use the blockchain system and be up to date with new business ventures in the healthcare sector. Furthermore, they can invest in healthcare providers' infrastructure, procurement of medical equipment, development of new medicines, and provide donations for medical treatment of seriously ill patients.
- **Health insurance companies.** Health insurance companies enable insurance that covers all or partial patients' incurring medical expenses. Depending on the state, insurance can be in accordance with the law regulating the field of health insurance or private. Each insured person has his own personal insurance number. Using blockchain health insurance companies can record if the patients' insurance is covered, and share these data with healthcare providers, laboratories and others.
- **Government and state authorities**. Government and state authorities should have authority to track and supervise all transaction in healthcare sector. They usually have G2G, G2B and G2C services available via e-government web portal. All these transitions among the government and each of the stakeholders in the healthcare sector can be recorded in blockchain.

- **Patients**. Patients can use blockchain applications to approach specific health data that are public in the blockchain. In the scope of the application, the patient can have an approach to his ePHR and EHR, record his personal health data, preview medical history and reports, electronic prescriptions, health insurance data, and different crowdsensing data collected using different intelligent devices for health monitoring. Patients can share their identity using private key and data on request to healthcare providers, laboratories, insurance companies, etc. With the key health providers can uncover the patients' data. All transactions between patients and different participants in the healthcare sector are recorded in the blockchain and stored in cloud database.

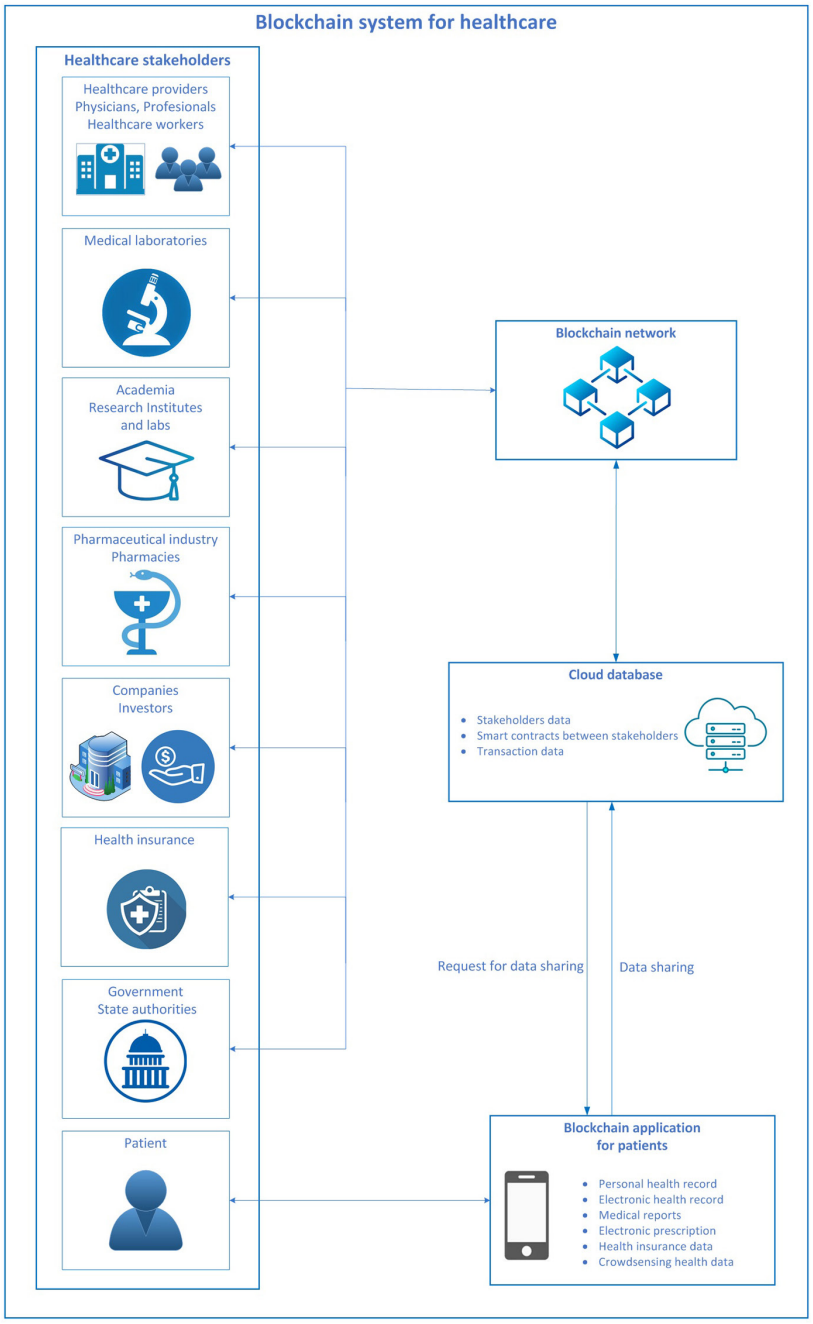

Figure 1: Blockchain system for healthcare

5. Conclusion

This paper presents a blockchain system for healthcare. This system enables the tracking of all business transactions, data sharing, and communication in the healthcare ecosystem among all stakeholders. In the future, it is planned to examine the readiness of the introducing the proposed system in the healthcare sector in the Republic of Serbia. The examination will be conducted using the surveying method. Projecting blockchain services will be adapted according to identified users' needs. As a proof of concept, the proposed system will be implemented a pilot project using Algorand blockchain network. For the patients it will be developed blockchain application that will enable manipulation with ePHR, EHR, medical reports, health insurance data, electronic prescriptions, crowdsensing health data.

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LEVEL OF DIGITAL TRANSFORMATION IN BOSNIA AND HERZEGOVINA

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Abstract

Digital transformation has affected all countries of the world, changed people's habits, the way of doing business, and increased the availability of products and services, as well as the efficiency of the use of scarce resources. Technology can help us solve the world's problems, it can connect governments with their citizens and provide access to new forms of education and health services. In order to see and build our understanding of digital transformation and to understand what it means for a country like Bosnia and Herzegovina to be digitally ready, the current level of digital transformation in Bosnia and Herzegovina was analysed through consideration of nine leading international indices that look at digital readiness and evolution from different points of view. countries. The new normal as a consequence of the Covid-19 pandemic has emphasized digital transformation, along with the energy transition, as key directions of change in the future. In this sense, Bosnia and Herzegovina still lags behind more developed post-transition countries and stronger pressure is needed to catch up with digital technological trends. Increased digital transformation in Bosnia and Herzegovina could increase its growth and development, and thus economic cooperation with other countries in the region.

Key words: Digital Transformation, Digitization, Technology Trends, Digital Economy, Bosnia and Herzegovina.

1. Introduction

We live in a digital world where digital technologies are advancing at a rapid pace, connecting people around the world, and creating new and exciting opportunities, greater access to knowledge, services, and resources thanks to general technological progress. Digital transformation has affected all countries of the world, changed people's habits, the way of doing business, and increased the availability of products and services, as well as the efficiency of the use of scarce resources. Technology can help us solve the world's problems, it can connect governments with their citizens and provide access to new forms of education and health services. At the same time, the digitization process is seen as one of

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the drivers of economic development. It has macroeconomic, sectoral, and microeconomic effects, but it can also promote regional economic cooperation. Digital transformation also affects the improvement of the attractiveness of the country for domestic and foreign investors.

The *new normal*, as a result of the Covid-19 pandemic, has emphasized digital transformation, along with the energy transition, as key directions of change in the future. In this sense, Bosnia and Herzegovina still lags when compared to more developed post-transition countries and stronger pressure is needed to catch up with digital technological trends. Increased digital transformation in Bosnia and Herzegovina could increase its growth and development, and thus economic cooperation with other countries in the region.

To see and build our understanding of digital transformation and to understand what it means for a country like Bosnia and Herzegovina to be digitally ready, the current level of digital transformation in Bosnia and Herzegovina was analysed through consideration of nine leading international indices that observe digital readiness and evolution of countries from different points of view. Indices related to the place of individual countries in the process of digital transformation include various components and dimensions in their evaluation of digital maturity of countries such as supply and demand conditions, institutional environment, innovation, connectivity, human capital, integration of digital technologies, digital public services, research and development, regulation, knowledge, business and start-up environment, readiness for the future and many other relevant dimensions that enable a better understanding of the country's level of digital readiness and provide better insight and recommendations for interventions and investments that can help countries in their readiness for digital transformation. It is imperative to understand the country's digital readiness to help create a more inclusive digital future for all.

2. Digital transformation, definition, and significance

Digital transformation, as a new and modern term in the business-technology literature, is most often defined as the integration of digital technology into business that results in changes in business and the delivery of value to customers (Mićić, 2017), and refers to transformations that have stimulated the mass adoption of digital technology that generates, processes, shares and transmits information. The entire transformation is built on the evolution of multiple technologies, starting from computer technologies, telecommunication networks, software engineering, and all the way to new technologies resulting from their combined use. Such is artificial intelligence (AI), which is considered a very critical tool used to accelerate digital transformation. According to Accenture Research (Accenture, 2018) AI is a set of multiple technologies that enable machines to detect, understand, act, and learn either independently or to augment human activities. Therefore, AI is considered an important component as well as an accelerator of rapid digital transformation.

Over the past few years, the popularity of digital transformation has skyrocketed, and its impact has reverberated across various areas of the economy, including business, medicine,

finance, and everyday life. The relationship between automation or digital transformation and economic growth is essential because digital convergence positively affects growth and development. The spread of digital innovations in the economy has many manifestations (Shkarlet et al., 2020; Bilan et al., 2019; Wolnicki and Piasecki, 2019; Vasilyeva et al., 2021; Novikov, 2021; Skrynnyk, 2020). Lyon (1996) considers the digitization of the economy as a new stage in the historical development of society, which is the result of the second industrial revolution and is based mainly on microelectronic technology. Kozubikova and Kotaskova (2019) concluded the significant role of digital innovations in the efficiency of public administration and their huge impact on indicators of social development. A similar opinion was held by Miller (1986) who claimed that digital innovations are one of the most important drivers of economic progress. Countries that implement digital innovations can produce financial instruments aimed at minimizing or transferring financial risks. Digitization changes economic relations, processes of production, exchange, distribution, and consumption, influencing the economic policy of the government, the strategy of economic development of the state and its economic security (Bacik et al., 2020; Cwiklicki and Wojnarowska, 2020; Karaoulanis and Karaoulanis, 2020; Kaya, 2021; Mokhtar et al., 2020). Sekhar (2013) even claims that the higher the level of a country's digital innovation activity, the higher its levels of macroeconomic stability. Digitization also has a significant impact on the development of the country's financial market, where the active use of digital technologies has a significant impact on the share of non-cash payments, contributes to the diversification of financial services, the development of internet and mobile banking in the country (Basri, 2018; Redda et al., 2017; Njegovanović, 2018; Brychko et al., 2021). Based on empirical calculations, Bhatt (1989) proved the impact of digitization of the economy on the level of risk in the country's financial market and the degree of diversification of investments. There is also a strong connection between digitization and the social and ecological development of the country (Didenko et al., 2020; Petrušenko et al., 2020; Pimonenko et al., 2021; Samusevych et al., 2021). Looking at the bigger picture, digital transformation primarily affects GDP level (Chou and Chin, 2011; Vasylieva et al., 2020; Obeid et al., 2020; Melnyk et al., 2018; Tiutiunyk et al., 2021), as well as on financial market indicators (Kuek et al. ., 2021; Leonov et al., 2019), labor markets (Smiianov et al., 2020; Didenko et al., 2021), and even environmental security itself (Vasylieva et al., 2021) al., 2019; Lyeonov et al., 2019), and plays a significant role in the effectiveness of public policy (Frolov and Lavrentjeva, 2019; Kolosok et al., 2018; Lopez and Alcaide 2020; Vasilyeva and et al, 2020, Skvarciany et al. , 2021; Vorontsova et al., 2020; Lyeonov et al., 2021).

Greater access to information and opportunities for technological collaboration can create opportunities for employment, skills transfer, and greater efficiency and transparency in politics and business (Finger, 2007). Sabbagh et al. (2013) concluded that a 10% increase in a country's digitization score promotes a 0.75% increase in its GDP per capita. However, the implications of digital transformation are not the same in different countries. In all developed economies, digitization improves productivity and has a measurable effect on growth. However, the result may affect the availability of occupations because lower-skilled, lower-value-added labour is usually sent abroad to developing markets, where human labour is cheaper. In contrast, emerging markets tend to gain more from digitization's employment impact than its growth impact.

The World Economic Forum has identified the information and communication technology (ICT) sector as one of the main sectors contributing to manufacturing growth,

where it is expected to impact GDP growth from 1.4% in emerging markets to 2.5% in China (Kvochko, 2013). At the level of the overall economy, Katz and Callorda (2017) estimate that a 1% increase in the digital ecosystem development index has a potential of 0.13% increase in GDP per capita, where the coefficient is higher for OECD countries than for developing countries. Park and Choi (2019) showed that it takes a certain amount of time for the progress of technological innovation to show an impact on the growth of different economies and that its effects spread throughout the economy.

Also, the impact of transformation reaches the competitive advantage of business (Bondarenko et al., 2020; Petroye et al., 2020; Chigrin and Pimonenko, 2014) and investment potential (Kliestik et al., 2020; Zolkover and Georgiev; 2020; Kotenko and Bohnhardt, 2021). Therefore, the impact of digital transformation does not only take place at the macro level. Mackenzie (2018) estimated that the economic potential of disruptive technologies that can transform life, business and the global economy can be so broad that it includes several individual effects, not just those at the level of one nation. Some of these effects are:

- reducing the cost of computers and super machines,
- 2-3 billion more people with internet access by 2025,
- a huge increase in the number of knowledge workers, and
- a significant increase in the use of smart products with much fewer errors.

However, the effects of digital transformation are not always positive. Although there are numerous significant advantages of the introduction of digital technologies in developed countries, for developing countries today there are some undeniable advantages, but also certain barriers. Regarding the relationship between digital transformation and employment, the concern that digital transformation might affect employment is not new. It dates to Aristotle's time when it was about the implications of machines displacing human labour, and the term *technological unemployment* was popularized by John Maynard Keynes in the 1930s, who saw it as just a *temporary phase of maladjustment*. Later, Schumpeter considered technological progress to be the centre of economic dynamics, explaining that innovation is the main source of imbalance in the economic system and the weapon that leads to its destruction, justifying his position with the understanding that the technical progress that occurs is not similar or the same throughout the economy, but it tends to concentrate on certain sectors, leading to structural adjustments between them, and that innovation leads to economic cycles with uneven periods of growth (Freddi, 2018).

When creating new jobs, digitalization increasing the need for professional work by destroying or changing existing jobs, i.e., the current workforce, causing many people to lose their jobs and creating a large wage gap and inequality. Not only does the digital evolution affect the total number of jobs created or lost, but it also greatly affects the composition of available jobs. Fossen and Sorgner (2018) proved that the significant effects of AI are visible at the individual level, i.e., that there is a high risk that the digital transformation would lead workers to change occupations or even to a complete loss of employment. Arntz et al. (2019) identified that cutting-edge digital technologies have little effect on the overall employment rate but lead to a large movement of workers within occupations and industries.

The disruptive effect of AI on employment tends to take many forms that can be seen as different stages of evolution (Ping and Ying, 2018):

- changes in the way of work, that is, changes in the tools used in the work process,
- negative impact on labour demand due to the replacement of human decisions with AI,
- changes in management and decision-making process to improve management efficiency,
- new technology that creates new jobs as old sectors and industries will gradually be replaced by new industries and departments, and
- increasing the income of residents and raising the standard of living because of reducing production costs, improving labour productivity and promoting economic development and social progress.

3. Level of digital transformation in Bosnia and Herzegovina based on international indices

The use of the integrated assessment method or the index method enables a comparative assessment of the level of development of certain economic phenomena in different countries. A comparative analysis of theoretical bases for assessing the level of digitization (Biegun and Karwowski, 2020; Roszko-Wójtowicz and Grzelak, 2020; Zolkover and Renkas, 2020; Yarovenko et al., 2021) shows that the simplest and most effective way to accumulate information about digital transformation is some countries use international indices. Based on that, and with the aim of objectively analysing the current level of digital transformation in Bosnia and Herzegovina, the integrated assessment method, i.e., the index method, was used in this paper.

The analysis considers the nine most significant indices that are brought to the digital transformation. After explaining the methodology for each individual index, an overview of the position of Bosnia and Herzegovina in relation to the ranked countries was given and based on the indicators contained in the individual indices, it was marked which segments of the digital transformation in which Bosnia and Herzegovina has the worst results, that is, the most lagging behind leading countries.

A systematic review and presentation of the analysed indices related to the degree of digitization of individual countries is given in Table 1.

Table 1. Indices of digital transformation

Index	Key drivers and index groups/indicators	Creator
DEI - Digital Evolution Index	It includes 4 key drivers: supply conditions, demand conditions, institutional environment and innovation and change.	University Tufts
DESI - Digital Economy and Society Index	A composite index that includes 6 index groups: connectivity, human capital/ digital skills, internet use, digital technology integration, digital public services, ICT research and development. DESI summarizes relevant indicators of digital performance and tracks the evolution of countries in digital competitiveness.	European Commission
DRI - Digital Readiness Index	It includes seven components: basic needs, human capital, ease of doing business, business and government investment, start-up environment, technology infrastructure, technology adoption.	Cisco
DAI - Digital Adoption Index	Digital adoption in three dimensions of the economy: people, government, and business.	World Bank Group
GII - Global Innovation Index	It is based on 80 indicators under the following categories: political environment, education, infrastructure, and business sophistication.	University Cornell, INSEAD, World Intellectual Property Organization
EDI - Enabling Digitalization Index	It consists of 5 components and 10 indicators. The components are regulation, knowledge, connectivity, infrastructure and size.	Euler Hermes
DiGiX - Digitization Index	Composite index of 21 sub-indicators. Structured around six dimensions: infrastructure, household adoption, business adoption, costs, regulation, and content.	BBVA Research
DCI - Digital Competitiveness Index	It is made up of knowledge, technology, and readiness for the future.	World Competitiveness Center
ICTDI - ICT Development Index	It is made up of ICT readiness, the intensity of ICT and the impact of ICT.	International Telecommunication Union

Source: based on data from Tufts University, European Commission, Cisco, World Bank Group, Cornell University, INSEAD, World Intellectual Property Organization, Euler Hermes, BBVA Research, World Competitiveness Center and International Telecommunication Union.

The Digital Evolution Index (DEI) is a data-driven overall assessment of the progress of the digital economy in 60 countries, including more than 100 different indicators across four key drivers. The index reflects both the current state of digital transformation within a country and the rate of progress at which a country is improving, which has the potential to identify and provide relevant implications for investment and innovation. This is achieved as a result of the interaction between four key drivers:

- digital infrastructure of the country,
- demand for technology,
- institutional environment, and
- innovation and development.

Also, this index highlights the growing risks and challenges associated with continued dependence on digital technology (Chakravorti and Chaturvedi, 2017).

The Digital Intelligence Index (DII) comprises the third edition of the Digital Evolution Index. It paints a picture of global digital development, provides insight into the key factors driving change, and reveals the impact of digital trust and digital evolution on a country's digital competitiveness. DII is a new interactive research platform created to provide evidence-driven, actionable insights on how to improve digital competitiveness, foster trust in the digital economy, and encourage responsible use of data, AI, and other advanced technologies for increased productivity and the common good (Chakravorti et al., 2020).

The Digital Economy and Society Index (DESI) is a composite index developed by the Cámara and published by the European Commission every year since 2014. It focuses specifically on EU countries to measure the steps and procedures those countries are taking towards promoting the digital economy and society. It consists of relevant indicators of current European digital policies. DESI consists of five main policies: connectivity, human capital, use of internet services, integration of digital technology and digital public services (European Commission, 2021a). The European Commission has made several changes to the 2021 edition of DESI. Indicators are now structured around four main areas in the Digital Compass, replacing the previous five-dimensional structure where 11 indicators now measure progress towards the goals set in the Digital Compass. The DESI rankings from previous years have been recalculated for all countries to reflect changes in the selection of indicators and corrections made to the underlying data (European Commission, 2021b).

The Digital Readiness Index (DRI) was developed by Cisco as a holistic measure of a country's level of digital readiness, providing guidance on how countries can improve their overall readiness to foster an inclusive digital economy. A holistic model was created to uncover key factors and improve understanding of what it means for a country to be digitally ready. Therefore, DRI includes components outside the domain of technology, such as basic needs, human capital development, business and start-up environment. While access to technology and infrastructure to support digital technologies is critical, if individuals' basic needs, such as access to clean drinking water, are not met, or they lack education or job opportunities, then a country cannot fully take advantage of digital opportunities. The essence of the model is to enable an understanding of a country's level of digital readiness and what interventions and investments can help countries advance in their readiness for digital transformation (Cisco, 2020). The digital readiness of countries is classified into three phases: Activate, Accelerate and Strengthen. For countries in the lower stage of digital readiness (Activate), the focus is on basic needs and the development of human capital. As technology consistently advances, there is a constant need to develop skilled talent with the latest employability skills for the job market and create new digital innovations. Countries in the middle stage of digital readiness (Acceleration) would benefit from investments in improving the ease of doing business in addition to these fundamental interventions. Cisco's study found that regardless of the stage of digital readiness, human capital development is critical to building a workforce capable of using and creating technology on an ongoing basis (Cisco, 2020).

The Digital Adoption Index (DAI) originally created as part of the *World Development Report 2016: Digital Dividends* (World Bank Group, 2016), measures the digital adoption of countries in three dimensions of the economy: people, government, and business, and emphasizes more on the supply side of digital adoption. Total DAI is calculated as a simple average of the three dimensions. Each dimension includes the technological requirements necessary to promote digital development, increase productivity and enable broad-based business growth (World Bank Group, 2016).

The Global Innovation Index (GII) captures the performance of the innovation ecosystems of 132 countries and tracks the latest global trends in innovation. This index annually ranks the performance of innovation ecosystems in economies around the world, highlighting innovation strengths and weaknesses and specific gaps in innovation metrics. Intended to create the most complete picture of innovation, it consists of around 80 indicators, including measures of the political environment, education, infrastructure, and knowledge creation. The latest edition of the GII provides new data and analysis on the state of global innovation and enables policymakers to compare the performance of innovation ecosystems in more than 130 countries. Also, this release includes a new feature, which provides insight into the pulse of global innovation including the Covid-19 pandemic. The GII showed that investment in innovation showed great resilience during the COVID-19 pandemic, often reaching new highs, but at the same time varying across sectors and regions (WIPO, 2021). The various metrics offered by the GII can be used to monitor performance and compare development against countries within the same region or income group.

The Enabling Digitalization Index (EDI) assesses countries in terms of their support for digitization and ranks them according to friendly digital regulation with its various institutional, logistical and technical aspects (Hermes, 2018). The primary focus of the index is on the organizational and enabling environment of digital transformation within the country and on the support that the government directs towards encouraging technical innovation. The EDI measures both the ability and agility of countries to help digital companies thrive and traditional businesses to take advantage of the digital dividend. The score is based on five components: regulation, knowledge, connectivity, infrastructure, and size, and is ranked from 0 to 100 (Hermes, 2019).

The Digitization Index (DiGiX) assesses the factors, behaviour of agents and institutions that enable a country to take full advantage of information and communication technologies to increase competitiveness and prosperity. DiGiX is a composite index of 21 sub-indicators calculated for 99 countries worldwide. It aims to measure the degree of digitization in countries through the collection and classification of information related to three fields: supply conditions (infrastructure and costs), demand conditions (technical social and government adoption) and institutional environment (regulations and logistics) (Cámara, 2018). DiGiX is structured around six main dimensions, and each dimension is in turn divided into several individual indicators. The results for 2020 show a global improvement in the digital frontier compared to 2019 (Cámara, 2020).

The Digital Competitiveness Index (DCI) represents the ranking of 64 countries in the world, which is calculated based on 52 ranking criteria: 32 quantitative data and 20 survey data. In addition to the global digital ranking, other rankings are provided that show comparisons based on different perspectives, including countries divided by population

size, GDP per capita and three regional rankings from different geographies (Europe-Middle East-Africa, Asia-Pacific and the Americas). The index shows a summary of the ranking for the countries included where it is possible to determine in which areas of digital competitiveness the country leads or has certain weaknesses and to make comparisons between countries. These rankings provide a more detailed examination of specific aspects of digital transformation and can be used to assess a country's technological framework or support international investment decisions (IMD, 2021).

The ICT Development Index (ICTDI) is a composite index that, until 2017, combined 11 indicators into a composite score and was used to monitor and compare the development of information and communication technologies between countries. In 2017, a revised set of 14 indicators was adopted to be included in the ICTDI. However, after the change from 11 to 14 indicators, countries faced challenges in collecting and reporting quality data. Thus, for the calculation of the ICTDI for 2018, half of the data had to be estimated, and there were also problems with the harmonization and quality of the data used, as well as with the methodology used to derive some of the newly adopted indicators. Due to these shortcomings, it was not possible to calculate a methodologically correct index that reflects the true state of ICT development, although since 2018 there have been attempts to harmonize the index or even to develop a completely new index. All attempts were unsuccessful, because it was not possible to reach a consensus within the expert groups, so this index will not be published until new agreements are reached.

An overview of the ranking of the top five countries according to the mentioned indices of digital transformation, as well as the ranking or non-ranking of Bosnia and Herzegovina is given in Table 2. Also, the table shows the biggest weaknesses of Bosnia and Herzegovina that were observed during the ranking within each of the mentioned indices. In the following, we will consider in more detail which dimensions are most hindering the process of digital transformation of Bosnia and Herzegovina.

According to the **Digital Intelligence Index**, Bosnia and Herzegovina is ranked 77th out of a total of 90 countries. Bosnia and Herzegovina belong to the so-called *emerging economies* facing significant challenges with their low state of overall digitization and low driving potential (Chakravorti et al., 2020). However, despite major infrastructure gaps, younger demographics in these economies are showing enthusiasm for the digital future with increased use of social media and mobile payments. Along with multiple sources of digital weakness, the existence of sceptical attitudes towards digitalization and technology, especially from the aspect of the government and government institutions, is highlighted here.

Bosnia and Herzegovina is ranked low in the domain of *innovations* (87/90). The scope of innovation in digitization is relatively low. This means that Bosnia and Herzegovina needs to work on the development and availability of talent as well as on cooperation between universities and industry in research and development, and stimulate the development of new digital products and services in order to increase the vitality of innovation and identify potential opportunities for future improvements.

Also, Bosnia and Herzegovina is ranked low in the domain of *institutional environment* (82/90). Government policies play a key role in supporting or hindering the business sector as the engine that creates and distributes digital technologies. Therefore, the role of governments is crucial to determine and create a suitable climate for investment

and innovation in digital technologies, whereby providing a stable environment that encourages investment and protects consumers, it creates favourable conditions that encourage digitization.

Table 2. Ranking of Bosnia and Herzegovina according to digital transformation indices

Index	Top 5 countries	B&H rank	Biggest weaknesses	Last year of ranking
D E I / DII	1. Singapore 2. USA 3. Hong Kong 4. Finland 5. Denmark	77/90	– Innovations – Institutional environment	2020
DESI	1. Denmark 2. Finland 3. Sweden 4. Netherlands 5. Ireland	Not ranked - missing data for 10 indicators	– Digital public services – Connection	2021
DRI	1. Singapore 2. Luxembourg 3. USA 4. Denmark 5. Switzerland	69/141	– Start-up environment – Business and government investments	2019
DAI	1. Singapore 2. Luxembourg 3. Austria 4. Korea 5. Malta	60/180	– The weakest adoption in the economy dimension - people	2016
GII	1. Switzerland 2. Sweden 3. NOW 4. Great Britain 5. Korea	75/132	– Creative results – Business sophistication	2021
EDI	1. USA 2. Germany 3. Denmark 4. The Netherlands 5. United Kingdom	Not ranked	Not ranked	2019

DiGiX	1. Luxembourg 2. Great Britain 3. Hong Kong 4. USA 5. Netherlands	Not ranked	Not ranked	2020
DCI	1. NOW 2. Hong Kong 3. Sweden 4. Denmark 5. Singapore	Not ranked	Not ranked	2021
ICTDI	1. Ireland 2. Korea 3. Switzerland 4. Denmark 5. Great Britain	83/176	– Use of ICT	2017

Source: Authors

Bosnia and Herzegovina is not ranked according to the **Digital Economy and Society Index**. Data for 27% of indicators are still not available. Regarding the availability of statistical data on digital performance and digital competitiveness in the context of DESI, Bosnia and Herzegovina is moderately prepared with the availability of 73% of indicators that are aligned with the DESI methodology. In relation to the environment, Serbia is currently the most prepared and can provide data for all 37 DESI indicators, followed by Montenegro and North Macedonia (34 indicators), Albania (32 indicators), Kosovo (31 indicators) and Bosnia and Herzegovina (27 indicators). (Jordanoski and Meyerhoff Nielsen, 2021). Data collection and monitoring of the development of the connectivity dimension (which includes indicators of fast broadband network coverage (NGA), very high-capacity fixed network coverage (VHCN), readiness for 5G, cost of broadband access) is the responsibility of Agency for Statistics of Bosnia and Herzegovina – BHAS (one indicator) and Communications Regulatory Agency – RAK (seven indicators). Data collection and monitoring of the development of the dimension of digital public services is the responsibility of the Agency for Statistics – BHAS (one indicator) and the Ministry of Communications and Transport of Bosnia and Herzegovina (four indicators).

The total results of the **Digital Readiness Index** according to the last measurement range between 4.32 and 20.26 out of the maximum possible total of 25 points. Bosnia and Herzegovina is above the average readiness rating with 12.13 points, which ranks it among countries in the middle phase of digital readiness (Acceleration) in 69th place out of a total of 141 ranked countries. Within the seven components of this index that are analyzed to determine digital readiness, Bosnia and Herzegovina achieved the worst results in two components: *start-up environment* and *business and state investments.* The start-up environment in Bosnia and Herzegovina indicates a deficiency in the availability and investment of venture capital, as well as the registration of patents and trademarks, which are the leading creators of new wealth from digital technologies and a key source of new job creation. Also, Bosnia and Herzegovina is trotting in the field of building digital

infrastructure and capacity. Investments from both private and public funding sources are necessary, including foreign direct investments, and investments in research and development, as well as enabling a free way of investing private capital.

According to the **Digital Adoption Index**, Bosnia and Herzegovina ranks 60th out of a total of 180 ranked countries. For Bosnia and Herzegovina, the biggest shortcomings are within the dimension of the *economy* related to *people*. Digital technologies promote inclusion by increasing employment and earnings in the ICT sector and by supporting jobs and earnings in sectors that use ICT through the adoption of new technologies. It is necessary for Bosnia and Herzegovina to increase the possibility of creating these jobs through existing businesses, but also through entrepreneurship and outsourcing. Also, it is necessary to increase the productivity of workers, because by taking over the tasks previously performed by workers, digital technologies increase the skills of workers, increasing their productivity and earnings. In this segment, it is possible to increase the benefit for consumers, considering that digital technologies automate processes and generate economies of scale, which can influence the lowering of prices and the creation of new goods and services.

The **Global Innovation Index** ranks Bosnia and Herzegovina in 75th place among 132 ranked countries, with Bosnia and Herzegovina in 38th place among 39 countries in Europe. This index highlights two critical fields within its index for Bosnia and Herzegovina: *creative results* and *business sophistication*. In the domain of creative results, Bosnia and Herzegovina falls in the domain of intangible assets, especially in the absence of global brand value and the low level of new organizational models made possible by ICT. Also, as part of the creative results, improvement is necessary in online creativity, especially in the creation of mobile applications in Bosnia and Herzegovina. As far as business sophistication is concerned, Bosnia and Herzegovina should work on creating innovation links that primarily relate to increasing cooperation between universities and business in research and development as well as the development of clusters within the country. Also, within the business sophistication of Bosnia and Herzegovina, it should increase its absorption of knowledge through intellectual property, the import of high technologies and ICT services and the inflow of direct foreign investments.

Bosnia and Herzegovina is still not included in the **Enabling Digitalization Index**, **Digitization Index**, or the **Digital Competitiveness Index**.

The **ICT Development Index** highlights for Bosnia and Herzegovina three indicators of intensity and use of ICT as the lowest rated sub-indices for Bosnia and Herzegovina. According to these data, Bosnia and Herzegovina has 69.33% of individuals using the Internet, 17.37 subscribers per hundred inhabitants to fixed broadband Internet access and 37.35 subscribers per hundred inhabitants to mobile broadband connections. Within this index, Bosnia and Herzegovina is ranked 83rd, out of a total of 176 ranked countries.

4. Discussion and conclusion

While the technologies to create a strong digitally capable society are developing and maturing, not all countries are able to use them effectively, thus risking their citizens missing out on many of the benefits of the digital era. Digital transformation is one of the most

important transformational processes that await Bosnia and Herzegovina in the future. The benefits of digital transformation can only be realized through coordinated planning and investment of the public and private sectors in activities that range from raising basic needs and education, all the way to improving technological infrastructure and building digital competence within the workforce and the capacity of the workforce itself. Based on everything presented, it can be concluded that, although most of the observed indices do not place Bosnia and Herzegovina at the bottom of the ranked countries, Bosnia and Herzegovina lags behind in the process of digital transformation compared to countries at the same level of development, which also includes neighbouring countries. What makes it difficult to realistically assess the current level of digital transformation is the fact that a significant number of indices do not include Bosnia and Herzegovina in their calculations at all. Therefore, it is important that Bosnia and Herzegovina work on the process and methodologies of data collection so that it can become part of the indices that have not yet included Bosnia and Herzegovina in their rankings. Thus, the EDI index, which includes 115 countries, has not yet included Bosnia and Herzegovina in its index, although countries from the region (Western Balkans) are already present, such as Serbia and Montenegro. The DiGiX index is calculated for 99 countries around the world, but not for Bosnia and Herzegovina, although it includes most of the countries of the Western Balkans, namely Serbia, Montenegro, Albania, and North Macedonia. Only the DCI index, which includes some of the countries of the Balkans, does not include any of the countries of the Western Balkans in its ranking.

The availability of technology in the digital transformation process is a prerequisite for the entire process. Although Bosnia and Herzegovina has room for progress in this segment, this analysis shows that the key obstacles in the digital transformation process relate to the general obstacles faced by the economy of Bosnia and Herzegovina in its efforts to become more competitive. Bosnia and Herzegovina lags behind the most in the domain of institutional environment, i.e., efficiency of public administration and innovation. Digitization of public administration in Bosnia and Herzegovina is at a very low level, this process does not even have an adequate legal framework, and it is currently taking place partially without adequate coordination, which complicates future integration. On the other hand, government policies have a disruptive effect on the business sector, which represents the bearer of digital transformation through the creation and distribution of digital technology. Therefore, the role of governments is crucial to determine and create a suitable climate for investment and innovation in digital technologies, whereby providing a stable environment that encourages investment and protects consumers, it creates favourable conditions that encourage digitization.

In the domain of business innovation, Bosnia and Herzegovina lags behind in the domain of intangible assets, especially in the absence of global brand value and the low level of new organizational models made possible by ICT. It is necessary to develop start-up business environments by enabling the availability and investment of entrepreneurial capital, as well as the registration and protection of innovations, which are the leading creators of new wealth from digital technologies and a key source of new job creation. It is necessary to create innovation links that are primarily related to the increase of cooperation between universities and the economy in research and development as well as the development of clusters within the country. Also, within the business sophistication, Bosnia and Herzegovina should increase its absorption of knowledge through the

protection of intellectual property, the import of high technologies and ICT services, and the inflow of direct foreign investments.

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DIGITAL TRANSFORMATION OF THE JUDICIAL SYSTEM IN BOSNIA AND HERZEGOVINA

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Abstract

The judicial system, as a branch of government in modern societies, aims to enforce laws prescribed on a state's territory. An independent judiciary is a challenge faced by all countries in the world, this problem is especially pronounced in countries in transition such as Bosnia and Herzegovina. Digitization is an extremely expensive and complicated process that requires maximum effort and responsibility from all participants so that the final results are in line with the set goals of the project. The goal of digitalization is to provide greater transparency, efficiency, security, control and record of processes within the organization, in this case a state institution. The digitization process in Bosnia and Herzegovina began in 2019 with the introduction of the first software solutions in its organization. Although a very short time has passed since the introduction of digital solutions in judicial institutions, this research records the first results of digitization in the judicial institutions of Bosnia and Herzegovina based on the submitted official data. The research aims is to show the current positive and negative sides of digitalization in one large entity, such as the judicial system of Bosnia and Herzegovina, and to show the related relations with other entities.

Key words: BiH Judicial System, Digitalization, Prosecution, Court, Quantitative Method.

1. Introduction

The modern man's perception of a successful state represents a state where an individual can realize her rights provided for by law in a short time period and without large financial investments. The judicial system represents the pillar of the state and ensures the safety of every individual within its borders, if the integrity of the judicial system is violated, then that system can be considered ineffective and it is necessary to reform system. Society most often puts a sign of equality between judicial institutions and the state, in a manner that judicial institutions have a great responsibility because their actions are always under additional public control. The term "state" philosophically represents a set of mechanisms that enable the social organization in a defined territory. We often encoun-

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ter this example in practice when interpreting legal provisions in two countries that with cultural differences. Through the culture of a country, laws are created to regulate the rules for all residents of the country or persons who are in the territory of that country. The need for social order is as old as society itself, the first examples can be found in ancient Mesopotamia and the popular Hammurabi Law, which was created around 1780 BC (Tomorad, 2014).

From ancient times to the present, society has made enormous efforts to achieve an acceptable social arrangement. The democratic way of dividing power has provided judicial institutions with the independence much needed when making judgments in society between two or more parties. Independence gives legitimacy to judicial institutions to make decisions in social disputes without bias to any side. Thereby preserving their integrity in society.

The subject of research in the paper is to establish how much the implementation of digital solutions in judicial institutions contributes to the efficiency of judicial institutions of Bosnia and Herzegovina in processing different types of cases in the judicial system. The goal of the research is a qualitative presentation of the efficiency of the judicial institutions of Bosnia and Herzegovina after the implementation of digital solutions in the judicial system. Efficiency is presented with numerical values from the annual reports of the judicial institutions of Bosnia and Herzegovina.

2. The Judicial system of Bosnia and Herzegovina

The judicial system of Bosnia and Herzegovina is organized in such a manner that the courts of the first instance are municipal courts in the Federation of Bosnia and Herzegovina, that is, basic courts in the Republic of Srpska. These courts deal with the basic determination of a citizen's rights, verdicts for minor crimes up to 10 years, fines, divorces, claims, debts and the like.

The second instance courts are cantonal courts in the Federation of Bosnia and Herzegovina and district courts in the Republic of Srpska. These courts are competent for prison sentences over 10 years, i.e., long-term prison sentences.

District courts in the Republika Srpska and cantonal courts in the Federation of Bosnia and Herzegovina are in charge of prison sentences lasting more than 10 years, and they also perform the functions of second-instance courts when deciding on citizens' appeals to basic and municipal courts. In this way, the two-stage of decision-making process and rendering of judgments is regulated.

The Supreme Court of the Federation of Bosnia and Herzegovina and the Supreme Court of the Republika Srpska have the task of ruling on regular and extraordinary legal remedies, that is, to review decisions already made at lower decision-making levels, in this case the first and second instance courts.

The Court of Bosnia and Herzegovina makes decisions on determining the rights of citizens if they believe that their rights have been violated by legal acts of the institutions of Bosnia and Herzegovina. The Court of Bosnia and Herzegovina can also judge criminal cases if the indictment is filed by the Prosecutor's Office of Bosnia and Herzegovina.

The Constitutional Court of Bosnia and Herzegovina is the highest court in Bosnia and Herzegovina that deals with determining the rights guaranteed by the Constitution of Bosnia and Herzegovina.

The High Judicial and Prosecutorial Council is a body that exercises control over the judicial system of Bosnia and Herzegovina and aims to appoint judges and prosecutors throughout the territory of Bosnia and Herzegovina and to carry out disciplinary procedures if there are grounds for suspicion.

Brčko District also has a Basic Court, which has the same jurisdiction as the basic court in the Republic of Srpska, that is, the municipal courts in the Federation of Bosnia and Herzegovina. The Court of Appeal of Brčko District is also defined by law.

In addition to the above-mentioned institutions, there are other bodies that control judicial institutions that are formed in accordance with the law in force in that territory.

3. Digitization

Digitization is the process of copying objects from physical to digital form in original format. The copying of objects into digital form is performed using hardware and software specially created for such purposes. Digitization aims is to make information easier to save, process, store, search and be more accessible in real-time. Today, when we talk about digitization, we most often think of the digitization of paper materials, but many other forms of digitization are used in industry.

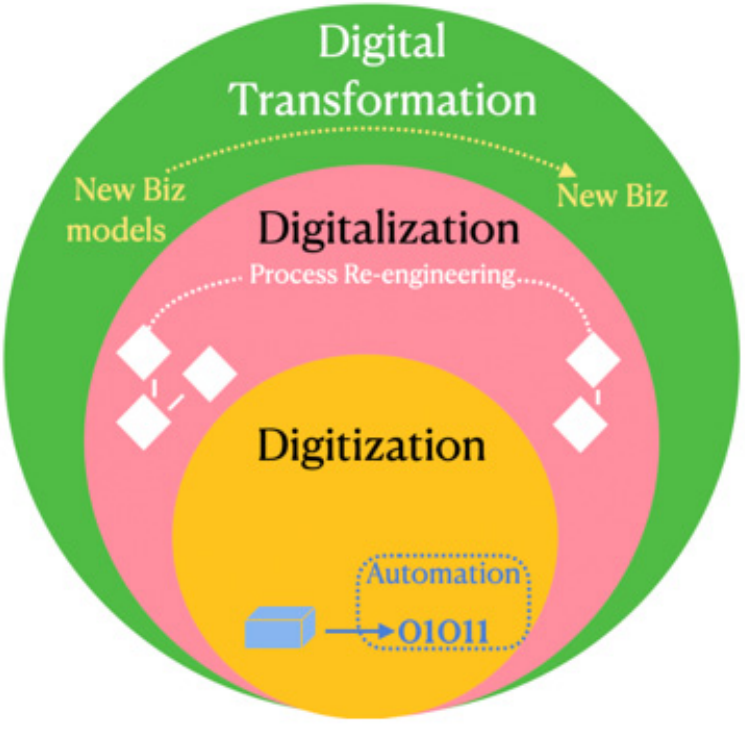

Figure 1. Digization process
Source: Saracco (2022)

The fact is that paper materials impose constant financial expenses for storage, maintenance, and also access and retrieval of documents is difficult. In addition, archival records are massively transferred to digital form in order to protect them from possible mechanical or other damage.

The digitization process itself is extremely complex because it requires for people with different knowledge and experience to participate so that the final product is in line with the goals set at the beginning.

The following picture shows the process of digitization and digital transformation.

3. 1. Use of ICT technologies in Bosnia and Herzegovina

According to official information on the use of ICT technologies in Bosnia and Herzegovina based on the profile of residents, we can conclude that the results are good when it comes to the use of ICT technologies in the lives of citizens in the territory of Bosnia and Herzegovina. The Agency for Statistics of Bosnia and Herzegovina conducted a survey on a sample of 6393 respondents, of which:

- 53,9% of the Federation of Bosnia and Herzegovina,
- 39,2% of the Republic of Srpska,
- 6,9 % of Brčko district.

According to the stated research results and the research performance description, the results are considered acceptable for processing and they convey the actual situation from the field. Pursuant to the data of the Agency for Statistics of Bosnia and Herzegovina, the research was conducted in 2021.

The research results show that the percentage of households with Internet access is growing from year to year, however, these changes are still moving in minimal percentages of 2-3% per year.

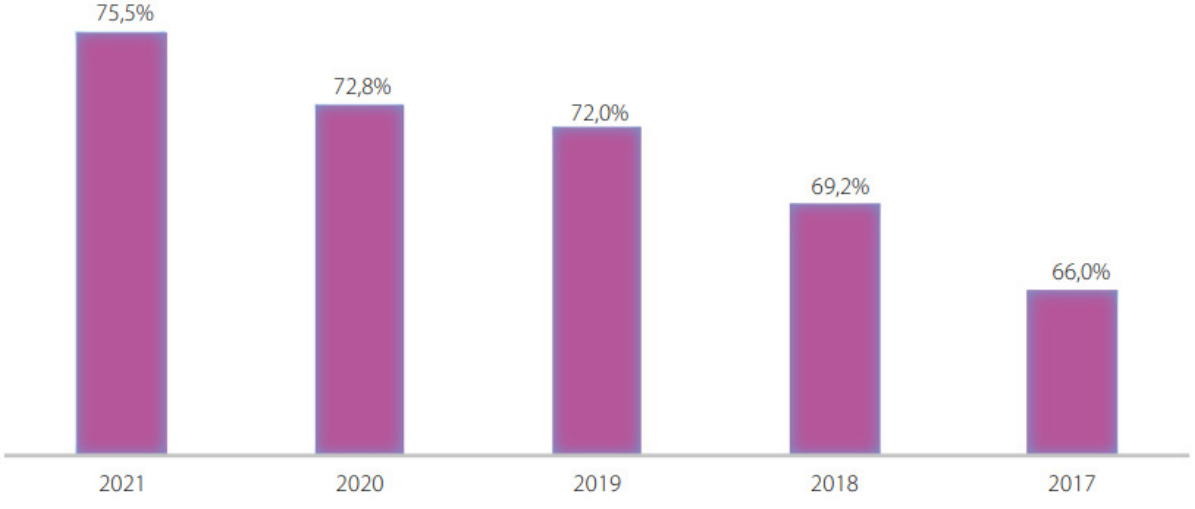

Figure 2. Percentage of households with internet connection
Source: Agency for Statistics of Bosnia and Herzegovina (2021)

The results presented in this section refer to the situation in 2021 when, due to the COVID-19 pandemic, all activities that could digitalized were already there, which means that the results show an increased trend of new users and use for different purposes.

The research also gives us information about on the online sites our citizens spend the most of their time and for what purposes they use the Internet in their households. People between the ages of 65 and 74 most often use the Internet for phone calls and video calls in the total amount of 96.4%. People between the ages of 16 and 24 mostly go online for social networks in the total amount of 89%. These are the more notable results that can be found when surveying citizens of Bosnia and Herzegovina, while other activities are mostly in percentages from 30% to 55% which include mobile banking, information about products and services, reading and searching for information, etc.

The public presentation of these results gave us a bigger picture of the general state of the nation, their habits, and skills when it comes to using devices with internet access. These general results help us to create profiles of employees in the judicial institutions of Bosnia and Herzegovina.

3. 2. Digitization of the judicial system

Digitization of the judicial system officially started in 2019, in special departments of institutions. It is planned that the overall process will be carried out until 2035, when we can expect complete digitization of judicial institutions in Bosnia and Herzegovina.

In the short period since the start of the digitalization process, the first official data appear that we can follow and that can help us to draw the first conclusions about the success of digitalization.

The first institution to start the digitization process was the Prosecutor's Office of Bosnia and Herzegovina back in 2019, department I (one), the War Crimes Department.

3. 2. 1. Prosecutor's Office of Bosnia and Herzegovina

The Prosecutor's Office of BiH digitalization process began in 2019 in the Special Department for War Crimes, which had a pronounced problem with the storage of evidentiary materials and the search for the same in cases pending before the institutions of Bosnia and Herzegovina. This project, organized within the OSCE Mission, aims to save and archive evidence from war crimes cases in a simple way. This will create simple access to evidence and enable the employees of the Prosecutor's Office of Bosnia and Herzegovina to easily review the evidence and record it.

The electronic database will contain all evidentiary materials collected by the Prosecutor's Office of Bosnia and Herzegovina during the investigation.

Figure 3. Meeting of the Prosecutor's Office of BiH and representatives of the OSCE project
Source: Prosecutor's Office of Bosnia and Herzegovina (2019)

The official results of the Prosecutor's Office of BiH for the year 2021 are not yet publicly available, so only after the adoption of the report, it is possible to perform an analysis and compare it with previous years. Reports are currently available for the years: 2018, 2019 and 2022.

The results of the report of the Prosecutor's Office of BiH for 2018 show:

Table 1. The results of the report of the Prosecutor's Office of BiH for 2018

Filed indictments	Number of persons	Confirmed indictments	Number of persons
27	62	33	95

According to the results from 2019, the first department of the Prosecutor's Office of BiH that implemented digitization had the following results:

Table 2. The results of the report of the Prosecutor's Office of BiH for 2019

Filed indictments	Number of persons	Confirmed indictments	Number of persons
24	47	22	44

As stated in the above table, we see that the total number of indictments filed in 2019 was 24, of which 22 indictments were confirmed.

The results of the Prosecutor's Office report for 2020 show that, the first department of the Prosecutor's Office of BiH had the following results: filed indictments (180), number of persons (284), confirmed indictments (181), number of persons (286).

Table 3. The results of the report of the Prosecutor's Office of BiH for 2020

Filed indictments	Number of persons	Confirmed indictments	Number of persons
180	284	181	286

In results of the report, we see that the number of indictments was 7.5 times higher than in 2019. The data that could be taken as a measuring instrument is the number of indictments filed, but many factors can affect the confirmation or rejection of the indictment, so in this research we only take the number of indictments filed by the Prosecutor's Office of BiH related to department (I).

Graphic display of digitization results in the Prosecutor's Office of Bosnia and Herzegovina, Department (I) Special Department for War Crimes.

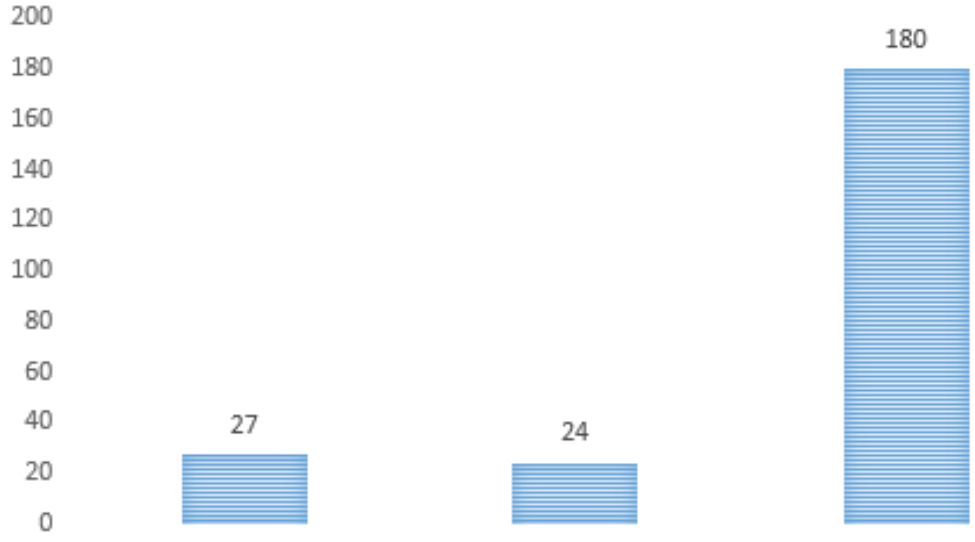

Figure 4. Graphic presentation of the results of Department I of the Prosecutor's Office of BiH

It is to be expected that the results of the research will continue in the years to come as we receive reports from the Prosecutor's Office of BiH on the results of previous years, thus we currently only have three years for comparison, which is not enough to draw a conclusion as to how successful the overall digitization process in the Prosecutor's Office of BiH really is. What we can see from the obtained results is that the digitization process has significantly increased the efficiency of War Crimes Department (I) in the BiH Prosecutor's Office.

3. 2. 1. Sarajevo Municipal Court

The Municipal Court in Sarajevo started the digitization process on April 1, 2019, with the introduction of the first software solutions for the digitization of cases for the Department of the Register of Enrolled Legal Entities. This department first started digitalization because the legal time period in which they were obliged make a decision was extremely short, so it was clear that a system that would be reliable, simple, and efficient simply had to be created.

The Municipal Court in Sarajevo amended the Law on Registration which enables business entities now to register via the court's website. Additionally, significant financial savings were made by introducing notification section in the court's official website, which means there is no need now for regular newspaper publications.

The court report shows the first results of digitization in the Sarajevo Municipal Court, which means the norm has been met in the amount of 159.41%, taking into account transferred cases from previous years.

The goal of digitization was to reduce the waiting time for the registration of business entities. The report of the Municipal Court of Sarajevo shows, the registration time in 2020 was 16.01 days, while in 2021 it was shortened to 12 days.

The deadline for obtaining a tax number was reduced from 5.18 days in 2020 to 3.10 days in 2021. For cases where the documentation is in order, registration currently takes 3.55 days, which is a shorter period than the 5 days prescribed by the Law for the processing of orderly applications.

Table 4. Results of the digitization of the department for the register of registered business entities

Year	Business entity registration time (days)	Time to get tax number (days)
2020	16,01	5,18
2021	12	3,55

The presented report gives the first results of the digitization of the department for the register of registered business entities, where it is clearly shown how the processing time of the request for registration in the register is reduced by a few days and thus fulfills the legal framework in which it is necessary to make a decision on the request of the user.

Editing of the physical archives of the Municipal Court began in 2008, and it has achieved tremendous results so far, both in financial terms and in terms of time. Over 120,000 new cases and cases from 1996 to 2009 were entered into the system. In this way, old cases are again put in the focus of the institutions.

3. 2. 1. High Judicial and Prosecutorial Council (HJPC)

Due to a large number of old cases, the High Judicial and Prosecutorial Council decided to make changes in its organization and help the courts to resolve the oldest cases that

have been waiting for resolution for years. One of the decisions was made back in 2011 by forming plans for solving the oldest cases, which would eventually increase the efficiency of the courts in Bosnia and Herzegovina.

With digitalization, the process has been significantly accelerated and cases that are several years old have come to the fore. This way, it is possible for the courts to easily access their cases and relevant documentation that is in digital form.

The plan foresees that in 2022, a total of 169,090 of the oldest cases that have been in the court process for years will be solved, and in the first quarter of 2022, 62,747 old cases were actually closed. In this way, the efficiency of the courts in Bosnia and Herzegovina has significantly increased.

Table 5. The success rate of resolved cases in the first quarter of 2022

Federation of Bosnia and Herzegovina	Republic of Srpska	Brčko District	Court of Bosnia and Herzegovina	Total
43.781	17.568	929	469	62.747

According to the results of the HJPC, the Federation of Bosnia and Herzegovina resolved 43,781 of the old cases, Republic of Srpska 17,568, Brčko District 929, while the Court of Bosnia and Herzegovina resolved 469 of the older cases that had been waiting for years to be processed.

HJPC states that in 2010 in Bosnia and Herzegovina there were a total of 1,480,032 cases before the courts that were not resolved, which required organizational changes and the formation of teams to resolve the oldest cases. One of the reasons why the digitization process was started is precisely this problem.

The success rate of resolved cases in the first quarter of 2022 is 37%, while other data will be available to the public at the end of the year in the final report of the courts. Compared to the report for 2021, in that year there were 2,488 or 4% less resolved cases for the above mentoned time period.

3. 2. 1. Digitization results

It is still not possible to carry out extensive research in the field of digitization of the judiciary system in Bosnia and Herzegovina, because some courts are at the very beginning of digitization, while for others there are relevant data that can be used in research. Courts that are in the process of digitization are: Municipal Court in Široki Brijeg, Basic Court Brčko, Basic Court in Derventa, Cantonal Court Tuzla, Municipal Court Gračanica and others. There is only enough relevant information for the institutions listed in this paper, namely the Sarajevo Municipal Court, the Prosecutor's Office of Bosnia and Herzegovina, the Court of Bosnia and Herzegovina.

Reports from institutions that have already completed the digitization process and recorded the first results of digitization were used for the purposes of this paper.

3. 2. 1. Tools in the digitization process

The institutions of Bosnia and Herzegovina have been using most modern tools in the field of digital processes and the transfer of archival material into digital form in the digitization process. Some of these products are as mScan, mSign, which are products of the organization Mikrgrafija .ltd, which operates in several countries of the European Union and the world, and are partners with corporations from the United States of America, Japan, and others. In addition to the basic tools, there are also others such as tools for displaying digital data with a modern interface from the popular company QSS. The organization of the network has been improved by the use of modern and licensed hardware devices that play a significant role in the digital transformation of large organizations.

4. Conclusion

The process of digitalization of judicial institutions in Bosnia and Herzegovina is at the beginning. The results in the so-far digitalized institutions show that the work of employees in is much easier, positive financial reports have been recorded, the time for resolving cases has been shortened by several percent, and all of this results in significant annual savings for institutions in the field of human resources, handling of cases and the overall efficiency of institutions. The conclusion in the reports of all institutions is that it is necessary to invest additionally in the digitization process and make constant improvements to the existing solutions that have been implemented. Transparency in the process is currently at a high level because the institutions can respond to the requests of the parties regarding the status of their case in a very short time, which in the past was extremely difficult due to the complexity of the case, huge archival material and other factors that make the transparency of the case difficult. Digitization is a continuous process that enables complex organizations to operate simpler, safer and more efficiently.

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