GODINA 5, BROJ 5 (2022)

ISSN 2566-4522

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INTERNACIONALNA
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AKADEMIJA
TUZA

ZBORNIK RADOVA

Book of Proceedings

5. MEĐUNARODNA NAUČNA KONFERENCIJA
O DIGITALNOJ EKONOMIJI DIEC 2022

5th INTERNATIONAL SCIENTIFIC CONFERENCE
ON DIGITAL ECONOMY DIEC 2022

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Izdavač / Publisher
Visoka škola za savremeno poslovanje, informacione tehnologije i tržišne komunikacije
"Internacionalna poslovno - informaciona akademija" Tuzla

ISSN 2566 - 4514 *(Print)*
ISSN 2566 - 4522 *(Online)*

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Keynote paper

CRYPTOCURRENCIES AND THEIR IMPLEMENTATION IN EVERYDAY LIFE[4]

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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4 This work was funded within the project line ZIP UNIRI University of Rijeka, for the project ZIP-UNIRI-130-7-20.

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 com-

puter 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 technol-

ogy 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 increase 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

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).

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 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,

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).

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 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

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.

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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Keynote paper

A BLOCKCHAIN SYSTEM FOR HEALTHCARE

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.
- Pharmaceutical 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.

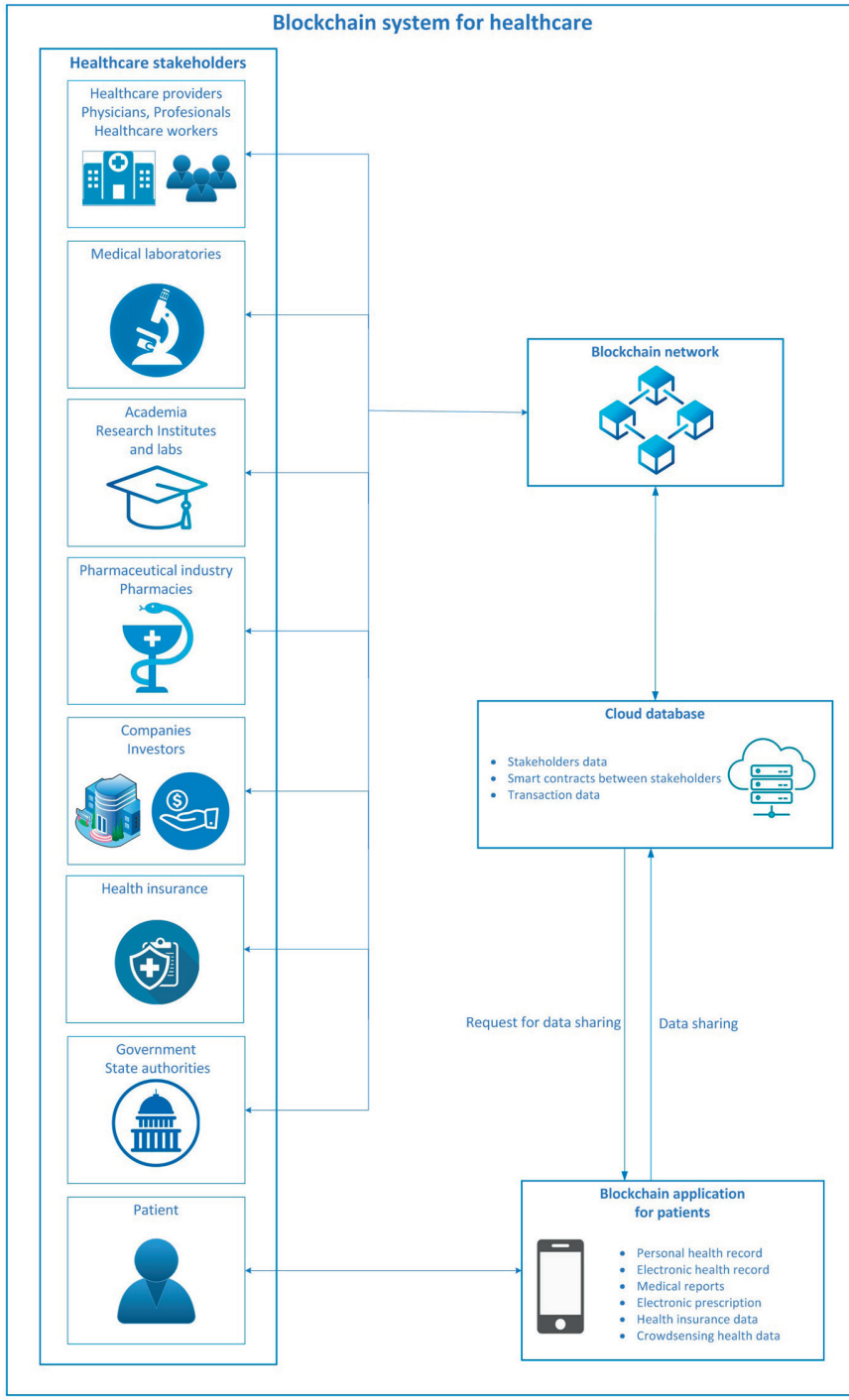

Figure 1: Blockchain system for healthcare

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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Jurica Grzunov, PhD[1] *Original scientific paper*

CAN "SMARTNESS" OF A DESTINATION BE MEASURED? BUILDING AND TESTING A GENERALIZED FRAMEWORK FOR MEASURING SMART TOURISM DESTINATION DEVELOPMENT ON THE EXAMPLE OF CROATIA

Abstract

Smart tourism is rapidly proving to be more than just a fancy buzzword in the tourism industry. It is a concept that highlights the already indispensable role of advanced technologies in tourism, but also emphasizes the importance of data and smart destination management. A review of the related literature shows that several authors have already tried to analyze the components of a smart tourism destination and build a general framework for measuring the state of development of such a destination. Therefore, this research aims at reexamining and testing the existing frameworks for analyzing the development of smart tourism destinations. The suggested framework should be flexible enough to allow analysis of the state of smart tourism development in destinations regardless of their size or tourism congestion, but it should also serve as a beacon for defining a possible direction of the development of a smart tourism destination. An extensive literature review was made and some of the related research findings were synthesized in order to describe a general framework for the analysis of the development of a smart tourism destination. The framework was subsequently tested on the example of Croatia, which can be considered a successful tourist destination. The suggested framework is just a theoretical construct which provides general guidelines on how to approach the implementation of a concrete apparatus and exact metrics for measuring smart tourism development. In practical terms, this research represents a small step towards building an operational framework that could be used in real life scenarios.

Key words: *Smart Tourism Destination, Measure, Framework, Croatia.*

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1. Introduction

Tourism industry has undergone many significant changes in the past 50 years, most of which are in many ways related directly to the propelling advancements in technology. Some of the technologies that made the biggest mark on tourism in global where those related to transportation (such as commercial flights), which made travelling significantly easier, quicker and, above all – affordable to wider audiences. However, all of those advancements would probably not yield as much results as they did if it wasn't for the invention and growth of the information superhighway also known as the internet. The biggest value of the internet lays in its capacity to store and convey vast amount of data, which in turns enables quick and easy access to information worldwide. The development of internet enabled further advancements related to information and communication technologies, such as different information systems, mobile gadgets, and end-user applications, all of which have proven to be extremely important for the tourism industry. The role of technology in tourism has been especially emphasized in the past two decades, as the number of leisure travels worldwide grew by around 250% annually (UNWTO, 2019). This growth was abruptly stopped by the global pandemic caused by the COVID-19, but it is likely to continue in a similar pace after the pandemic comes to an end.

As a direct consequence of such a rapid growth in the numbers of tourist travels, many destinations have started struggling with overtourism, which can be directly responsible for mediocre tourist experience, reduced quality of life of the local population, degradation of public spaces and cultural heritage, appearance of monofunctional spaces, pollution caused by tourism, decline in local values and customs, conflicts between residents and tourists, rising prices and over dependence on tourism. (Nunkoo & Ramkissoon, 2010) These effects are often a result of poor destination management caused by a lack of knowledge, expertise and motivation among the decision makers and other important stakeholders, but also insufficient and inadequate information about visitors and available resources within the destination. Many researchers see the solution to some of these problems in the smart use of technology. With respect to that, in the past 15 years there has been an increasing interest in the concept of Smart tourism. The phrase "Smart tourism" first appeared as a result of the reflections on the impact of technology on tourism, and it primarily refers to a framework for understanding tourism in a new context in which information and communication technologies have already reshaped the entire industry and transformed the behavior of tourists (Femenia-Serra, Neuhofer, & Ivars-Baidal, 2019). Several authors have argued on the definition of smart tourism, and on of the most commonly used comes from Gretzel et al., who define it as: "… tourism supported by integrated efforts at a destination to collect and aggregate/harness data derived from physical infrastructure, social connections, government/organizational sources and human bodies/minds in combination with the use of advanced technologies to transform that data into on-site experiences and business value-propositions with a clear

focus on efficiency, sustainability and experience enrichment" (Gretzel et al., 2015). From this definition it is clear that the concept itself is very complex and requires a great deal of knowledge, cooperation, resources and motivation from all of the important stakeholders in the destination. One of the crucial components of smart tourism according to Gretzel et al. is definitely the Smart Tourism Destination (STD) itself (Gretzel et al., 2015). According to López de Ávila Muñoz et al., STD can be defined as "… an innovative space, accessible for all, established on a cutting edge technology infrastructure which guarantees sustainable development of the land, facilitates the interaction and integration of the visitor with the surroundings and increases the quality of their experience in the destination, as well as the quality of life of residents" (López de Ávila Muñoz et al., 2015). Given the complexity of this definition, the following question comes to mind: "Is it possible to measure the smartness of a destination?". Several authors have tried to reply to this question, and this paper reexamines their work and provides another small step towards such an apparatus.

2. Related research

After examining recent literature in the context of smart tourism, it can be argued that not many authors dealt with concepts such as metrics, ranking or any form of quantifying smartness for that matter. This may be due to the fact that the whole concept of smart tourism is still relatively vague and lacks proper theoretical foundations, which makes it even more difficult to implement in practice (Femenia-Serra & Neuhofer, 2018). On the other hand, there is substantially more research and papers addressing the problem of ranking when it comes to smart cities, which is actually not that different from the concept of smart tourism destinations. The basic difference between the two concepts is that smart tourism destinations also consider improving the tourist experience alongside enhancing the quality of life of local residents with the use of technology (Gretzel et al., 2015).

The literature review shows that there are only a few researchers who were dealing with problems related to measuring smartness in the context of tourism, and majority of them used a rather qualitative approach to describe or rank smart tourism destinations. For instance, in their work from 2018, Tardivo, Viassone and Santoro described a relatively simple framework for measuring smartness of a destination, and they applied that framework to the city of Turin, as one of the candidates for the 2020 Smart City competition. Their model was spread across five dimensions of smartness: smart people, smart mobility, smart living, smart environment and smart governance. They argued that a destination can be denoted as smart when all of the important stakeholders (such as firms, governmental bodies, tourists, etc.) interact constantly and continuously to collect data and analyze tourist behavior and activities within the destination. As one of the results of their research they present a sort of an index ordained to measure the level of smartness of a destination, as well as provide some

important guidelines to policymakers for improving the smartness of the destination and creating additional value for all stakeholders. (Tardivo, Viassone, & Santoro, 2018) This research deals with measuring smartness in a way that it describes what a smart destination should encompass, and how "smartness" can be measured, but it does so using a mostly qualitative methodology which could be hard to generalize.

On a similar note, an initiative called "European Capitals of Smart Tourism" was started back in 2019 by the European commission, aimed at recognizing outstanding achievements in smart tourism in bigger European cities (with population over 100000, or the largest city in countries where no city has more than 100000 residents). The initiative started an annual competition that evolves around the idea that a smart tourism destination must be digitally accessible to all travelers and visitors, sustainable (to reduce impacts of tourism on the environment and to involve the local residents), digitalized (to enhance all aspects of the tourism experience and stimulate the growth of local businesses), and finally, protect the city's cultural heritage and stimulate creativity. Each city that applies to the annual competition is assessed in four categories: Accessibility, Sustainability, Digitalization and Cultural heritage & Creativity. Each category is evaluated based on 4 criteria, and each of the criteria rated with maximum of 5 points, to give a total of 80 points (with a 10-point threshold for every category). After the initial evaluation by a panel of independent experts, 7 cities are shortlisted as finalists and two of those cities are named the European Capital of Smart Tourism for that year, with an additional award presented for outstanding achievement in every of the 4 categories. (European Commision, 2022) The described ranking model used in this competition is fairly simple, in a sense that the experts award points subjectively based on a set of only 4 very general criteria for each category, without a specific set of indicators that would enable a transparent and uniform ranking process. Hence, it can hardly be considered as a general framework for ranking smart tourism destinations.

Last but not least, in 2017, Hà My, Huertas & Moreno suggested a new framework for the smart tourism destinations analysis called the (SA)6. (Hà My, Huertas, & Moreno, 2017) Their framework was based on the 6A's framework originally described by Buhalis in 2000 (Buhalis, 2000). Namely, Buhalis argued that there are 6 dimensions of any successful tourism destination: Accessibility, Attractions, Amenities, Activities, Ancillary services, and Available packages. The 6A's framework has subsequently been recognized by many researchers as very useful in both theory and practice related to tourism destinations. The (SA)6 framework was built basically by adding a smart layer on top of the 6A's framework, in such a way that all of the dimensions and indicators previously described by Buhalis have been upgraded and described in accordance with the definition and the context of smart tourism, especially in terms of the new disruptive technologies that made a significant mark on tourism and tourist behavior in the last two decades. Specifically, all of the dimensions of the 6A's framework were

added a “Smart” prefix, so the (SA)6 framework consists of the following dimensions: Smart Accessibility (20 indicators), Smart Attractions (7 indicators), Smart Amenities (7 indicators), Smart Activities (5 indicators), Smart Ancillary services (12 indicators) and Smart Available packages (6 indicators). The indicators in the (SA)6 framework are described in more detail by Hà My, Huertas & Moreno in their paper titled “(SA)6: A New Framework for the Analysis of Smart Tourism destinations” (Hà My, Huertas, & Moreno, 2017, str. 198-201), in which they also tested the framework by comparing two Spanish destinations using a completely qualitative approach. In one of their later papers from 2019 those same authors suggested a quantitative upgrade to their (SA)6 framework by adding a hierarchical structure with weights for each of the 6 dimensions and all associated indicators (57 in total) and suggesting how the overall score of a destination can be obtained by aggregating all the weighted values. (Huertas, Moreno, & Ha My, 2019) Their original model with suggested weights is shown on Figure 1.

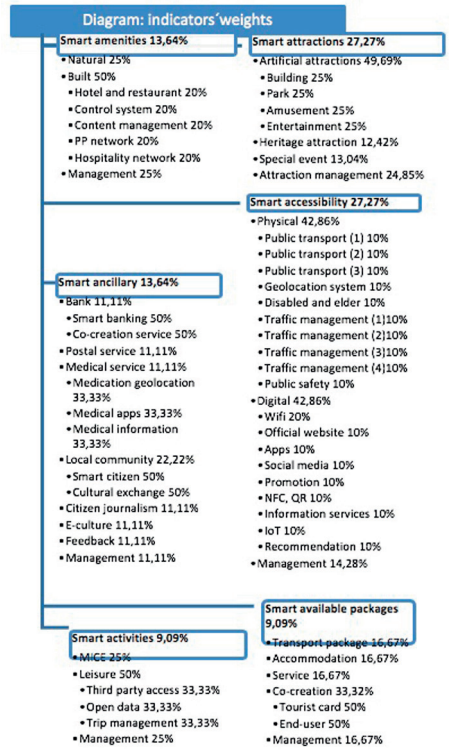


Figure 1. The hierarhical (SA)6 ranking model
Source: Huertas, Moreno & Ha My (2019)

The weights suggested within this model have been calculated by the respective authors using the Analytic Hierarchy Process (AHP) originally defined by Saaty in 1980 as a tool for the analysis of multi-criteria deci-

sion making problems. Although the overall score can be aggregated in many different ways once the indicator values are known, the authors also suggested a possible aggregation operator which could enable calibration of the model if needed. Namely, they suggested the use of the so called Weighted Ordered Weighted Averaging (WOWA) operator originally defined by Torra in 1997. The WOWA operator is defined with:

$$WOWA(v) = \sum_{j=1}^{k} \omega_j v'_j$$

where k-dimensional vector represents the original indicator scores, and vector consists of the same values as vector but in a descending order , while the components of the weighting vector are defined with:

$$\omega_j = g\left(\sum_{i=1}^{j} p_i\right) - g\left(\sum_{i=1}^{j-1} p_i\right)$$

using any monotone increasing function on a [0, 1] interval. The authors also suggest a particular generating function that can be used for the calculation of the components of the weighting vector . To be more specific, they suggest a function described by Kasperski & Zielinski in 2016, defined with:

$$g_\alpha(x) = \frac{1 - \alpha^x}{1 - \alpha}$$

where the value of the parameter α can be chosen in such a way that it can influence the overall aggregation score in different ways if necessary. To be more specific, the lower value of the parameter α can increase the overall score for destinations with higher values of only a small number of indicators, while the higher value of the parameter α results in a better overall score only if most of the indicators have higher values, thus enabling different scoring models be used by only tuning the parameter α. (Huertas, Moreno, & Ha My, 2019)

The proposed aggregation operator with different α values was also tested by Huertas, Ha My & Moreno in the aforementioned paper as a part of their case study which included several destinations in Spain, suggesting that the framework can be applied to different types of destinations. Therefore, the framework was chosen to be tested in this research, with respect to the weights and the methodology suggested by the authors.

3. Methodology

The research was conducted using an online questionnaire which was distributed online via e-mail directly to the mayor (mayor's office) of every city (N=127) and head (head's office) of every municipality (N=429) in Croatia. The reason why mayors and heads of municipalities were chosen as respondents is because according to the Croatian legislation on local self-government, they are the decision makers, and therefore directly responsible for the development and management of information and other public infrastructure (e.g. energy, telecommunications, water supply, transport, waste disposal, security and health, etc.), as well as creating and implementing tourism development strategies when it comes to Croatian cities and municipalities. The questionnaire was sent three times in the period from July 2019 to January 2020, in order to receive as many answers as possible. Finally, out of the 293 (52.69%) questionnaires collected in total, only 123 (22.12%) were fully completed and taken into consideration.

The questionnaire consisted of a total of 15 questions, the first 11 of which were composite scales with multiple particles. All the questions and sub-questions were closed-ended, whereby the answers to the sub-questions in the first 11 questions were formed using a five-point Likert scale. Also, questions from 2nd to 11th contained the option "I don't know/Not sure" for every particle, and it was possible to add an "other" answer. In the 12th question, respondents could choose their city or municipality from the drop-down menu, but it was pointed out within the question that the answer is not mandatory, in order to avoid a possible failure to complete the questionnaire if the respondent felt uncomfortable because they didn't know the answer to some of the questions. The 13th question examined the regional affiliation of the respondent's destination, according to the NUTS-2 classification (*Nomenclature of territorial units for statistics*) whereby Croatia was divided into 2 regions – Adriatic and Continental Croatia[2]. The final two questions examined the size of the destination (in terms of the number of residents) and the number of tourists overnight stays in the past year. The most important questions with respect to this research were those addressing the dimensions and the individual components of a smart tourism destination according to the previously described model (questions from 4th to 9th).

The six dimensions of a smart tourism destination (as described in the model) were examined within the questionnaire through six composite scales, each consisting of 5 or more particles (57 in total). Each particle represented one of the indicators of development of a particular smart tourism dimension according to the previously mentioned (SA)6 model. Particles were rated using a five-point Likert scale, where 1 represented very low and 5 represented very high level of development of a particular indicator. The obtained ratings were analyzed both individually and with

2 This NUTS-2 classification was revised in 2021, when Croatia was divided into 4 regions (Pannonian, Adriatic, Northern and the city of Zagreb).

respect to the regional affiliation of the destination. Additionally, the examinees had to provide some general information about the size of the destination and the number of tourists overnight stays in the past year (both were categorized with respect to the actual statistical data available at the webpage of the Croatian Bureau of Statistics at https://podaci.dzs.hr/en/).

4. Results

The structure of the destinations included in this research is shown on the following charts, with respect to their size (in terms of population), number of tourist overnight stays, and geographical affiliation:

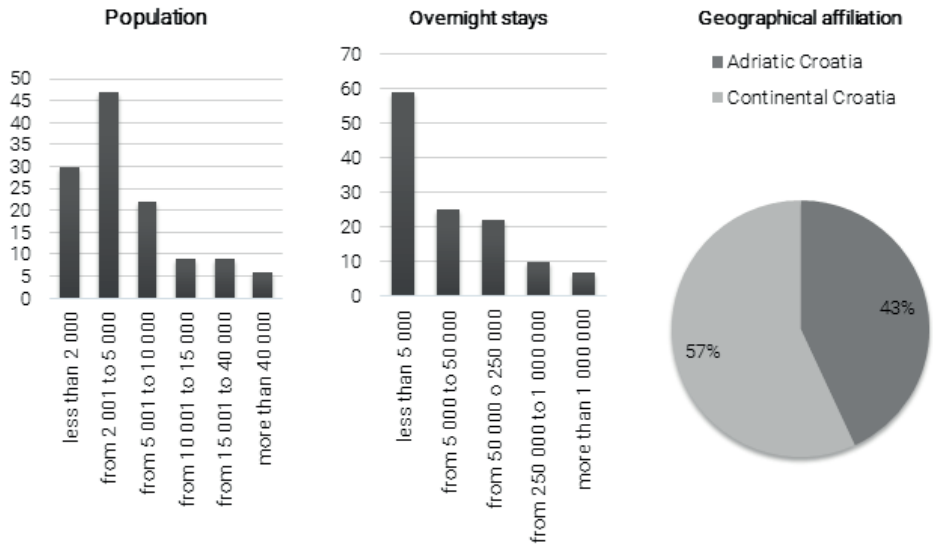
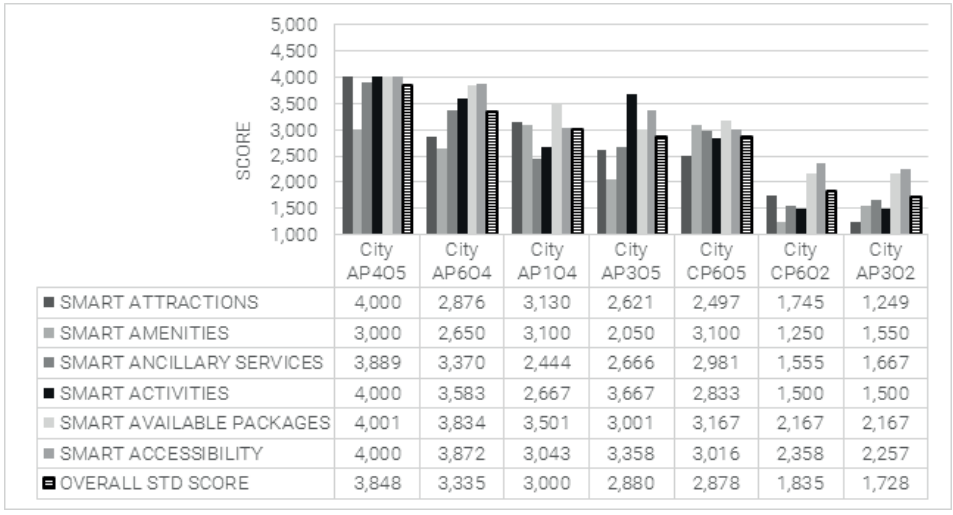


Figure 2. The structure of the sample with respect to the population size, number of overnight stays and geographical affiliation
Source: authors work

As far as it can be seen from the authors description (Huertas, Moreno, & Ha My, 2019), the (SA)6 model by default doesn't necessarily consider the size of the destination nor the level of tourism saturation (in terms of e.g., number of tourist visits or overnight stays) as variables when it comes to calculating the STD score. Therefore, to further explore how the (SA)6 model corresponds with different sizes and tourist loads of a certain destination, the (SA)6 model was applied to 6 different destinations in Croatia whose mayors participated in this research. Considering that the question related to the name of the destination wasn't mandatory (to maximize the possibility of completion of the questionnaire), most of the answers were submitted anonymously (only questions related to geographical affiliation, size and

number of overnight stays were mandatory). Therefore, the destinations in this test were differentiated based on their geographical affiliation (Adriatic or Continental Croatia), number of residents (6 population categories : P1: “less than 2000”, P2: “from 2000 to 5000”, P3: “from 5000 to 10000”, P4: “from 10000 to 15000”, P5: “from 15000 to 40000” and P6: “more than 40000”), and number of tourist overnight stays (5 categories : O1:”less than 5000”, O2: “from 5000 to 50000”, O3: “from 50000 to 250000”; O4: “from 250000 to 1000000” and O5: “more than 1000000”), and described accordingly with codenames. For example, a destination located in Adriatic Croatia (A), with a population between 5000 and 10000 residents (P3) and more than 1000000 overnight stays in the past year (O5) is labeled as AP3O5 city. These 6 destinations for which overall STD scores were calculated, were chosen so that they represent different types of destinations with respect to their location, size and tourism load. Namely, 4 out of 6 destinations are cities in the Adriatic region, which is accountable for almost 95% of all visits and overnight stays in the Republic of Croatia (CBS, 2018), with all 4 somewhat different in size and tourist numbers. The remaining 2 destinations are bigger cities from Continental Croatia, one with high number and one with significantly lower number of overnight stays.

The obtained results are presented in Figure 3. These results were calculated with original weight factors suggested by the authors of the (SA)6 model, without any corrections to either the individual indicator weights or dimension weights.



	City AP4O5	City AP6O4	City AP1O4	City AP3O5	City CP6O5	City CP6O2	City AP3O2
SMART ATTRACTIONS	4,000	2,876	3,130	2,621	2,497	1,745	1,249
SMART AMENITIES	3,000	2,650	3,100	2,050	3,100	1,250	1,550
SMART ANCILLARY SERVICES	3,889	3,370	2,444	2,666	2,981	1,555	1,667
SMART ACTIVITIES	4,000	3,583	2,667	3,667	2,833	1,500	1,500
SMART AVAILABLE PACKAGES	4,001	3,834	3,501	3,001	3,167	2,167	2,167
SMART ACCESSIBILITY	4,000	3,872	3,043	3,358	3,016	2,358	2,257
OVERALL STD SCORE	3,848	3,335	3,000	2,880	2,878	1,835	1,728

Figure 3. Dimension scores and overall STD scores for 6 different destinations in Croatia according to the proposed (SA)6 model
Source: authors work

The same results were subsequently calculated using the aforementioned WOWA operator with the generating function (where α=0.1) in order to

see if it would make a difference when it comes to overall scores of these destinations (reduce the possible imbalances between different dimension scores). The results of these WOWA corrected overall STD scores are shown in Figure 4. It can be seen that the overall STD scores have increased for all destinations (from 2,71% to 12.69%) after the use of WOWA operator, with the most significant increase (12.69%) in the case of the city AP3O2 which had the worse original overall STD score out of all 6 destinations. However, it is also notable that after the application of WOWA operator, the ranking order of some of the destinations has changed. Namely, city AP3O5 had lower overall rating compared to the city AP1O4 prior to the use of WOWA operator (3.000 : 2.880), but was ranked higher after the WOWA operator was applied (3.145 : 3.166). This is likely due to the fact that the dimension scores related to the city AP3O5 were considerably less uniform compared to the city AP1O4, as WOWA operator with the generating function and a smaller alpha value applies more weight to the components with greater initial value, thus emphasizing the strong suit of a destination (as opposed to the higher alpha values, which favors consistency and higher initial scores). These differences confirm that the use of WOWA operator with the generating function , where alpha has a lower value (e.g. α=0.1) can help in reducing the score gap between destinations in different development stages. This is particularly important when it comes to comparing the well-developed destinations with smaller ones who struggle with financing expensive infrastructural issues, as not all destinations have the resources or the manpower to develop all of the smart dimensions equally.

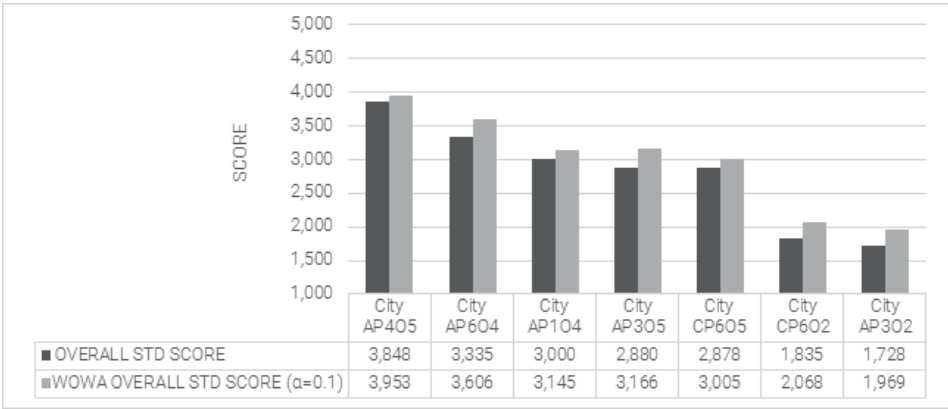


Figure 4. A comparison of overall STD scores for 6 different cities prior and after the application of WOWA operator (α=0.1)
Source: authors work

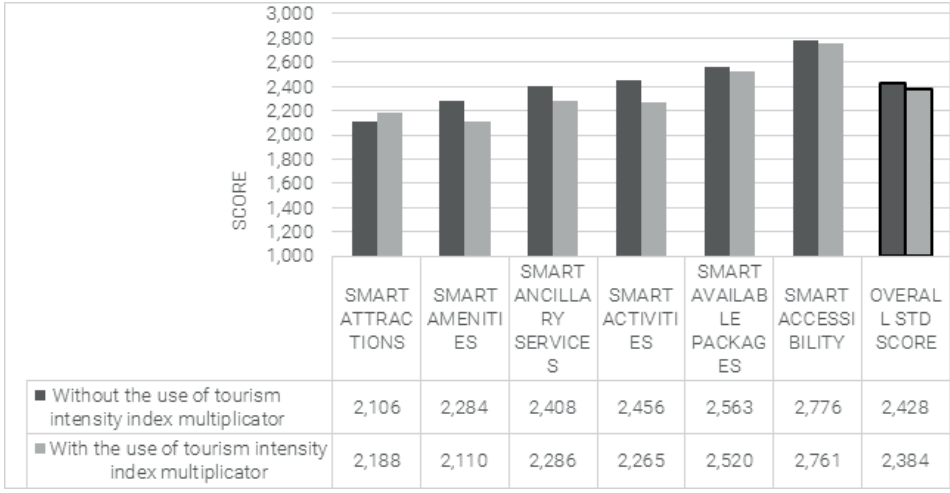
To obtain an overall STD score of the entire sample, average ratings of all indicators were calculated, multiplied with individual indicator weights (described in the previous section) and summed up to form the indicator weighted score sum (*Iwss*). The *Iwss* score was subsequently multiplied by

the appropriate dimension weight factor (*Dwf*) which resulted in a composite dimension score for each of the six dimensions of the (SA)6 model for all 123 cities and municipalities taking part in this research. The composite dimension scores were then added together to get the overall STD score. The overall STD score is a decimal number from the [1, 5] interval which can be seen as a general "smartness" score or a level of development of a region (to simplify, it could be considered the overall STD score for Croatia presuming the sample is statistically representative, which would be possible to prove only if the names of all participating cities and municipalities were known). All of the aforementioned scores and weights are visible in Figure 5. Composite STD score for Croatia based on the proposed (SA)6 model, including all individual indicator scores, weighted indicator scores, composite dimension scores for all 6 dimensions, and overall STD score which (rounded to three decimals) equals 2.428.

Finally, besides the suggested weights within the original (SA)6 framework, and those calculated using the WOWA operator, an additional approach to aggregating the indicator values was tested when calculating the overall STD score for the entire sample. Namely, the suggested (SA)6 framework didn't consider the level of tourism saturation of the destinations. Considering many studies have shown that in urban destinations with a lower saturation in terms of tourist visits or overnight stays, there is much less thought given to the problems and opportunities related to the development of tourism in the destination (Klarin, 2017), these indicators could therefore have an impact on the overall score (in addition to the indicators already described). Hence, an index of tourism intensity was calculated as the ratio of the number of tourists overnight stays and the number of residents of each destination, and it was applied to the values of the indicators as a multiplicator when calculating the average values of the indicators on the given sample. The obtained results for the entire sample, with and without the use of the tourism intensity multiplicator, are shown in Figure 6. From the obtained results it can be seen that the use of the multiplicator has generally decreased the scores by the dimensions, as well as the overall score, which can be explained by the structure of the sample, i.e., a high percentage of destinations within the sample with a relatively low tourism intensity index (which can be seen from the structure of the destinations included in this research, as shown on Figure 2).

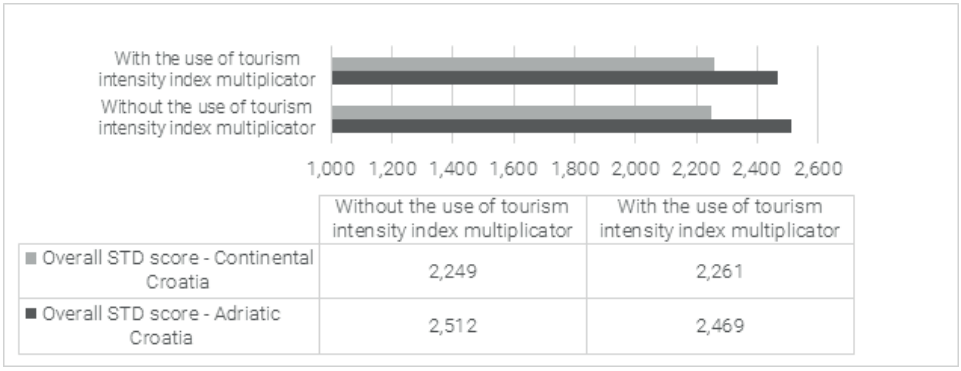
DIMENSION (Dimension weight factor)	Categories	Indicators & Individual weigths							Weighed indicator score sum (Iwss)	Dimension weight factor (Dwf)	Composite dimension score (Iwss*Dwf)
SMART ATTRACTIONS (27,27%)	Indicator section	Artificial attractions				Heritage attractions	Special events	Attraction management			
	Indicator sub-section	Buildings	Parks	Amusement centers	Entertainment						
	Individual indicator weight	12,42%	12,42%	12,42%	12,42%	12,42%	13,04%	24,85%			
	Indicator score	1,739	1,605	1,550	1,846	1,934	1,713	3,242			
	Weighed indicator score	0,216	0,199	0,193	0,229	0,240	0,223	0,806	2,106	27,27%	0,574
SMART AMENITIES (13,64%)	Indicator section	Natural amenities	Built amenities					Amenities management			
	Indicator sub-section		Hotel and restaurant	Control system	Content management	PP network	Hospitality network				
	Individual indicator weight	25%	10%	10%	10%	10%	10%	25%			
	Indicator score	1,794	1,798	2,147	1,917	1,681	1,660	3,661			
	Weighed indicator score	0,449	0,180	0,215	0,192	0,168	0,166	0,915	2,284	13,64%	0,312
SMART ANCILLARY SERVICES (13,64%)	Indicator section	Bank services		Postal services	Medical services			Local community			
	Indicator sub-section	Smart banking	Co-creation services		Medication geolocation	Medical apps	Medical information	Smart citizen			
	Individual indicator weight	5,56%	5,56%	11,11%	3,70%	3,70%	3,70%	11,11%			
	Indicator score	3,310	2,390	2,135	2,069	1,823	1,802	1,964			
	Weighed indicator score	0,184	0,133	0,237	0,077	0,068	0,067	0,218			
	Indicator section	Local community	Citizen journalism	E-culture	Feedback	Ancillary services management					
	Indicator sub-section	Cultural exchange									
	Individual indicator weight	11,11%	11,11%	11,11%	11,11%	11,11%					
	Indicator score	2,171	2,037	2,080	2,157	4,385					
	Weighed indicator score	0,241	0,226	0,231	0,240	0,487			2,408	13,64%	0,328
SMART ACTIVITIES (9,09%)	Indicator section	MICE activities	Leisure activities			Activities management					
	Indicator sub-section		Third party access	Open data	Trip management						
	Individual indicator weight	25%	16,67%	16,67%	16,67%	25%					
	Indicator score	1,822	2,240	1,919	1,781	4,043					
	Weighed indicator score	0,456	0,373	0,320	0,297	1,011			2,456	9,09%	0,223
SMART AVAILABLE PACKAGES (9,09%)	Indicator section	Transport packages	Accommodation packages	Service packages	Co-creation packages		Available packages management				
	Indicator sub-section				Tourist card	End-user apps					
	Individual indicator weight	16,67%	16,67%	16,67%	16,67%	16,67%	16,67%				
	Indicator score	1,536	2,448	1,721	2,364	3,256	4,050				
	Weighed indicator score	0,256	0,408	0,287	0,394	0,543	0,675		2,563	9,09%	0,233
SMART ACCESSIBILITY (27,27%)	Indicator section	Physical accessibility									
	Indicator sub-section	Destination public transport	Public transport between attractions	Intercity public transport	Geolocation systems	Disabled and elder	Realtime Traffic management	Smart parking management			
	Individual indicator weight	4,28%	4,28%	4,28%	4,28%	4,28%	4,28%	4,28%			
	Indicator score	2,598	2,775	3,025	2,632	2,099	1,907	1,580			
	Weighed indicator score	0,111	0,119	0,129	0,113	0,090	0,082	0,068			
	Indicator section	Physical accessibility			Digital accessibility						
	Indicator sub-section	Intermodal transport	Traffic congestion management	Public safety	Free Wi-fi	Official websites	Mobile apps	Social media			
	Individual indicator weight	4,28%	4,28%	4,28%	8,56%	4,28%	4,28%	4,28%			
	Indicator score	1,386	1,435	2,171	3,231	3,269	2,518	2,861			
	Weighed indicator score	0,059	0,061	0,093	0,277	0,140	0,108	0,122			
	Indicator section	Digital accessibility					Accessibility management				
	Indicator sub-section	NFC & QR codes	Online promotions	Information services	IoT	Recommendation					
	Individual indicator weight	4,28%	4,28%	4,28%	4,28%	4,28%	14,40%				
	Indicator score	3,155	2,931	2,500	2,061	2,321	4,513				
	Weighed indicator score	0,135	0,125	0,107	0,088	0,099	0,650		2,776	27,27%	0,757
OVERALL STD SCORE (sum of all composite dimension scores)											2,428

Figure 5. Composite STD score for Croatia based on the proposed (SA)6 model
Source: authors work



	SMART ATTRACTIONS	SMART AMENITIES	SMART ANCILLARY SERVICES	SMART ACTIVITIES	SMART AVAILABLE PACKAGES	SMART ACCESSIBILITY	OVERALL STD SCORE
Without the use of tourism intensity index multiplicator	2,106	2,284	2,408	2,456	2,563	2,776	2,428
With the use of tourism intensity index multiplicator	2,188	2,110	2,286	2,265	2,520	2,761	2,384

Figure 6. The smartness scores calculated with and without the use of the tourism intensity index multiplicator
Source: authors work



	Without the use of tourism intensity index multiplicator	With the use of tourism intensity index multiplicator
Overall STD score - Continental Croatia	2,249	2,261
Overall STD score - Adriatic Croatia	2,512	2,469

Figure 7. The overall scores for Adriatic and Continental Croatia
Source: authors work

In addition to the overall scores *calculated on the ba*se of the entire sample, the same calculations were made with respect to the geographical affiliation of the destination. The aim was to identify whether the less touristically developed areas (such as Continental Croatia) differ significantly when compared to better developed areas such as Adriatic Croatia (from a touristic development point of view). The results were calculated with and without the use of tourism intensity index multiplicator, and the results can be seen in Figure 7. The overall scores for Adriatic and Continental Croatia. It is obvious that the Adriatic Croatia has a better overall score, and it is only reasonable to presume that this is a direct consequence of the higher

tourism development level. Also, it is worth noting that the overall scores haven't changed much after the use of the tourism intensity multiplicator index, as most of the destinations within each of the regions have relatively uniform tourism intensity (relatively low in the Continental Croatia, and relatively high in the Adriatic Croatia).

5. Conclusion

This research reexamines the hierarchical (SA)6 framework described by Huertas, Moreno and Ha My, and further addresses some of it positive and negative aspects. The results indicate that the (SA)6 framework has the potential to grow into a fully functional STD development rating tool. However, in order to get to that point, some of the shortcomings of the framework would have to be seriously studied and dealt with. For example, this framework requires additional work when it comes to taking into consideration the specifics of the destination in the ranking process, such as the size and the level of tourism saturation, which could have a strong influence on the overall results. Also, the smart tourism destination ranking must take into account not only the technologies and infrastructure, but also the end results of their use, in the sense of the quality of tourist experience and the satisfaction of the local population, as that is one of the main goals of the smart tourism concept. In other words, a successful smart tourism destination has to fulfill its primary goals in order to be considered successful, and that is to have satisfied visitors and happy residents, regardless of how well its infrastructure is developed or how much technology is utilized in the destination.

As for the obtained results, it must be pointed out that the rating of the indicator development was done subjectively, according to the examinee's current knowledge and opinion on the matter, which can be considered a serious limitation to the precision and representativeness of the obtained results. However, since this is a preliminary research, the rating system should not be treated as a major shortcoming. Nevertheless, before any real attempt to measure the "actual value" of indicators, it should be well thought-about on how to define a standard rating system. Moreover, a proper rating system would have to involve some sort of expertise (e.g. an expert committee) and an extensive research that would have to be performed *in situ*.

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Original scientific paper

USING ARTIFICIAL INTELLIGENCE WITH J48 TO PREDICT ALARMS IN A SMART CITY

Abstract

Although smart city research has been underway for a long time, it is estimated that we are still at the very beginning of smart city development. One aspect of smart cities is the safe city, which includes everything related to safety. The focus of our research is to analyze the forecasting of alarms that occur due to emergency-related events. The use of the J48 classification algorithm is envisaged for this purpose. The comparison itself includes analysis for different cases with the use of data for two time periods, the use of data for a whole time period or by quarterly time periods, and the use of balanced and unbalanced data. Such an analysis will help us better understand what is happening regarding alarm detection, which helps to increase situational awareness in the control rooms of smart cities.

Key words: *Smart City, Artificial Intelligence, J48, Classification, Open Data.*

1. Introduction

Many natural conditions in the world, such as earthquakes, tsunamis, floods, and sleet, cause major disasters. In Europe, the emergency telephone number 112 collects information on such events. A key issue in this paper is the forecasting and classification of incoming 112 emergency calls in the smart city of Ljubljana. While the forecasting of existing incoming calls is based on an average and a maximum number of incoming calls, this paper deals with a more dynamic, artificial intelligence-based forecasting of the alarm detection number of incoming calls.

Smart cities are still at their beginnings. They add intelligence to existing city systems, enabling more to be done with less. The result is applications with transparent real-time information that aid in making better choices. The paper examines public safety, which is part of safe cities. The goal is to recognize in advance, by using a J48 classifier, when the extent of incoming calls to the 112-emergency number due to natural hazardous events

will be so large that it will be necessary to trigger an alarm within the public safety system.

The basic problem for the safe city is how to increase awareness within control rooms. Any additional information is welcome as long as it helps to increase situational awareness.

As for the data, it is derived from two time-varying datasets. The first time period contains data for the period between 2013 and 2016 and is intended to establish the model. In addition, a second time period relating to the year 2018 was prepared. This is intended for additional control evaluation. In the case of data for the city of Ljubljana, a total of 20 attributes were used, which are directly related to the city of Ljubljana and include data for the day of the week, river flows and weather data.

The comparison and evaluation of data mining methods were carried out for different cases, with the aim of obtaining sufficiently detailed and comprehensive analyses, which are related to the central question of this paper. The model was set for the whole first time period, and also quarterly within the first time period. Moreover, a comparison was made with both balanced and unbalanced data.

The rest of the paper is organized as follows. First, related work is presented. Then, the description of the methodology, problem definition, and evaluation are given. Finally, the conclusions and future work are discussed.

2. Related work

Information and communication technology enables the transformation of traditional cities into smart cities (Mohanty, Choppali and Kougianos, 2016). New and closely related technological frameworks are the Internet of Things and Big Data, which contribute to making smart cities efficient and responsive.

There are several definitions of smart cities. According to the definition of the European Commission, a smart city is a place where traditional networks and services are made more efficient by the use of digital and telecommunication technologies for the benefit of its residents and businesses (European Commission, 2019). According to the definition of the UK government, the concept of smart cities is not static (Department for Business Innovation and Skills, 2013), because there is no absolute definition of a smart city or an endpoint, but rather a process or a series of steps that make cities more alive and flexible and therefore able to respond more quickly to new challenges. One of the formal definitions of a smart city claims that a smart city connects physical infrastructure, information technology infrastructure, social infrastructure, and business infrastructure to foster the collective intelligence of the city (Mohanty, Choppali and Kougianos, 2016).

Smart cities are considered to be complex ecosystems, which include public safety; Ren and Sanz (2011) proposed a holistic and integrated approach to modelling the entire functioning of the city, along with its constituent parts and dependencies among them. One crucial question is how to raise situation awareness for cases of natural disasters and catastrophes (Middleton, Middleton and Modafferi, 2014).

It has been suggested that socio-economic change plays a significant influence in disaster risk management (Fakhruddin and Chivakidakarn, 2014). Islam et al. (2014) present the design and implementation of a water monitoring system, which provides a solution to remotely monitoring water levels, early warning of events, sending notifications when critical water levels are reached through mobile devices and accessing all information via a website. Meng and Jin (2012) deal with major issues confronting a multilevel warning system, involving the municipality, districts, enterprises and communities. In the work of Ma et al. (2010), the precipitation of the current day and the previous three days, topographic elevation, topographic standard deviation, a network of rivers and lakes, population density and GDP density were extracted as assessment factors, and a risk assessment model was built for national-scale flood disasters.

Information about emergency events is collected by 112 systems (EENA Operations Document, 2015) or by NG112 systems (EENA Operations Document, 2013). Example of smart city solutions include alarm detection in the event of an increased number of incoming calls to the 112 emergency call system (Grašič & Mileva Boshkoska, 2018). However, the issue of a smart city is not only about a simple alarm system, but also about intelligence, such as the issue of classifying incoming calls for a smart city (Grasic, Kos and Mileva-Boshkoska, 2018; Grašič, 2021). The evaluation of the number of incoming calls was analyzed for the floods that occurred in 2010, while the analysis refers to Ljubljana and its surroundings (Klici na 112, 2010; Tavčar, 2011; Tavčar and Švab Tavčar, 2012).

Calls to 112 may refer to the police, emergency medical services, or firefighters. Public safety and crime prediction have been addressed in Natal, Brazil (Coelho et al., 2016; Mendonca et al., 2016). In 2015, the City of Natal joined the IEEE Smart Cities initiative. Such an example is monitoring of the movement of police personnel, to aid in more effective planning of responding to security incidents. Time series of incoming emergency medical calls are developed and evaluated for the city of Calgary, Canada (Channouf, L'Ecuyer, Ingolfsson and Avramidis, 2007). They aim to provide simple and efficient models that can be used to forecast daily and hourly call volumes. The subject of the research is the prediction of incoming 911 calls for firefighters in case of fires (Zhong, Duckham, Chong and Tolhurst, 2016). The authors analyze fire-related call data for Victoria, Australia. When incoming calls arrive at the call center, they also contain location information. Using machine learning, the authors were able to track the progress of a fire with a spatial component in real time.

3. Problem definition

The 112 standard emergency telephone number can be dialed free of charge from any stationary or mobile phone. In Slovenia, the 112-emergency call system consists of two levels. The operators of the first level in the control room receive all incoming calls to the 112-emergency number. After receiving the call and to the extent the operator deems necessary, he can redirect the incoming calls to the second level: to special services, which include paramedics, police, or firemen. In the case of Slovenia, the current principle of predicting the number of incoming calls for the 112-emergency call is based on average and maximum values.

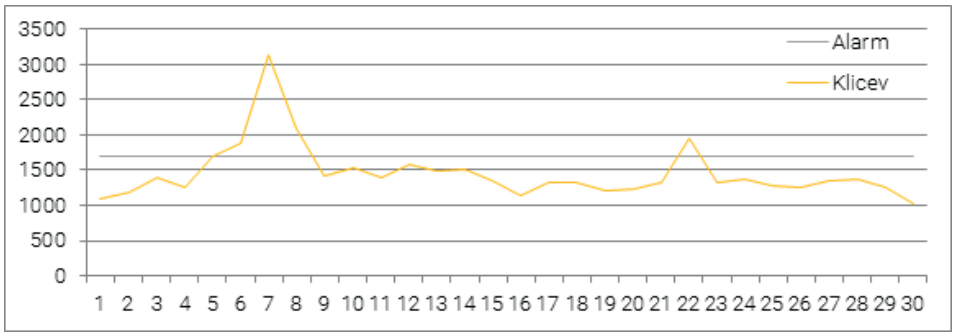


Figure 1. Movement of daily incoming calls in case of flooding in Ljubljana in November 2014

In November 2014, there were floods in central Slovenia, including Ljubljana. Hundreds of buildings were flooded, and 100 km of roads were damaged. Movement in the number of incoming calls can be seen in Figure 1. The horizontal line represents the boundary where we would like to place the alarm trigger point for the number of incoming calls.

From the user's point of view, the problem is how to define in advance the number of incoming calls that will cause an alarm condition on a daily basis, with daily fluctuations in the number of incoming calls. From the operator's point of view in the control room, the problem appears as the system for the number of calls is not flexible enough, and existing systems do not take advantage of the use of artificial intelligence to detect or predict changes in the number of calls. From the point of view of a smart city, the problem is how to make the call center smarter, more intelligent, and how to ensure greater flexibility for all future changes in the number of calls.

4. Methodology

4. 1. Methodology description

We are using J48 decision trees as a classifier. The data sets are for the first and for the second time period. Both balanced and unbalanced data were used. The tool used was Weka (Frank, Hall and Witten, 2016). For the evaluation measures (Witten, Frank and Hall, 2011) we have used TP (True Positive), F-Measure, and ROC.

4. 2. Machine learning

Automated learning is the goal. Computers are programmed to learn from the input that is available to them. In this case, learning is the process of converting experience into expertise. The term "machine learning" refers to the automated detection of significant patterns in data (Shalev-Shwartz and Ben-David, 2014). In recent decades, it has become a common tool for almost all information retrieval tasks involving large amounts of data.

Classification is part of machine learning (Hastie, Tibshirani and Friedman, 2009; Witten, Frank and Hall, 2011; James et al., 2014). By definition (Han, Kamber and Pei, 2011) predicting class labels is classification, which is different from predicting values (e.g., using regression techniques) which is called a "prediction". Predicting a qualitative response for observation can be referred to as "classifying" that observation since it involves assigning the observation to a category or class (James et al., 2014).

4. 3. Forecasting

In machine learning, the dominant task is predictive modeling: creating models for the purpose of predicting the labels of new cases (Fawcett, 2017). Prediction is concerned with estimating outcomes for unseen data and is future oriented. Predictive analytics is also to what statistics is so often compared.

Forecasting is a sub-discipline of prediction in which the future is predicted based on data that have a time component, that is, that changes over time. In short, the only difference between prediction and forecasting is that, in the latter case, the time dimension is also considered.

4. 4. J48

Decision tree algorithms (e.g., ID3, C4.5, and CART) were initially intended for classification (Han, Kamber and Pei, 2011). They are conceptually simple yet powerful (Hastie, Tibshirani and Friedman, 2009). Decision tree induction constructs a flow chart like structure in which each internal (non-leaf) node denotes a test on an attribute, each branch corresponds to an

outcome of the test, and each external (leaf) node denotes a class prediction. At each node, the algorithm chooses the "best" attribute to partition the data into individual classes. When decision tree induction is used for attribute subset selection, a tree is constructed from the given data.

C4.5 is an algorithm used to generate a decision tree developed by Ross Quinlan (Quinlan, 1993). The J48 algorithm is Weka's implementation of this decision tree learner (Witten, Frank and Hall, 2011). The J48 implements a later and slightly improved version called C4.5 revision 8, which was the last public version of this family of algorithms before the commercial implementation C5.0 was released.

4. 5. Evaluation measures

For the evaluation measure TP, F-Measure and ROC are used.

TP (True Positives) represents correctly predicted positive values, which means that the value of the actual class is "yes", and the value of the predicted class is also "yes". (FP) False Positives represents cases in which the value of the actual class is "no", and the value of the predicted class is "yes". Precision is the number of correct results divided by the number of all returned results. The formula is Precision = TP/(TP+FP). Recall, also called "Sensitivity," is the ratio of the correctly predicted positive observations to all the observations in the actual class – "yes". The formula is Recall = TP/(TP+FN). F-Measure (also known as "F1") is the weighted average of Precision and Recall. Therefore, this score takes both false positives and false negatives into account. The formula is F-Measure = 2*(Recall * Precision) / (Recall + Precision).

ROC-curve is a two-dimensional graph that visually depicts the performance and performance gain for a classification model. An ROC area approaching 1 means the best classifier. If the value for ROC is 0.5, it means a random guess. The formula for ROC is ROC = TPR/FPR = RE/FPR, where FPR (False Positive Rate) is defined as FPR = FP/(FP+TN).

4. 6. Data used

Open data are used, which are data that can be freely used, modified, and shared with anyone for any purpose. They are easily accessible, always reachable, and not limited in any way.

The data used in this study are mostly related to the city of Ljubljana. They include attribute data for day of the week, river flows, and weather. These data were chosen because the greatest damage in recent years in Slovenia was caused by natural events related to the weather, such as floods, droughts, and ice. The data used were collected and placed online (SafeCity112, 2022).

Both river flow attributes and weather data are obtained from the open data system of the National Meteorological Service of Slovenia on the Meteo portal (Meteo.si, 2022). Data for incoming calls are obtained from the StatKlic application (StatKlic, 2018).

4. 7. Balanced and unbalanced data

Essentially, the evaluation can be based on the data as they are; these are unbalanced data. However, research shows that, and such is also the practice, that even better results are obtained in cases in which the data are balanced. This is also true for the present paper, since the data are not completely balanced, and the majority class contains between 80 and 90% of all data instances.

The field of unbalanced data has been actively studied since the year 2000. An overview survey from 2015 contains over 220 references on the topic of unbalanced data (Branco, Torgo and Ribeiro, 2016). Classifications for the case of unbalanced data present a challenge for predictive modeling, as most machine-learning algorithms used for classification were designed assuming an equal number of examples for each class, which can lead to completely incorrect findings in the case of unbalanced data (Brownlee, 2020).

4. 8. Model deployment

The model was prepared based on the entire first time period and on individual quarters of the first time period. For balanced and unbalanced data, suggestions were followed as given (Fawcett, 2016).

In the case of unbalanced data, the data are kept as they are, so they remain unbalanced. For this case, stratification and normalization of data are used in accordance with the guidelines. Additionally, a 10-fold cross validation is used. The basic idea of 10-fold cross-validation is to divide the data into several data subsets and to use each dataset for training and testing. The data used for each of the cross-validation is the same for each of the methods, which is provided in the Weka tool with the parameter seed = 1. Since the input data for each of the methods is the same, the results for the different methods are also comparable to each other.

In the case of balanced data, after normalization, data balancing using the SMOTE approach and use of cost-sensitive classification is made. Table 1 shows the procedure in the case of balanced data.

Table 1. Commands for methods and different approaches in Weka tool for balanced data

Command (settings) in the Weka tool	Comment
weka.classifiers.trees.J48 -C 0.25 -M 2	Method J48
weka.filters.unsupervised.attribute.Normalize -S 1.0 -T 0.0	Command to normalize the data, ranging from 0 to 1
weka.filters.supervised.instance.SMOTE -C 0 -K 5 -P 600.0 -S 1	A data balancing command using the SMOTE approach. The –P option means a percentage increase for the minority class (-P 600.0 means a 600% increase). The –C option tells which class label the increase applies to.
weka.classifiers.meta.CostSensitiveClassifier -cost-matrix "[0.0 C_1; C_2 0.0]" -S 1 -W METODA	Settings for cost-sensitive classification, where C_1 and C_2 are parameters for cost sensitivity and METHOD is the command for the method used which is J48.

Procedure for the preparation of the model is carried out for the entire first period from 2013 to 2016. After the model is prepared, an evaluation is made by comparing the obtained metrics. Then the evaluation is done for the entire second time period (2018). In the hope of obtaining even better results, the data of the first period are additionally divided into quarters. The described procedure for the entire period is thus repeated for each quarter separately, first for the first time period and then for the second time period.

5. Evaluation

5. 1. Evaluation of the data

For the day data, meaning the information about whether it is a weekday, Saturday or Sunday is used. The weather station in Ljubljana is taken for the weather data, and 16 attributes are taken for the mentioned weather station. For river flows, two measuring points are taken, which are connected to the city of Ljubljana. Table 2 presents used data evaluation.

Table 2. Evaluation of the data

Incoming call characteristics	First time period (2013-2016)	Second time period (2018)
Number of attributes for setting the model	20	
Data granulation	Daily	Daily
Number of data instances	1,186	365
Min/max number of incoming calls per day (min/max ratio)	890/9,538 (1:11)	963/2,937 (1:3)
Average number of incoming calls	1,479	1,369

A total of 20 attributes were used for the city of Ljubljana. These data were collected for the period between 2013 and 2016, a total of 1,186 data instances. Each data record represents one day of data. Data for the second period were additionally used. These were the same attributes, except that the data was collected for the year 2018, which represents a total of 365 data instances.

5. 2. Alarm triggering evaluation

For each data instance, we defined a class with two different values (regular, alarm). There are two values in a class to distinguish regular traffic from alarm triggering. In the latter case, the operator in the control room would be informed by the alarm of the number of incoming calls to the 112 system. The boundaries between the values within the class have been set to 1,700 incoming calls.

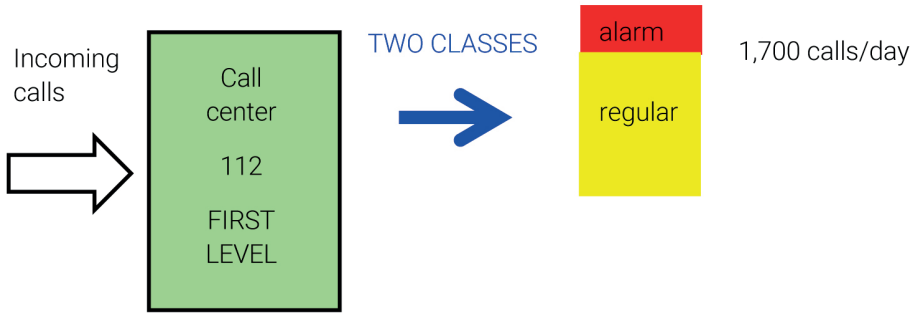


Figure 2. Alarm triggering

Figure 2 shows alarm triggering. In total, 1,041 (88% of all incoming calls) records are classified as a class regular, and 145 records (12% of incoming calls) are classified as an alarm class.

5. 3. Simulation results for unbalanced data

A simulation on unbalanced data was made. Table 3 presents evaluation results.

Table 3. Evaluation results of different model for unbalanced data

Data set	Accuracy (%)	F1	ROC	Appropriate-ness of use
2013-2016	87.27	0.862	0.659	+
Q1	91.97	0.904	0.594	-
Q2	82.78	0.822	0.695	+
Q3	86.59	0.859	0.691	+
Q4	89.86	0.883	0.626	+
2018	87.10	0.875	0.617	+
Q1	92.22	0.939	0.678	++
Q2	79.12	0.812	0.644	+
Q3	81.52	0.850	0.556	-
Q4	93.48	0.941	0.699	++

Results are presented for all the cases. At the right most column of the table the appropriateness of use is given; "-" means not suitable, "+" means appropriate use and "++" means very good use.

Figure 3 shows the results for different evaluation metrics for the entire first time period.

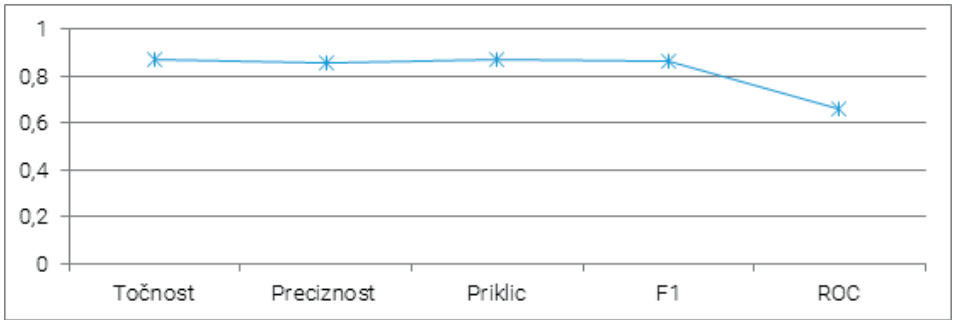
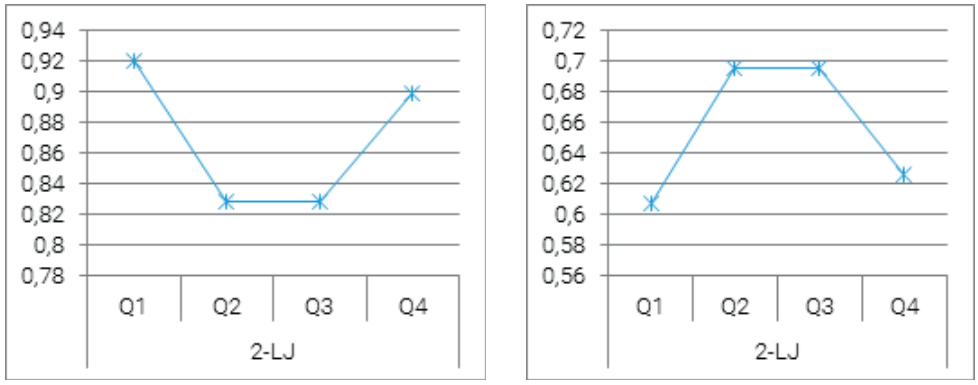


Figure 3. Evaluation metrics for Ljubljana and J48 for the entire first period

Figure 4 shows the evaluation results of J48 by quartiles for Ljubljana and two classes for the first time period.



(a) Accuracy (b) ROC

Figure 4. Evaluation of J48 by quartiles for Ljubljana and two classes for the first time period

In the case of unbalanced data, it seems that J48 is good method for the first time period and for the second one. In some cases, the results are even better. However, in some cases, the method could not be used since it is not suitable.

5. 4. Simulation results for balanced data

A simulation on balanced data was made, and Table 4 present the evaluation results for all the cases. At the right most column of the table, the appropriateness of use is given; "-" means not suitable, "+" means appropriate use and "++" means very good use.

Table 4. Evaluation results of different model for balanced data

Data set	Accuracy (%)	F1	ROC	Appropriate-ness of use
2013-2016	84.87	0.849	0.876	+
Q1	92.69	0.927	0.936	++
Q2	88.72	0.887	0.912	+
Q3	88.60	0.886	0.897	+
Q4	86.31	0.863	0.886	+
2018	73.15	0.796	0.626	+
Q1	85.56	0.891	0.337	-
Q2	70.33	0.750	0.706	+
Q3	77.17	0.824	0.737	+
Q4	83.70	0.879	0.706	+

Figure 5 shows accuracy in case of J48 for Ljubljana and two classes for balanced data. The data show the accuracy for the whole period, as well as for each quarter (Q).

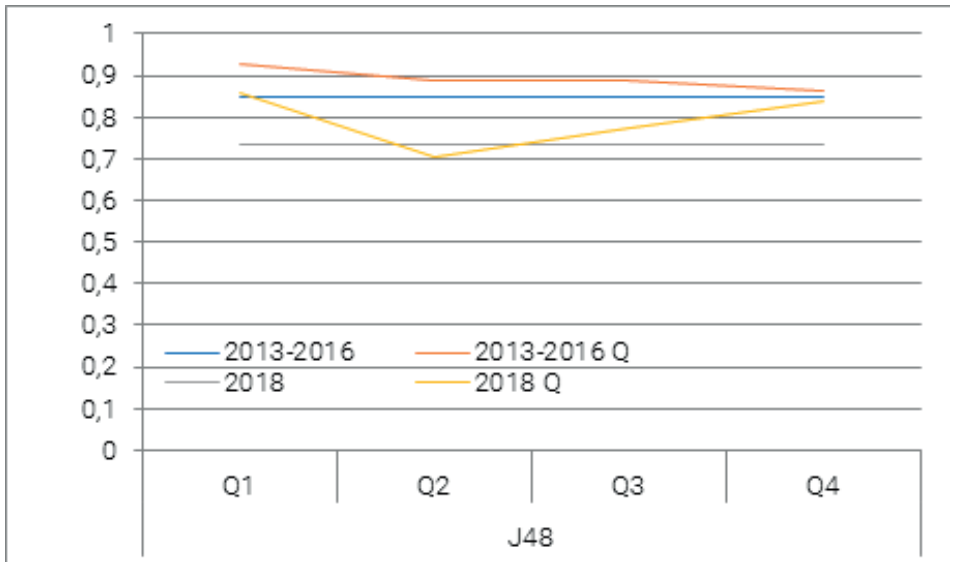


Figure 5. Accuracy in case of J48 for Ljubljana and two classes for balanced data

6. Discussion

A method of decision trees, in which at each node the algorithm selects the "best" attribute for dividing the data into individual classes, is good for cases of missing data and for data of different types. It is resistant to the inclusion of irrelevant variables and performs internal variable selection.

In case of the model made on quarterly data, the results are in some cases better as for the whole time period data. Also, as shown in Table 5, where a comparison of evaluation results for balanced and unbalanced data for the entire time period is done, it is very clear that ROC has better results in the case of balanced data.

Table 5. Comparison of evaluation results for unbalanced and balanced data for entire time period

	Data set	**Accuracy (%)**	**F1**	**ROC**	**Appropriateness of use**
Unbalanced	2013-2016	87.27	0.862	0.659	+
Balanced	2013-2016	84.87	0.849	0.876	+
Unbalanced	2018	87.10	0.875	0.617	+
Balanced	2018	73.15	0.796	0.626	+

The results show that it is possible to predict in advance the size class of the number of incoming calls using the model. This means that the given proposal makes it possible to predict the number of incoming emergency calls 112 in Slovenia that cause an alarm.

7. Conclusion

An evaluation of the prediction of the number of incoming calls of the emergency call system 112 was made using open data of the Internet of Things. The data used were attributes for days, weather, river flows, and traffic accident attributes. They were chosen because the greatest damage in recent years in Slovenia has been caused by natural events related to the weather, such as floods, droughts, and ice.

The results show that it is possible to forecast in advance the alarm class of the number of incoming calls using the model. The proposal shows that it is possible to apply the principles of machine learning in the context of artificial intelligence to real systems and examples in the field of public safety, and consequently also to broader systems, such as systems for smart and safe cities. The proposal makes it possible to improve the situational awareness of the staff in the control rooms, which helps them prepare a big picture of what is happening. This means that the given proposal makes it possible to predict the number of incoming emergency calls 112 in Ljubljana.

Information about the future number of calls introduces intelligence into such a system, which aids in the planning of the staff, the call center itself, and back-end systems. This helps when an alarm condition is expected. If there is information on how many calls are expected, it is possible to organize even better in the event of an expected increase in the number of calls. In such a case, the staff can answer all incoming calls and thus help to solve problems faster.

Although disaster control is the subject of many articles and research, and increasingly in the field of smart and safe cities, the issue of predicting the number of incoming 112 calls has been addressed to a limited extent. Such promising results and proposals are a step forward in the direction of forecasting incoming calls, which makes it possible to improve the awareness of the situation in the control rooms, including both the dynamics of the calls themselves and the fact that various services prepare in advance for natural disasters or exceptional occurrences.

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Review paper

SMART CITY – MAKING DIGITAL TRANSFORMATION

Abstract

Smart cities are committed to sustainable and integrated urban development. Digital transformation offers cities and municipalities opportunities to move towards sustainability and promotes resource-friendly, needs-based solutions for meeting the key challenges of urban development. The main subject of the research refers to the presentation of digital technologies in the context of the bearer of digital transformation towards smart cities. Main goal of study was to research and present the importance of digital technology and digital transformation in smart city domain. The findings of literature review emphasise that digital transformation requires cities and municipalities to be open to new technologies, and to be aware of their broader values and goals in order to be able to apply those technologies with a long-term and considered view. Results of literature review stand out that core value lies in empowering people to make informed decisions in both the private and public domains and incorporates the smartness of citizens instead of referring merely to the deployment of smart technologies. Also it is important to emphasize the four guidelines ensuring that digital transformation is understood as the transition of cities into smart cities: digital transformation requires goals, strategies and structures; digital transformation requires transparency, participation and co-creation; digital transformation requires infrastructures, data and services; digital transformation requires resources, skills and cooperations.

***Key words**: Smart City, Digital Transformation, Urban Development, Sustainability.*

1. Introduction

Since the late 1980s, the digital revolution has transformed the economy and society. First came the development of a connected economy, characterized by mass take-up of the Internet and the roll-out of broadband

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networks. This was followed by the development of a digital economy via the increasing use of digital platforms as business models for the supply of goods and services. Now the movement is towards a digitalized economy whose production and consumption models are based on the incorporation of digital technologies in all economic, social and environmental dimensions (ECLAC, 2021).

The adoption and integration of advanced digital technologies (fifth-generation (5G) mobile networks, the Internet of things (IoT), cloud computing, artificial intelligence, big data analysis, robotics, etc.) means that we are moving from a hyperconnected world to one of digitalized economies and societies. It is a world in which the traditional economy, with its organizational, productive and governance systems, overlaps or merges with the digital economy, with its innovative features and dimensions in terms of business models, production, business organization and governance. This results in a new, digitally interwoven system in which models from both spheres interact, giving rise to more complex ecosystems that are currently undergoing organizational, institutional and regulatory transformation (ECLAC, 2018).

These dimensions of digital development are constantly evolving, in a synergistic process that affects activities at the level of society, the production apparatus and the State (see Figure 1.). This makes the digital transformation process highly dynamic and complex, and thus challenging for public policies insofar as it requires constant adaptation and a systemic approach to national development. Within this framework, 5G networks will make the convergence of telecommunications and information technologies viable, changing the structure and dynamics of the sector, while the adoption of digital technologies and artificial intelligence (as general purpose technologies) marks a new stage, that of the digitalized economy (ECLAC, 2021).

OECD (2019) points out that digitalisation is one of several megatrends, including globalisation, demographic change and climate change that are reshaping policies from the ground up. For two decades, digital innovation has been at the heart of discourse around “smart cities” to build more efficient and liveable urban environments. In a first instance the concept of “smart cities” was largely supply-side and sector-driven, with the private sector taking the leading role in defining both the problem and the solution for digital innovation to generate new economic opportunities, improve service delivery and facilitate citizen engagement. While digital innovation remains central to the smart city concept, a key policy question for local and national decision-makers is how to make the most for citizens’ well-being of the costly investment in smart technologies, applications and digital innovations.

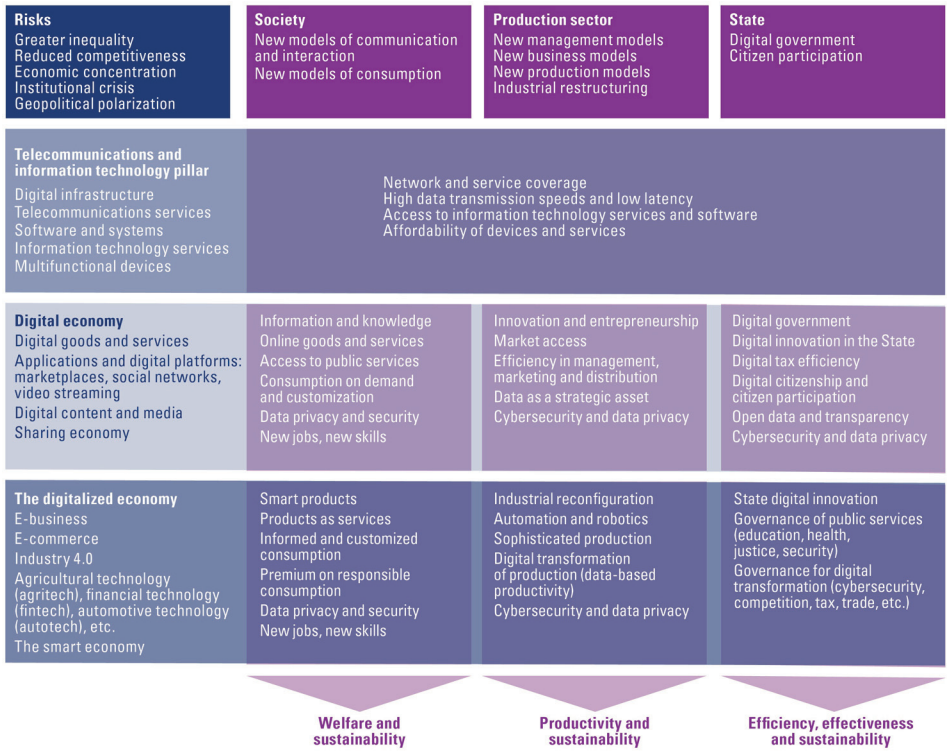

Figure 1. Dimensions of digital development and the effects on society, the production sector and the State
Source: ECLAC (2021)

European Parliament (2014) has defined smart cities as "a place where the traditional networks and services are made more efficient with the use of digital and telecommunication technologies, for the benefits of its inhabitants and businesses". The focuses of smart cities development are improvements in citizens' life (Neirotti et al., 2014), environment efficiency, security and sustainability (Niaros et al., 2017) with centrally controlled and monitored technological infrastructures. Giffinger et al. (2007) have defined smart governance, smart people, smart environment, smart economy, smart mobility and smart living as six major dimensions of a smart city. The smart cities would incorporate the ICTs (Kramers et al., 2014) and Internet of Things (IoT) (Elmaghraby and Losavio, 2014) embedded into most of the sector of urban development such as government functionality, city operations, services deliveries, and intelligent analytics to optimize the services, production and usability (Kumar et al., 2018). OECD (2019) emphasises that smart city concept is evolving and is still subject to debates. OECD also points out that there is a range of definition for "smart cities" across OECD countries and institutions. In most cases, smart cities have been defined as initiatives or approaches that use digital innova-

tion (including digital-enabled innovation) to improve competitiveness in a community and efficiency of urban services.

OECD (2019) also point out that the concept of smart cities has changed significantly since the original (and narrow) usage combining ICT, digital usages and citizen participation and navigating a complex system of governance involving local administrations, public agencies, firms, citizens and communities. While digital innovation remains central to the smart city concept, a key question is whether investment in smart technologies and digital innovations ultimately contribute to improve the well-being of citizens. This is why the OECD defines smart cities as "initiatives or approaches that effectively leverage digitalisation to boost citizen well-being and deliver more efficient, sustainable and inclusive urban services and environments as part of a collaborative, multi-stakeholder process" (OECD, 2018a). This definition stresses (OECD, 2019):

- the need to document better the contribution of smart cities' to improving the life of people while continuing to deliver solutions to some of the most common urban challenges in a sectoral or multi-sectoral fashion;
- the importance of citizen engagement and collaborative partnerships to boost civic engagement (citizen participation and feedback; co-creation and co-production models; citizen-centred services and engagement platforms);
- the value of experimentation with public access to open data and collaboration within/between cities; private-public-people; national-regional-local scale; and
- the need for integrated, holistic approach to addressing urban challenges through digital innovation in a city's governance, planning, and infrastructure investment.

Yigitcanlar et al. (2021) stated that over 55% of the world's 7.7 billion human population is housed in urban areas, where this figure is expected to increase to over 70% by the end of the century (Sotto et al., 2019). The urban growth and city population are growing in a fast pace causing different issues to the environment, economic and social sustainability of cities (Bibri and Krogstie, 2017). Many countries today have already exceeded this projected global urbanisation level—e.g., Australia with 86% (Zhang, 2016). These rapid population and urbanisation trends are not only accelerating global natural resource and environmental depletion, along with food, water and energy insecurity, but they are also worsening socioeconomic inequity, and making our cities almost ungovernable (Yigitcanlar, Butler, et al., 2020). The traffic congestion, poor urban infrastructure, health issues, energy shortages, educational challenges (Lee et al., 2013), inadequate housing, increasing crime rates, higher unemployment, ageing infrastructure, power thefts, issues in supply connections, insufficient power generations capacity, high power loss in transmission, frequent power breakdowns and lack of real time data sharing are some of common concerns in existing cities

mostly in developing countries like India, as the Bosnia and Herzegovina as well (Kumar et al., 2018). Kumar et al. (2018) also points out that the restrictions on critical infrastructures and resource availability constraints create challenges for the healthy food, energy and clean water supply for increasing population. The cities are under strains on public finances to reduce budgets along with cost cutting measures, paradigm shifts towards online services, concerns about climate changes, economic restructuring with reducing the unemployment. Therefore, smarter ways are needed to manage the urban challenges and to revamp urban life, efficient infrastructures and quality services to its citizens.

Yigitcanlar et al. (2021) point out that with the increasing popularity of this city brand, city administrations across the globe have started to consider or develop various strategies and initiatives for a smart city transformation (Fernandez-Anez et al., 2018). Nonetheless, besides a limited number of best practices, many cities have either failed or experienced a financial roadblock due to the heavy technocentric view of this city brand (Yigitcanlar, Hoon, et al., 2019). Subsequently, it was comprehended that digital data and technology are not the only key ingredients of the making of smart cities (Araral, 2020). In fact, increased technological reliance could bring new policy challenges related to data management, privacy, security (Vandercruysse et al., 2020), and accessibility to digital technology and infrastructure (Yigitcanlar, Desouza, et al., 2020). These could further complicate city governance where economic, social and environment challenges related to health care, employment, financial and resource management, air and water quality, social equity, housing, and mobility (Butler et al., 2020) persist.

2. Smart cities in the city century

This chapter represents a look at how technology enablers and AI will benefit how we live, including smart cities, tailored markets for one, industry, and cyber security.

2. 1. Urbanization is on the rise and question of money

Wang (2016) points out that worldwide demographic and technological trends are driving the need for cities to rethink how they use ICT, existing infrastructure, and core resources like government workers, citizens, and community and business groups. Many cities in both developed and developing countries face financial challenges that are exacerbated by current financial uncertainty and global austerity. In many countries, the aging workforce is felt more heavily in government, where a higher percentage of workers are nearing retirement age. City leaders must do more with less and look at problems in new and innovative ways to achieve change and digital transformation, both of which are necessary. They can then move

seamlessly into the stage Augmented Innovation and the era of smart cities and digital economies can truly begin.

2. 2. A question of technology

Wang (2016) points out that as the next cycle of e-government innovation, the key objectives of smart cities are to improve economic development, sustainability, innovation, and citizen engagement. Progress requires building an ecosystem of partners to improve the quality of life for residents. Smart city projects, including citizen engagement, depend on the major technology enablers of Augmented Innovation: broadband, data centers, big data analytics, cloud, and the Internet of Things (IoT). Other crucial technologies in the smart city mix are AI and cognitive systems, robotics, 3D printing, next-gen security, augmented and virtual reality, and social networks. AI, in particular, will form the cornerstone of smart cities, a fact that telcos are waking up to. Transforming smart cities is a complex system and many parameters must be taken into account in the decision-making process. The economic development of the city, the level of ICT infrastructure, the population of the city and its geographical features may be the determining parameters.

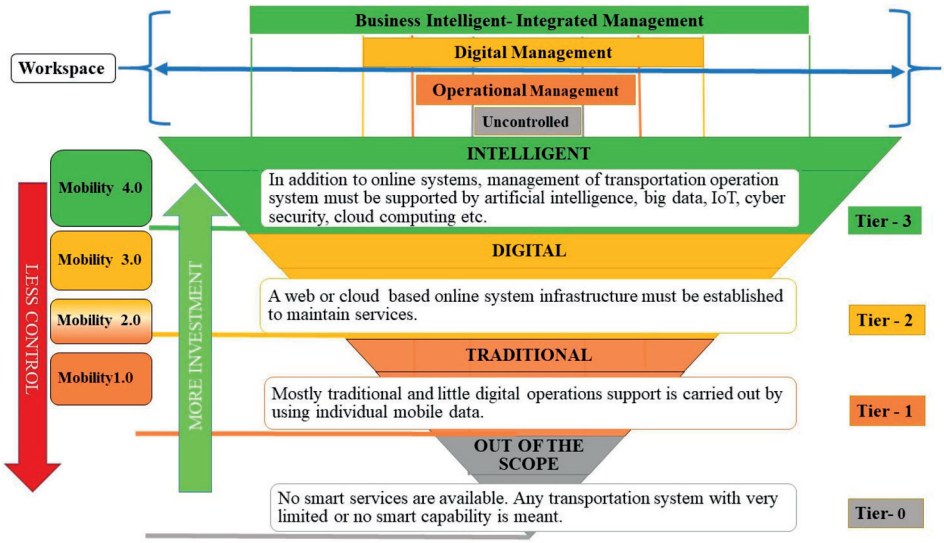

Figure 2. Component of the Mobility 4.0. reference model
Source: Inac & Oztemel (2022)

The reference model is designed as a 4-tier model, including "out of scope", "traditional", "digital" and "intelligent". Each tier indicates the level of smartness. Traditional systems are transforming themselves to digital ones, and digital services are transforming to autonomous systems, which are capable of self-decision making and performing operations with no or little hu-

man intervention. If the respective operations and services are running with no or little digital support, it considers that services run on a "traditional" level (Mobility 1). If the respective transformation services are conducted with fully or highly significantly digital processes, then, the system level is upgraded to "digital" level (Mobility 2 and Mobility 3) and last but not least, enriching the services with intelligent capabilities transform themselves to "intelligent" level (Mobility 4) (Inac & Oztemel, 2022).

Currently, smart city data collected from sensors is done so vertically and, according to Deutsche Telekom board member Claudia Nemat, is confined to a "landlocked lake." She believes that, "The content of such data 'oceans' will be so massive, and the relevant analysis so complex, that only artificial intelligence will be able to carry out the relevant data processing and forwarding with the necessary accuracy and speed." Technological progress will underpin the shift from second platform technologies to third platform technologies. Second platform tech focuses on cost cutting, sustainability, outsourcing, citizen engagement, and performance and risk management. Third platform tech centers on economic development; sustainability, resilience, and climate preparedness; partnerships and ecosystems; civic tech; open data, transparency, and accountability; and innovation management (Wang, 2016).

2. 3. Roadblocks to smart cities

All cities focus on driving economic development, foreign investment, and job creation. But, challenges exist in various areas (Wang, 2016):

- **Technology infrastructure**: includes fragmented, aging, outdated, or undeveloped infrastructures; information and process siloes; and bureaucratic and cultural issues.
- **Data use**: involves a lack of data interoperability standards within and across domains and a lack of policies or guidelines defining how to securely exploit the value of data in a multi-stakeholder environment.
- **City infrastructure**: includes traffic, crime, and poor waste and energy resource management.
- **Development path**: refers to the complex goal of achieving growth in a way that keeps pace with technology and the changing expectations of citizens and businesses.
- **Threats**: includes factors like financial, organizational, civil unrest, cyber security, and public safety.

Most cities don't look for a single silver bullet, and instead aim for shared goals and close partnerships between stakeholders, which tend to include government organizations, tech and domain suppliers, manufacturers, planners and developers, academia, NGOs, energy providers, users, and community groups.

2. 4. Citizen engagement

Large-scale transformation requires experimentation, collaboration, and new ideas that iteratively build upon successes and failures over time. One way is to engage citizen groups, business leaders, and IT vendors in IT organizations, city administration, and innovation. People have high expectations. They want 24/7 access to services through any channel — in person, by mobile device, or computer. They want these services with some level of personalization, or at least preference recognition, and consistent interaction. This influences mobile strategies in how cities interact with citizens, how services can be delivered, and how ICT works to support government departments and citizens. A strong digital infrastructure must exist alongside ways to engage citizens and business communities in designing the services they want to use. A key feature of the Augmented Innovation stage is that people will have the ICT tools to do this (Wang, 2016).

Cities can use open data and transparency initiatives to drive more private, citizen, or crowdsourced mobile apps for government services than cities, and this is a trend we expect to see.

By making high-value data and content openly available through web application programming interfaces (APIs) and websites, cities make it easier for departments to share key data internally and with other agencies. Additionally, developers can build applications around city data, which the public can find, use, and visualize on user-friendly charts, graphs, and maps. The key steps for using open data strategically are choosing data sets to open up based on their impact and usability; providing a platform on which developers can build; balancing improved access to local government information against security and privacy issues based on the types of APIs used; and promoting the use of data via hackathons, ideas, challenges, and other means (Wang, 2016).

2. 5. Looking ahead to Augmented Innovation

Innovation, experimentation, and knowledge creation are no longer primarily in the hands of universities and research organizations. As people are enabled by more complete data sets alongside the technology and computing power to use them, innovators will emerge from business and community groups, individuals, government agencies, philanthropic organizations, and other nonprofits and private companies that serve government clients. The challenge is how to promote and harness the ideas from those inside and outside of government. Innovating to improve services for citizens and operate more efficiently is invariably the foundation of smart city projects and is often accompanied by an expectation of lower costs (Wang, 2016).

Figure 3. Smart cities become smart nations
Source: Wang (2016)

However, there are other benefits that innovation inspires: one, harnessing the collective wisdom of citizens and, two, attracting and retaining younger government workers. Innovation requires the ability to experiment and collaborate, which means policy makers must be willing to try new things and take risks, potentially expose themselves to failure, and use an iterative process built upon successes and failures over time. Notably, more mayors and CIOs with vision are getting the attention of constituents, other cities, and the media via high-profile projects with vendors, heavy involvement in the smart cities movement, and personal interaction with citizens via social media. As other key players watch their success, more are becoming open to using emerging technologies and fostering new relationships with citizens and stakeholders (Wang, 2016). Based on all the above, it can be said that smart cities contribute to the creation of smart nations.

The literature lists a large number of reasons why smart cities are interesting for citizens, businesses and all other actors. Some of these reasons are listed in the following figure.

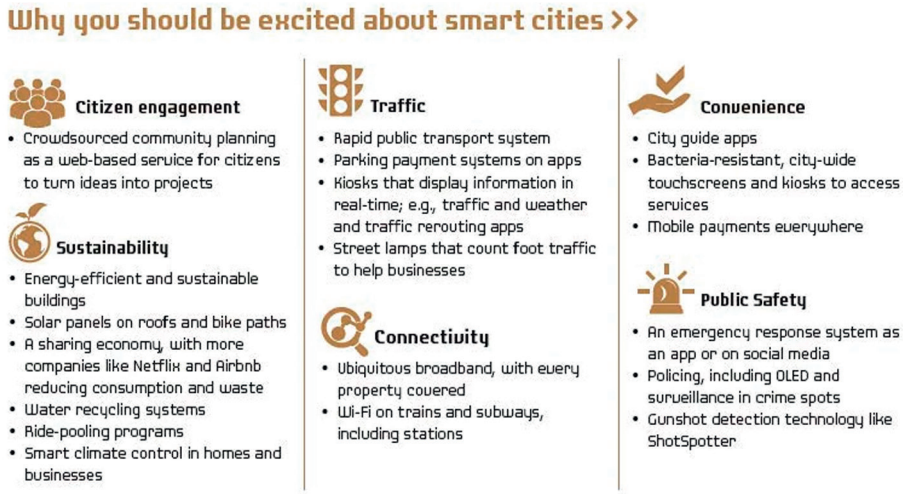

Figure 4. Why you should be excited about smart cities
Source: Wang (2016)

3. The technological transformation of urban planning in the age of 'smart cities'

Karvonen et al. (2020) point out that urban planning practices have always been closely intertwined with technological development. From the rise of nineteenth century infrastructure networks to the introduction of automobiles, streetlights, spatial analysis tools, personal computers, and the World Wide Web, planners have been tasked with mediating and aligning society and technology to produce contemporary cities (Rutherford, 2020). Today's smart city agendas embody the latest iteration of sociotechnical innovation with the promise of using information and communication technologies (ICT) to improve the economic and environmental performance of cities while hopefully providing a better quality of life for residents. The rise of smart cities has catalysed numerous debates around the heightened role of technology firms in the management of collective urban services (Coletta, et al, 2019), the importance of global competition in attracting businesses and residents (Hollands, 2015), and the dangers of privatising infrastructure networks (Marvin et al., 2015). At the same time, the influence of urban planners has been surprisingly muted, despite the fact that smart city agendas are "challenging longstanding principles and practices of planning" (Späth & Knieling, 2020, p. 3). Indeed, the smart city competes with (and sometimes overshadows) sustainable urban development agendas (Parks & Rohracher, 2019; Yigitcanlar et al., 2019a) and tends to promote universal standards that reinforce a "reductionist mode of urban planning and development" (Joss et al., 2017, p. 31). Cowley and Caprotti (2019) go so far as to characterise the smart city as a form of 'anti-planning' that is rapidly replacing the normative foundations of the profession with notions of efficiency, standardisation, and corporate control. These critiques raise

significant questions about how planners and incumbent planning practices are currently contributing to smart cities and more importantly, how they should contribute in the coming years. In short, what is the role of urban planning in the twenty-first century smart city? (Karvonen et al., 2020).

Parlikad et al. (2022) stated that the term "smart city", though poorly defined in academic terms, epitomizes a wide range of policy initiatives and corporate projects around the world that aim to utilize the power of data and digital tools for city planning, management, and operation. The transition to smart cities is driven by several factors and challenges, including increasing urbanization, growing stress on resources, inadequate infrastructure, rising environmental challenges, and rapidly improving technology capabilities. Given the wide diffusion of smart city initiatives across the globe, the variety of local contexts and purposes of these initiatives has made it hard to identify shared definitions and common interests at a global scale. To facilitate the policy discussion, Parlikad et al. (2022) proposes the following three key dimensions for disentangling the nexus of smart city initiatives (Figure 5).

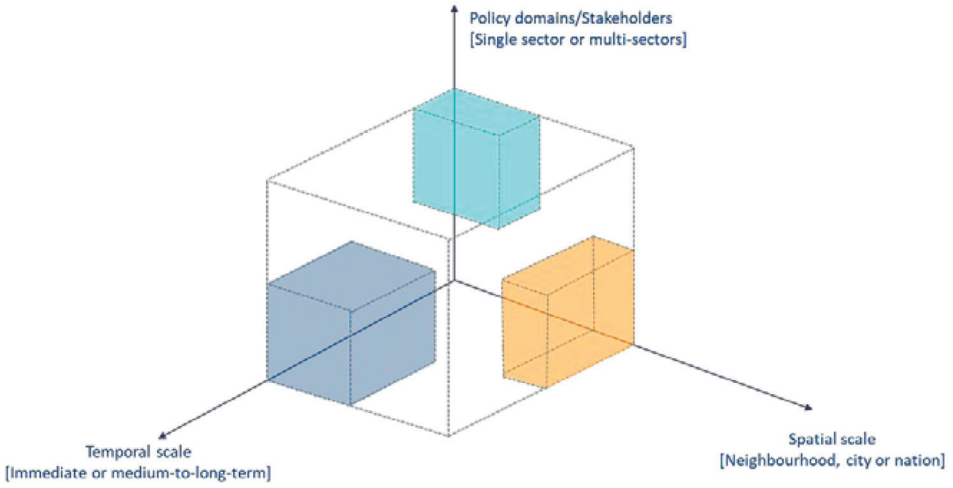

Figure 5. Key Dimensions of Smart City Initiatives
Source: Parlikad et al. (2022)

Parlikad et al. (2022) explains that the first dimension is the policy domain and main stakeholders that the smart city initiative targets. Some initiatives may focus on a single sector (e.g. energy-saving for office buildings), while others may be crosscutting and involve a wide range of stakeholders. The second dimension is the temporal scale related to either the initiative itself or the expected impacts. This dimension raises a critical question about mediating the relatively short political cycles and the continuity and durability that some smart city initiatives require in order to achieve the expected outcomes. The third dimension is the spatial scale, including both context

and location and institutional and administrative scale in which the smart city initiative takes place. A common approach of implementing smart city initiatives is the creation of demonstrators or pilots, which tend to focus on a small geographic or sectoral domain. The majority of small-scale smart city pilots aim to address the main concerns about the political, financial, and technical risks, particularly when the application of an emerging technology is the main component of investment.

However, the scalability of such pilots (in terms of upscaling the initiative to a longer time span, other sectors, and/or larger spatial scale) has proven to be more complicated than previously anticipated. One reason for this is that "despite the continuous rhetoric around the smart city agenda seeking to solve city challenges, many demonstrators have ended up as technology demonstrations". In fact, although desired policy outcomes are expressed in most cases in order to justify investment, very few demonstrators present technology as part of a comprehensive solution package to address specific city challenges. It can be emphasized that Figure 5 summarizes the main policy domains of existing smart city initiatives. It is shown that existing smart city initiatives cover a wide spectrum of policy domains, ranging from interventions aimed at short- term (real-time) dynamics in cities (e.g. transport monitoring and control) to initiatives serving medium-to-long-term social outcomes (e.g. improving the mobility of the disabled, increasing productivity through labour-augmenting/saving technologies). Studies of existing smart city initiatives also reveal that the majority of initiatives involve the application of new technologies and data to improve the provision and operation of urban infrastructure and services. Given the wide spectrum of policy domains, a critical question arises regarding the dilemma of addressing multiple policy outcomes (Parlikad et al., 2022).

As illustrated at the Figure 6, the smart city agenda covers a wide range of policy domains. A relevant question has been raised by Hollands in his early critical review of smart cities: Can cities give the same priority to all aspects of the smart city agenda, or do some elements automatically take precedence over others? (Hollands, 2008). As all cities differ in their history, and economic and political make-up, prioritization of the smart city agenda needs to engage with the specific political and socioeconomic context of the city. Given the diversity of city functions and systems, digital transformation is unlikely to take place simultaneously over all policy domains. While some urban systems and policy domains may see immediate efficiency and productivity gains from digitalization (thus potentially taking up the digital agenda relatively quickly), some sectors tend to be more inertia-prone. However, the inherent inertia of these city functions does not necessarily indicate local protectionism or conservativism; and understanding the underlying causes of the inertia requires empirical investigation. The results of this investigation must inform the prioritization of the smart city agenda (Parlikad et al., 2022).

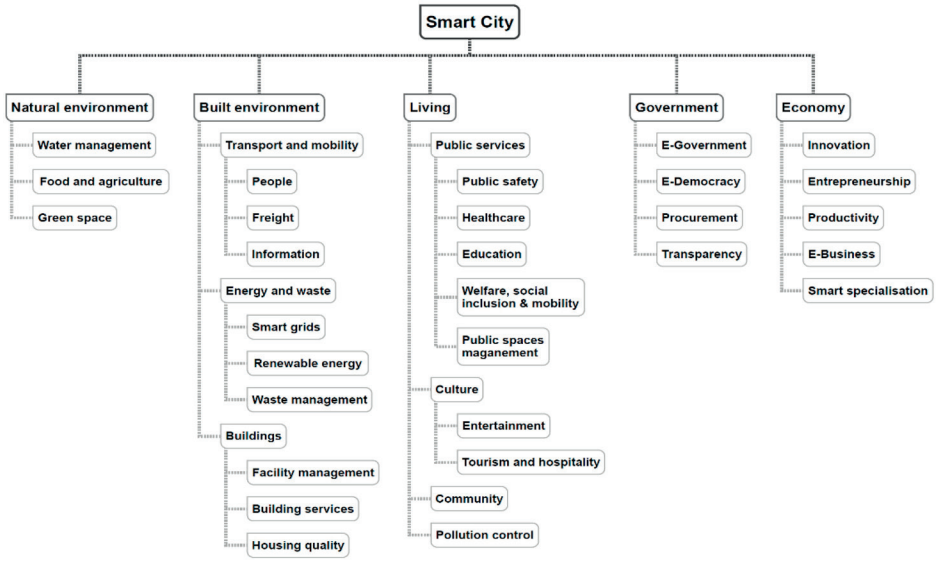

Figure 6. Main Policy Domains of Existing Smart City Initiatives
Source: Parlikad et al. (2022)

In conclusion, smart city development and implementation are progressive in nature, consisting of a combination of radical and incremental changes. Their core value lies in empowering people to make informed decisions in both the private and public domains and incorporates the smartness of citizens instead of referring merely to the deployment of smart technologies. A shift in focus has been witnessed in smart city practice – from demonstrating technical functionality to a more citizen-centric solution design targeting specific urban challenges and policy goals.

4. Technology for smart cities: the pillars of urban planning of the future

Ramos (2021) points out that one of the most defining features of a smart city is its capacity to assimilate new technologies. However, what do we understand by technology for smart cities? No, it is not a list of devices "that make urban life easier". Self-driving cars, Big Data, robots, self-supply, remote public services… reveal the degree of urban intelligence on the surface. However, their integration is based on a more complex equation. To resolve it, it is important to note that these smart city solutions are closely interrelated and generate effects at many levels. Precisely, the value of the technological revolution we are living is that the introduction of technology brings with it consequences at other levels. Therefore, many experts use the organic description and imagine a smart city as a living entity.

4. 1. Which technologies are used by smart cities?

Knowledge and information are great powers. The key principle of empiricism in philosophy is transferred to our era in the development of Big Data. Now, the power not only consists of knowing, but in the mass management of that knowledge and its uses. That is why Big Data is understood to be the new oil. The use of vast masses of data is key for public administrations and private corporations in terms, for example, of processing millions of files or controlling flows of transport. Big Data should be aimed at strengthening the democratic values, security or social inclusion of cities. The luck of an oracle or "psychohistory" that aspires to solve current problems or before future ones make an appearance (Ramos, 2021).

a) Artificial intelligence

Artificial intelligence (AI) has proven useful in decision-making in various fields, including smart cities, medical tests and diagnostics, organizations, the public and private sector, and medicine. AI informs the decision-making process in the same manner that various computer technologies serve as the foundation of planning support systems. In terms of smart city planning, few tools have been produced to demonstrate how AI may advance the state of the art. As cities are becoming smart and digitized globally by installing sensors, computer cores, and other communication networks [48], as pushed by the modern notion of "Smart", this is becoming increasingly possible [1]. These digital ideas are linked to AI and machine learning technologies, which enable collecting near real-time data, allowing for a better knowledge of how cities change, adapt, and respond to diverse environments (Bokhari & Myeong, 2022).

b) Internet of things (IoT) in cities

IoT is one of the most palpable and organic advances of a smart city. The integration of sensors and objects on the cloud have opened up a world of possibilities in all urban departments, from controlling energy flows, traffic or any incident in real time. Gartner has reported that the investment in IoT will be crucial to build smart cities, services as data using will generate most of the revenues. Safety and security of smart homes will be the second largest market in terms of service revenues. As for services related to health and well-being, they should represent a market of $ 38 billion in 2020 (Hammi et al., 2017; Ramos, 2021).

c) Connectivity

If we talk about connectivity, we cannot ignore, in terms of infrastructure, another technological pillar of cities: smart communication networks. Today this is strongly related to the implementation of 5G, but it is not the only area in which telecommunications work. 5G will contribute to the improvement of IoT by allowing the interconnection of up to 20 billion devices. It will also help in terms of energy sustainability (Ramos, 2021).

d) Toward a model of sustainability

The reduction of energy bills by exploring new forms of producing and managing existing models is essential in order to talk of the future (or of life on the Earth's crust). This is another structural factor that is integrated in the genetics of technologies for smart cities. We can find it in the exploitation of renewable energies or in waste management. In this war against pollution, we may still have a few battles to lose (Ramos, 2021).

e) Smart lighting and transport network in a smart city

Smart Lighting comprises an heterogeneous and multidisciplinary area within illumination management, with the possibility of integrating a wide set of sensor and control technologies, together with information and communication technologies, with the aim of achieving a higher efficiency and a lower negative impact derived from the use of energy for illumination, in combination with enhanced intelligent functionalities and interfaces of lighting in the ambient, commercial and public domain. Regarding to cities, street lights are one of the most important assets to maintain and control, providing safe roads, inviting public areas, and enhancing security in homes, businesses, and city centers. However, this concrete asset is very costly to operate, with a share of about 40% of the total amount of electricity spent in a city (Castro et al., 2013).

Transport will be one of the areas that will see the most developments. Electrification and self-driving vehicles are directing the automotive industry today. The former entails the improvement of batteries; the latter, the enormous challenge of applying artificial intelligence to mobility. However, they are not the only trends. There are new forms of urban communication on the horizon, in which cars do not play such an important role and which sees the emergence of a new meaning of public mobility.

5. Local leadership for democratic digital transformation

Smart cities need to be governed, and there are new challenges when public management is set in digital contexts (European Commission, 2017) that are open to the interdisciplinary research field (Yildiz, 2013). As governments engage in rapid digitalization of their organizations and services, competence gaps and cost-effectiveness demands have led to the outsourcing of digital infrastructure development and maintenance to third party suppliers. This has, as OECD points out, generated lock-in effects and decreased the organizations' internal capability for policy and service delivery (Welby, 2019). These consequences have direct implications for coherence between the political strategy, policy aims, and the municipal services.

A recent literature review identified that public values are addressed in digital government to improve public services, public administration and the legitimacy of public services among the general public (Twizeyimana

& Andersson, 2019). The orchestration of public services on digital platforms can enable public administration to deliver services in line with public values (Cordella & Paletti, 2019). The review also concluded that there is a lack of studies with a comparative focus and that there has been little focus on organizational change, and on how to deliver services in line with public values (Twizeyimana & Andersson, 2019). Thus, we will here focus on how political leaders see values in relation to digital transformation towards smart cities.

Public leadership, in contrast to leadership in market-driven organizations, has to build on public values and deliver results and outcomes such as democratic legitimacy and trustworthy public services (Bergström & Eklund, 2019). To sustain citizens? High trust in local democracy and welfare provision in the digital age, there is a need to analyse and build new types of leadership for change. The public leadership of digital transformation is currently influenced by market-driven organizations (Dunleavy et al., 2006). There is a need for analyses of leadership styles that combine the individual perspective of the public leader with perspectives on the situations within which he acts (Alvesson et al., 2017). Leadership in the local digital transformation towards smart cities is expressed in strategic decisions, as well as in many daily practices that can range from information security policies to daily struggles with learning platforms in schools. In all such situations, the leaders have to reassemble and act in line with core public values (Gustafsson, 2017).

At a recent Cities Today Institute event in Philadelphia, US digitalisation leaders discussed their efforts to retain new-found agility without creating expectations that they can't fulfil. During the height of the pandemic city digitalisation leaders rapidly adapted the smart city plans they were gradually rolling out to saving lives, keeping essential services running and preventing businesses going to the wall. This saw them turn their tools and teams to facilitating COVID-19 testing, vaccinations and emergency disbursements, and launching new services in weeks and days rather than months and years. According to some, the crisis accelerated ten years of transformation and proved the value of digital technologies and data to solve real problems. It also imbued a new-found confidence in local government's ability to innovate despite bureaucracy and limited resources. As the pandemic evolves and cities look to the longer-term view, they are left asking themselves what their roles and responsibilities look like now, and whether they can truly maintain what they've started. Although they are taking steps to make sure their spending and innovation projects have longevity, some cities are still concerned about living up to new expectations. This is compounded by the influx of American Rescue Plan Act (ARPA) and other federal funds, which cities are working hard to make sure deliver benefits that are financially and practically sustainable (Wray, 2022).

One issue is that during the pandemic, a lot of residents started shopping online for the first time. Now they expect the same level of service and speed from their city as they get from companies like Amazon, and could

be left disappointed. Another is the wide range of responsibilities that cities have assumed during the pandemic. Many cities used funds from the Coronavirus Aid, Relief, and Economic Security Act (CARES) and now ARPA to support small businesses with grants, expedited processes, and marketing programmes. These funds are not recurring, though, so for maximum long-term impact, more effort is needed to build long-term resilience. Cities discovered that some small businesses have limited digital skills – for example, they don't have a website or use social media. Cash-only companies struggled to access support during the pandemic without the right paperwork. The City of South Bend, IN, launched a 'digital storefront' grant programme to help local businesses develop or enhance their online presence and capabilities. The city is also focusing on user experience to prevent small businesses being "overwhelmed" by too many resources. This includes rationalising processes between departments and merging as many applications as possible, said Denise Riedl, Chief Innovation Officer at the City of South Bend. Also, the pandemic has highlighted the power of data to help cities solve challenges, from understanding COVID hotspots and recovery trends to getting support to those who need it most. But some cities still struggle to persuade certain departments to share their data, and others are concerned about the ability to sustain data efforts when priorities shift (Wray, 2022).

6. Conslusion

This paper employed a systematic review on digital transformation in smart cities. This paper contributes to the research on digital transformation within smart cities in oreder to support actors in co-creating individual, organisation value, and societal well-being from business strategies and IT initiatives. Smart cities have become a very popular approach to solving complex urban problems like environmental sustainability, economic recovery and social cohesion. Urban planning should go beyond digital transformation and beyond GDP and effectiveness to well-being, happiness and quality of life. Focusing on smart-people and smart-environment could bring quick and sustainable gains on efficiency. The analysis presented earlier highlights that smart cities represent a model of governance based on collaboration between local stakeholders, citizen participation, experimental innovation and a holistic approach to the development of local policies. In order to foster an integrated vision of the process of innovation and to facilitate collaboration with partners, public actors created different governmental structures, internal or external to the administration, and adopted various policy tools.

The findings from this study presents the importance of digital transformation in smart city domain. Findings reviewed that smart city governance would potentially support the digital transformation of traditional public administration into NPG (New Public Governance). As societies and businesses become intensively digital, so it needs to be the city and its

institutions. Findings also reveal that regarding a lag in proper institutional digital advancement, a diversified approach to every singular city development smart dimension may be avail if identifying measures of digitisation, digitalisation and digital transformation pursuant to needs, readiness, and goals of the community.

Smart city initiatives visualise the culture and the ambitious of the society for a better life. Its understanding of the shared success is so much valid as it is its lack of understanding for the shared failure. It is as simple as to decide what city we want and to unit around clear and straight messages and objectives, then to fix the short and long run priorities and to execute properly the plan established. So, the core value of smart city lies in empowering people to make informed decisions in both the private and public domains and incorporates the smartness of citizens instead of referring merely to the deployment of smart technologies.

This study, as well as previous research, imposes a large number of open questions. The first and most important issue relates to the fact that there is no single definition of a smart city or digital transformation. Accordingly, it is necessary to work on harmonizing attitudes and views in terms of creating a generally accepted definition of a smart city. Another open question relates to digital infrastructure and political and constitutional arrangements in the states. this is an important question considering that it constitutes the most significant factors in a successful digital transformation. therefore, the question is whether the different constitutional and political arrangements of the countries affect the success of the implementation of digital transformation? Also, another open question that remains relates to the influence of the executive power and citizens on the implementation and acceptance of all the changes that digital transformation brings?

The limitation of the study is based on the fact that only secondary data from the literature were employed. Further studies could be conducted by using real mobility data to validate the applicability of digital technologies for digital transformation in smart cities. Also, current research opens the doors for further research to deepen notably the analysis in every dimension of any smart city current state and prospective development.

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Review paper

LEVEL OF DIGITAL TRANSFORMATION IN BOSNIA AND HERZEGOVINA

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

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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 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 readi-

ness (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
DEI/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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Mustafa Bešić, MA. Soc. Sci. Inf.[1] *Professional paper*

DIGITAL TRANSFORMATION OF THE JUDICIAL SYSTEM IN BOSNIA AND HERZEGOVINA

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

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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 encounter 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.

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.

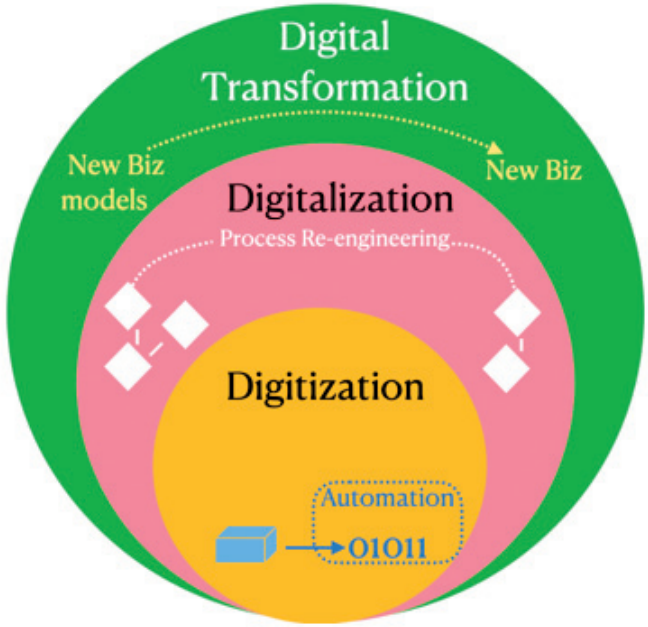

Figure 1. Digization process
Source: Saracco (2022)

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.

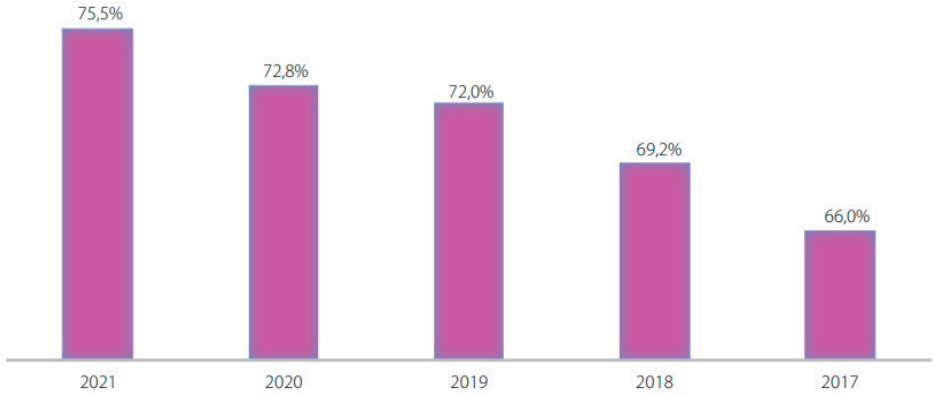

Figure 2. Percentage of households with internet connection
Source: Agency for Statistics of Bosnia and Herzegovina (2021)

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.

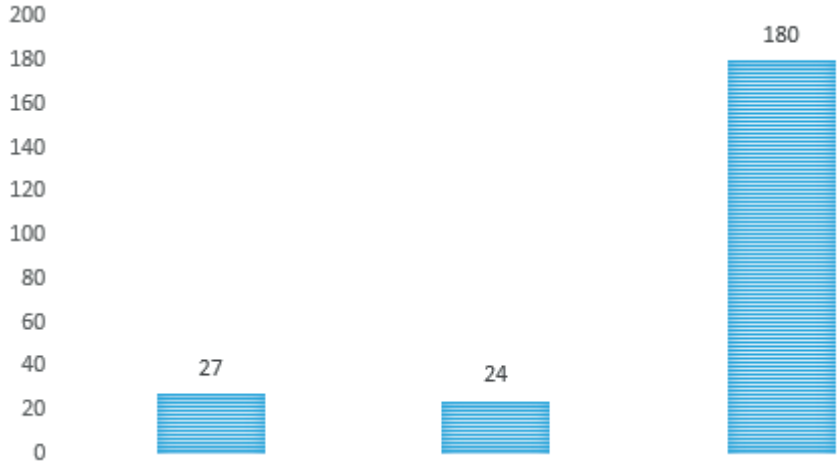

Figure 4. Graphic presentation of the results of Department I of the Prosecutor's Office of BiH

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. 2. 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. 3. 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. 4. 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. 5. 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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Preliminary communication

THE IMPACT OF DIGITIZATION OF ACCOUNTING ON THE ACTIVITIES OF ENTERPRISES IN BOSNIA AND HERZEGOVINA

Abstract

Every day is a challenge that requires a lot of knowledge and time for the purpose of achieving planned sales, finding the best suppliers, achieving set business goals. Accounting is an integral part of any business, and it is important for the successful operation of any business. Accounting has changed and continues to change and expand from the moment it emerged. Accounting has undergone a special transformation with the information technology. Digitalization as one of the most important phenomena of the 21st century has affected all parts of society and business. Accounting software has become an integral part of the business of every enterprise, and without it would be almost unthinkable to track the company's business going from procurement, production to product sales. Business processes that involve accounting tasks should be designed, optimized and simplified for the purpose of ensuring time savings. Precisely due to the fact that time is money, and in order to save time, business is increasingly being transferred to digital form. The advantages and disadvantages of digital accounting were best seen during the COVID-19 pandemic. The purpose of this paper is reflected in demonstration of the impact of digitalization of accounting on the company's activities. The subject of research is to prove the positive and negative effects of digitalization of accounting on company's activities. Empirical studies will prove what kind of impact the use of digital accounting has on the company's business, and task set for accountants and management in the future.

Key words: *Accounting, Digitalization, Information Technology, Business.*

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1. Introduction

Information technology have progressive, intensive progress and development due to the enhanced technological progress. Every company strives to save time and money, and the goal is to get as much income as possible at minimal cost. It is precisely because of saving time and money that company have begun to introduce computerization into their business.

Computerization was introduced primarily in order to facilitate simpler and faster data input, data exchange, storage and processing of information. Using computerization, the final data is achieved faster and more efficiently, thanks to a better understanding and supervision of the business, and in this regard, it is much easier for management to make decisions, since business information is much more accessible. The biggest advantage is that the software can speed up certain processes, and certain data and information are available to end users faster than it was before, when there was no computerization of the business. Today, in Bosnia and Herzegovina, companies, in accordance with their needs, use computerization in business in various measures. Namely, as the company grows, the number of employees' increases, the number of branches increases, incomes or production increases, and all this leads to the purpose to introduce new software that will contribute to business development in a reporting form.

When we go back twenty years ago, the business we have today looks like a sci-fi movie. Namely, starting the production of a new product, which requires the purchase of raw materials from a new supplier, meant going to certain fairs, frequent visits to the supplier, until the deal was finally agreed. Today, this is being agreed within a few hours. Namely, in Internet search engines, we can quickly find suppliers of the desired raw materials, immediately contact them and look directly at the video link to the production of this raw material, and then receive proforma invoices, contracts and other documentation by mail. Work that previously could take months is now completed within one working day. If, for example, a loan from a bank is required for the purpose of purchasing this raw material, this previously meant visiting a bank with numerous papers that accountants manually prepared for days for the bank. Today, we receive analytical cards of customers, suppliers, balance sheets or other additional documentation based on accounting programs within a few minutes, send them to the bank and receive feedback on whether the bank can provide a loan. If the bank approves the loan, in the past the money was used to buy the raw material by going to the bank and filling out a payment order at the bank, while today with the help of electronic banking the money transfer is completed without going to the bank, and in a few minutes. In this simple example, which is every day in business, it is easy to see the savings in time and, consequently, money with the introduction of digitalization in business.

2. Theoretical basis of the research

2. 1. Digitalization of the business

There has been a significant simplification of the daily activities of the company with the development of information technology. Information technologies have contributed, first of all, to saving time, money, energy, as well as other important resources. The process of digitalizing of the business took a long time, and every day it undergoes new transformations. Digitalization of the business involves the creation of a digital version of paper documents, images, which are later used for further processing and analysis. Digital transformation implies the transformation of a business based on digital technologies. Digital transformation starts from changing the work of the company, the earlier business model, and with the use of different information technologies (Majdandžić, 2004). Digital transformation implies a change in the work of the company, which implies a high level of use of digital technologies (Javorović & Bilandžić, 2007). There are various definitions of business digitalization, the most commonly used are:

- Digital transformation is characterized as a fusion of advanced technologies and the integration of physical and digital systems, and predominantly affects the change of business departments, defining new processes and creating Smart products and services (European Commission, 2019).
- Digitalization is the transformation of analog data and processes into machine-readable, so that they become suitable for automatic processing (OECD, 2018).
- Digital transformation is the process by which companies intersect their business processes with new digital technologies, use omnipresent machine connectivity to achieve higher productivity of equipment and processes, gain a market or comparative advantage, change the size of businesses, services and operations, as well as business models, and increase productivity throughout the chain creating and delivering value to the end user (Ismail, Khater and Zaki, 2017).
- Digital transformation is the application of technologies to create new business models, processes, programs and systems that lead to increased revenue, comparative advantage and new business models (Schwenter, 2017).
- Digital transformation is the use of technology in a radically new way to radically increase productivity or achieve a new operating model of the company, where digital technologies provide more efficient processes, a higher level of talent attraction and new business models (Deloitte, 2018).
- Digital transformation requires that the organization better manage overall change, especially when changes are made to the core competencies and business processes, and that companies focus their customers and / or users, which implies agility at all levels (Bloomberg, 2018).

The introduction of business digitalization simplified the use of many business systems and there has been a change in the way employees work, and significant time savings have been noticed in jobs that were previously performed. The usual course of business has changed with the introduction of digitalization of the business.

Digitalization of the business contributes to the fact that it is possible to track business activities better and more successfully, that data can be constantly collected, processed, analyzed, that historical, achieved and future target values of data can be compared (Kasich, 2017). Easier and faster data availability also allows you to react faster to certain business events and make certain decisions more correctly.

In everyday work, digitalization most often refers to one new and simpler approach to processing, sharing, analyzing and presenting data. The digitalization process allows better, faster and more efficient exchange of information and business data, which is of great importance for better business management. Business digitalization is an ongoing process that requires constant innovation, investment, and monitoring of needs, and in this regard, the needs of companies are adjusted.

Digitalization of the business implies, first of all, optimization based on digitalization of the existing business process, and innovations that imply continuous improvement of these processes.

2. 2. Digitalization of accounting

Today, it is almost impossible to imagine accounting that does not use information technology. Accounting uses various software, but primarily for data entry and archiving, as well as software for digitizing financial documentation, and this is the starting point for digital transformation. In order to achieve a complete digital transformation, it is necessary to change the previous approach that was applied in the business of the company.

Digitalization of the business entails digitalization of accounting business. Erasing of boundaries between markets, the sale and purchase of products from all over the world, brought a new approach to business, and digitalization and digital transformation of enterprises became necessary.

Information technology has long been a key carrier of accounting information. Accounting software is being improved and developed every day. The advantages of business digitalization are increasingly being used and applied in order to develop the business and in an effort to make the business even better, to make the business more competitive in the market in accounting, digital transformation has brought extremely big changes. Those changes do not only refer to software changes but they are necessary in the work, or in the way of posting, but there has been a so-called online-real-time mode of operation that results in increased business efficiency.

Accounting work primarily involves constant monitoring and accounting of business events. The work of accountants has been significantly improved and facilitated with the digitalization of accounting. The search for accounting information use to take a long time, because every piece of information required also finding of documents in binders, which were often placed in remote locations. Today, data is available in a matter of seconds thanks to the developed software solutions. In addition to the fact that data is available quickly, a particular advantage is that this data can be accessed at any time and no matter where you are anywhere in the world. The advantage of digitalization was especially noticeable during the pandemic caused by the COVID-19 virus, when work was carried out smooth from home as well.

Cloud accounting is increasingly being used, which actually provides access to any information, at any time and from any place.

Digitalization of accounting in Bosnia and Herzegovina has not yet been applied as in developed countries, because most accountants are still using, in addition to the software, paper documentation with the appropriate signature and seal. One of the biggest breakthroughs in the digital transformation of accounting has been made by banks with the introduction of electronic banking.

3. Methodological basis of the research

3. 1. Subject, purpose and hypotheses of the research

Empirical studies were aimed at proving the impact of digitalization of accounting about the company's activities.

The research also wanted to point out the positive and negative sides of the digitalization of accounting, and why digitalization of accounting is still not applied in Bosnia and Herzegovina as in developed countries. Target group of the research were people employed in the accounting sectors of the company. In this context, a survey was conducted on the impact of digitalization of accounting on the company's activities among 32 employees of the accounting sector, who duly completed questionnaires.

The time in which you have to constantly adapt to market needs requires a lot of knowledge and time on the one hand, and on the other hand, if you want to stay competitive in the market it is necessary to have information on time to achieve planned business goals. The development of science and technology has greatly facilitated doing business, and erased the boundaries between the markets of different countries. It has now become common practice to make deals and enter into contracts with customers and suppliers around the world. Information technology has changed business and changed the old ways of negotiating and doing business thanks to the speed of transmission and exchange of information and documents. Trips to remote countries of the world are no longer required to conclude a deal. Communication is carried out through video calls, document ex-

change by e-mail, which significantly affects both cost reduction and significant time savings as one of the most significant business resources.

Digitalization of the business, in addition to the numerous advantages also certain problems but without it would be difficult to remain competitive in the market today. First of all, we are talking about business security. There are more and more problems with the loss of certain data due to insufficient protection, and due to frequent cyber-attacks.

There is a certain fear in this regard, and digitalization of accounting is not accepted in Bosnia and Herzegovina as it is accepted all over the world. Accountants, in addition to recording data electronically are using various software, still widely use paper documentation.

The paper sets the task to research the effects of digitalization of business, both positive and negative, as well as the reason why there is still resistance of accountants towards the digitalization of business.

In accordance with all the above, the paper sets out the main and two auxiliary scientific research hypotheses:

H_1: *Digitalization of accounting has a significant impact on the enterprise activities.*

PH_1: *The misuse of data as a result of cyber-attack creates resistance to the application of digitalization of accounting, which affects the activities of the company.*

PH_2: *Digitalization of accounting helps save time and increase business efficiency.*

3. 2. Techniques and methods of research

The conducted research is based on the collection of primary data, a method of surveys through a highly structured questionnaire intended for employees in the accounting sector, who are also the most competent to provide answers to the research topic. 32 duly completed questionnaires were filled out of the total number of questionnaires sent to 48 e-mail addresses, which makes the response rate of 66.66% of the total sample in the monthly survey, from May to June 2022.

The response rate is considered acceptable for this type of research given the short period of time in which the research was conducted. The results of the study would probably have been different if the initial sample number had been determined in a larger number. In this regard, the results of this study are not the rule, but they certainly provide a good guide for future research on the impact of digitalization of accounting on the business of the enterprise.

In the empirical part of the research, the methods were used for the purpose of forming and presenting results on the subject and the answers to the set goal and set hypotheses of this scientific research.

On the basis of analysis of the obtained results, an insight into the effects of digitalization of accounting on business in theoretical and practical terms is given, as well as an insight into the attitudes of the accounting profession on the effects of digitalization of accounting on company's activities.

4. Research results

In addition to the extremely great advantages brought by the digitalization of business it is important to mention that the digitalization of accounting can be abused. In the absence of sufficient data protection or irresponsible work of individuals, the company may face data loss.

This research of the impact of digitalization of accounting on business aimed to find out how accountants see the effects of digitalization, and why the digitalization of accounting is still not applied to the extent that it is applied in the world.

The research determined application of digitalization of accounting in the practice of companies in Bosnia and Herzegovina, as well as the impact of its application on the activities of companies.

On the basis of 32 duly completed questionnaires, we came to a new way of using digitalization of accounting in practice.

In the research, accountants have made an exceptional contribution to a better understanding of the topic under consideration.

Of the 32 respondents to the survey, 13 accounting managers gave answers to questions, while the remaining 19 respondents declared themselves as referents engaged in accounting.

All respondents agreed with the statement that digitization of accounting is present and applied in accounting practice. Thanks to this issue, there was a room for further study of the positive and negative effects of digitization of computer technology in practice.

The purpose of the study was to find out what impact the digitalization of accounting has on the activities of companies in Bosnia and Herzegovina.

In accordance with the previously mentioned, it was logical to conduct a research of positive and negative effects of digitalization of accounting that has on business.

In this regard, the following questions of the questionnaire focused on the negative side of the application of digitalization of accounting in order to verify, confirm or deny some theoretical interpretations and conduct a research.

When asked what are the negative effects of digitalization of accounting, the majority of respondents stated that it is data security (79%), a slightly smaller percentage of respondents said that it is a problem with learning and replacing the old way of working with computers or new programs (9%), a smaller number of respondents (5%) believe that these are additional operating costs, while a certain number of respondents (7%) do not know what would be the negative effects of digitalization.

From the previous question, a new question also arose concerning the security of accounting data. In particular, out of the total number of respondents, 37% stated that they were victims of a cyber-attack, and 63% stated that they were not victims of a cyber-attack. From this question, a new question arose concerning those who were victims of the cyber-attack, and concerned of the loss of data. In particular, of the respondents who were victims of the cyber-attack, 18% of respondents stated that they experienced partial data loss, while 82% of respondents stated that no data loss occurred.

The second part of the questionnaire focused on the positive impact of digitalization of accounting on the business. When asked about the general application of digital accounting in practice, respondents said that the application of digitalization of accounting facilitates business, and 92% of respondents said they fully agree, while 8% of respondents said they are not sure whether digitalization of accounting makes business easier.

Of the total number of respondents, the largest number (84%) fully agreed that the digitalization of accounting contributes to saving time, 6% of respondents believe that the digitalization of accounting does not contribute to saving time, while 10% of respondents said they do not know whether digitalization of accounting contributes to saving time.

When asked that the digitalization of accounting contributes to the reduction of operating costs, the largest number of 56% agreed with the above, 43% of respondents did not agree with the above, and 1% of respondents do not know whether it contributes to reducing operating costs.

In the following question, out of the total number of respondents, the largest number of them, or 93%, fully agreed that the digitalization of accounting speeds up the exchange of information, 4% of respondents do not think that the digitalization of accounting speeds up the exchange of information, and 3% said that they do not know whether they would get a faster exchange of information with the digitalization of accounting.

Of the total number of respondents, the largest number, 56%, fully agreed that the digitalization of accounting makes it easier for managers to make decisions, 38% of respondents believe that digitalization of accounting does not make it easier for managers to make decisions, and 6% said they do not know whether digitalization make it easier for managers to make decisions.

4. 1. Confirmation of hypotheses

The use of multiple regression analysis in the study confirmed the assumption of a link between cyber-crime and the general use of digital accounting in the company's activities.

Table 1. Statistical overview of the connection between the general application of digital accounting and data misuse as a consequence of cyber-crime on business operations

Model	R	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin Watson
1	,636	,401	,60102	,454	19.101	*1*	*26*	,000	1.801

Source: Author's research

The correlation coefficient R (0.636) reveals a medium-strong correlation between the observed variables, data misuse as a result of digitalization of accounting and business operations. F (19,101) indicates that the results are statistically significant, and based on this, it is concluded that data abuse as a result of cyber-crime is a consequence of digitalization of accounting and is related to the activities of the company. The obtained data confirm hypothesis PH_1, which assumes that there is a statistically significant connection between data misuse due to cyber-crime and digital accounting and that this leaves room for impact on company's business.

Table 2. Statistical overview of the connection between the general application of digital accounting and time savings to increase the efficiency of the company's business.

Model	R	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin Watson
1	,685	,453	,60208	,473	22.422	1	26	,000	1.686

Source: Author's research

The correlation coefficient R (0.685) reveals a medium-strong correlation between the observed variables, saving time as a result of digitalization of accounting and increasing the efficiency of company's business. F (22,422) indicates that the results are statistically significant, and based on this, it

is concluded that time savings as a result of digitization of accounting affect the efficiency of the company. The data obtained confirm the PH_2 hypothesis, which suggests that there is a statistically significant connection between digital accounting and time savings, and that this increases the efficiency of the company.

Taking auxiliary hypotheses, the main hypothesis H_1, with which it was assumed that there is a significant connection between the digitalization of accounting and the company's business is accepted as true.

5. Conclusion

Information technologies are an integral part of modern business today. The introduction of information technology into business has greatly facilitated business, and the introduction of digitalization of accounting has had a special effect. Information technologies contributed to the change in the basic mode of work of accountants, contributed to the fact that accountants compiled timely and accurate reports, and thus influenced the fact that accountants receive a new advisory role in the company due to time savings, since there is much more time left to analyze data. The results of the conducted research indicate that the digitization of accounting has a significant impact on the company's operations. However, despite the fact that information technologies and digitalization of accounting facilitate the work of accountants, in certain segments they also pose a problem for accountants in the form of increased responsibility and necessary competencies. Namely, tracking new trends in the development of information technology requires both certain adjustments and training of accountants. In addition, a special problem today is the frequent cyber-attacks, which are extremely difficult to deal with. This is one of the main reasons why digital accounting is not used in our country, as in the world. The protection that needs to be done requires certain investments, such as antivirus programs, new individual servers, etc., which represents additional costs for businesses that companies often do not want to accept. On the other hand, cloud accounting makes accountants suspect that, perhaps, someone will be able to abuse data and they have more trust in storing data on their servers, and printing documentation and storing it in their archives. However, despite the fact that accountants still have some resistance, digitalization of accounting is a process that needs to be controlled, and without the use of which it would be unthinkable to conduct business in the future. It is concluded and indicated that there are positive and negative effects of digitization of business. Due to the short period of the research, the research sample is also small in this regard, so the recommendation for future research is to conduct research that would include a larger number of respondents, which would surely provide more detailed information about the effects of digitization on business.

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Assoc. prof. Ljiljana Zekanović-Korona[1] *Preliminary communication*

USE OF DIGITAL TECHNOLOGIES FOR EDUCATION PURPOSES IN REPUBLIC OF CROATIA - ANALYSIS

Abstract

In the last decade, digital technologies are omnipresent in daily life, work and education. Internet and information technologies are changing the way we do business, communicate and educate ourselves. Pandemic of 2020 made digital technologies even more used and accelerated processes of digitalization and digital transformation. Education system is inevitable part of digital transformation process. Digital technologies in education should be used properly and efficiently. IT experts from Croatia are extremely esteemed world wide. Many innovative programming solutions of how to implement digital technologies in education are being currently developed in Croatia. Some of these solutions are being financed by Digital Europe Programme. In this paper we have analysed the state of digital transition in education, available information systems, digital resources and services in education in Croatia. For the purpose of this paper, there was a primary online poll on. The targeted population were random pupils, students and professors, all of which are part of Croatian education system. The poll was made by online questionnaire distributed via e-mail and social media. The goal of this questionnaire was to find out users' attitude towards already existing digital resources and services in education. The purpose of this research is to collect data about efficiency and way of use of already existing digital resources. Results of this research will show digital technologies advantages and disadvantages for use in education purposes. Results generated by poll were analysed by various statistic tools.

Key words: *Digital Technologies, Digital Transformation, Information Systems, Education.*

1. Introduction

Over the past century, the technology development experienced a tremendous acceleration affecting our planet, people and existing societies. The rapid technology development has its positive and negative sides,

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and our understanding of technology is divided. People are involved in all the technological changes, innovations and systems that shape the way people act, live and think. Humanity cannot be placed out of technology and technological systems, and without technology, humanity is inconceivable.

Our technologies take part in the biggest challenges we are currently facing: an out-of-control economic system that increases poverty and continues to expand the gap between the rich and the poor, the breakdown of political and social consensus across the planet, resulting in the rise of nationalism, social divisions, ethnic conflicts and wars in the shadow, as well as climate changes that are essentially becoming an existential threat. (Bridle, 2019:12)

The use of new technologies in science, education, society, trade and in general in all segments of life, in addition to increasing human capabilities, shapes and governs human skills. We should consider the use of new technologies in various ways, including from a critical point of view, all with the aim of using new technologies in the most purposeful way possible. It is necessary to understand the functioning of complex technologies as connecting and interaction of technological systems. Technologies need to be understood, and this does not necessarily mean that everyone needs to learn programming. Technological systems should be understood without learning how to develop them.

Educational institutions and universities are centers of research and innovation and, through cooperation with the economy, encourage the use of new technologies. The publication *Promoting Higher Education Values: A Guide for Discussion* (Scholars at risk, 2017) provides a good definition of higher education: "The higher education is the engine of knowledge production, discovery and innovation, skill development, cultural preservation and national progress. But, in order to be healthy, the higher education community must be based on fundamental values - equal approach, accountability, academic freedom, institutional autonomy and social responsibility. When these values are respected and nurtured, higher education communities not only contribute necessary skills and services to society, but also maximize the ability of individuals to think independently and make informative creative contributions to their own lives, as well as to the lives of others." (Softić, Odak, Lasić Lazić, 2021:7,8)

At the beginning of 2020, the education system of the Republic of Croatia, like the entire world, faced the COVID-19 pandemic which changed our lives. Literally overnight, we changed the way we work, live and study, and digital transformation, which was part of the strategies of all higher education institutions, experienced tremendous acceleration. Everything foreseen in the five-year strategic plans had to be realized immediately.

By adopting the Strategy for Education, Science and Technology (Ministry of Science and Education, 2014) in Croatia, the goal of improving and expanding the use of ICT in education was also adopted. The strategy rec-

ognized e-learning as one of the most important factors in improving the education process. The education system did not provide a plan for extraordinary circumstances, but now, looking back, we can say that in times of pandemic, the entire Croatian education system was organized very quickly and, without interrupting the teaching process, switched to models that did not require the physical presence of pupils/students and teachers in classrooms. Previous studies of distance learning models, the topics of PhD thesis, were applied in practice. The pandemic showed us the great importance of applying new technological solutions and e-learning in education. Within its Strategic framework - Education & Training 2020, the European Commission highlighted six new priorities and one of them was the use of tools for the development of digital competences and innovative pedagogies. The development of digital competences among pupils and students is necessary for the implementation of the digital transformation of society. The digital transformation, that in the circumstances of the COVID-19 pandemic had to be implemented instantly, is not only the request for the implementation of new technologies, but also the modernization and improvement of processes and people, as well as encouraging the development of adequate knowledge and skills. At the time of immediate transition to online classes, there was no time for preparation and training, so individual components of higher education institutions managed as best they could to train teachers to use new technologies most often in the form of short and intensive trainings on the use of some kind of new technology for online learning. The teachers were frequently using multiple technologies since there was internet connection issues, so they managed in different ways, including improvising and combining several different technologies, all with the same purpose: mastering the curriculum. Teachers worked intensively on their training and broadening their horizons, which is one of the positive consequences of the pandemic. Now teachers have no problem with using new technologies, while before the pandemic they resisted using something new, especially the senior teachers. Methods that were used in e-learning during the pandemic and resulted as effective continued to be a matter of use even after the pandemic, under normal conditions. E-learning as the only model of teaching did not prove to be a good solution, but the use of combined, i.e., hybrid learning models is acceptable and useful for pupils and students.

The digital transformation of higher education institutions also includes the organizational structure of higher education institutions. The administration of higher education institutions, as well as administrative and professional services should follow up and ensure sufficient infrastructural capacities, technical equipment, as well as information and communication infrastructure, which are a prerequisite for good organization of higher education institutions and the successful implementation of educational programs. At European Universities, digital transformation starts with process innovation within the scope of scientific and teaching activity using ICT technologies, preceded by continuous education and training of teachers. The European Union encourages the digital transformation of

education with a number of documents such as the Digital Transformation Agenda, EU Strategy for Modernizing Higher Education 2020, EU Policy, Strategy and Legislation for 2030. As a member state, the Republic of Croatia provides its own documents to encourage digital transformation, namely: Guidelines for the Strategy of Education, Science and Technology (HAZU-MZOS, 2012), Strategy of Education, Science and Technology of the Republic of Croatia (2014), Smart Specialization Strategy of the Republic of Croatia for the period 2016 to 2020, National Development Strategy of the Republic of Croatia until 2030.

Digital transformation is implemented over a long period of time and, in addition to introducing digital technology into the business activity, its implementation requires the education of employees. Digital transformation also implies a change in all forms of business and processes within which the organization's employees interact with their users (Softić, Odak, Lasić Lazić, 2021:18). The results of research conducted by Educause (Brooks & MCCormack, 2020) indicate that only 13% of higher education institutions are in the process of digital transformation, 38% are considering it, and 32% of institutions are starting the process of digital transformation. The development path of starting the digital transformation process differs from institution to institution. For some higher education institutions, it is enough to hire a few experts, open digital communication channels and launch a website, while in other institutions, due to successful business organization, it is necessary to introduce much more complex technological processes.

Rapid changes occur all over the world, so companies, schools and universities need to follow these changes. People and employees are key to implementing changes, and the goal of the education system should be to train educated personnel who are able to follow up and implement changes imposed by the rapid development of new technologies. Digital transformation creates a connected learning environment. It is an ecosystem that combines technologies, services and security in order to bridge the digital gap in creating collaborative, interactive and personalized learning experiences (Softić, Odak, Lasić Lazić, 2021:20).

2. Use of digital technologies in the education system of the republic of Croatia

Figure 1 shows the Digital Economy and Society Index for 2021 in the European Union. It is clearly visible that Croatia ranks 19th out of a total of 27 EU member states according to the Digital Economy and Society Index (DESI) for 2021. A comparison with the DESI index of previous years shows the progress of Croatia, contributed by better results in some categories included in the DESI index. The use of fixed broadband Internet connection in the Republic of Croatia is slightly below the EU average, although Croatia is well covered by a high-speed broadband Internet (86% at the national

level and 39% in rural areas). Additional benefits for both individuals and companies will be provided by the allocation of harmonized 5G spectrum in August 2021. At the same time, there will be a further acceleration of digital transformation. Regarding the category of above-basic digital skills, it is positive that Croatia is above the EU average. At the same time, the share of citizens with at least basic digital skills is low compared to the EU average. The extremely successful e-school project is currently in the second phase of implementation, and the project includes all schools, i.e., a total of 1,320 schools.

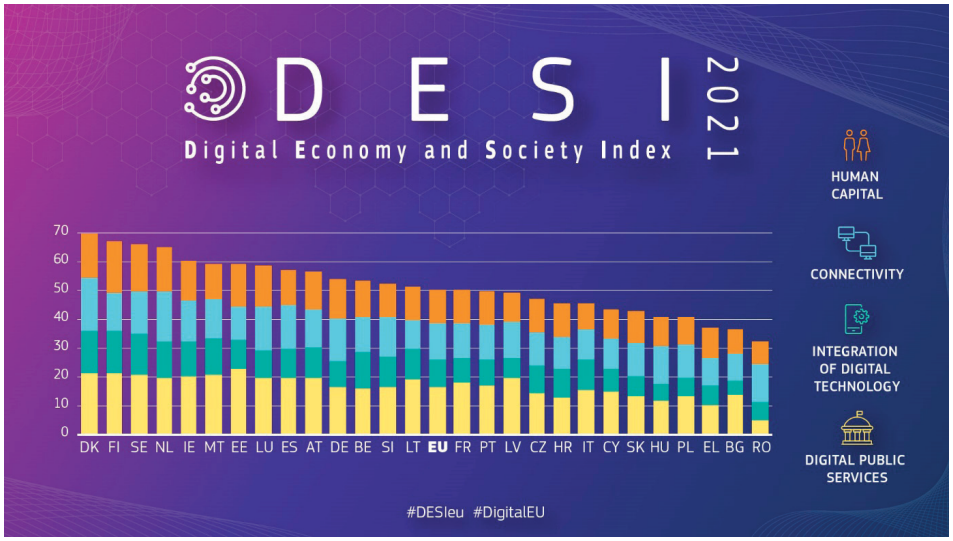

Figure 1. Digital Economy and Society Index (DESI) for 2021, Croatia, Source: https://www.carnet.hr/wp-content/uploads/2021/11/DESI_2021__Croatia__hr.pdf

The National Recovery and Resilience Plan, which includes research, science and education, should further encourage the digital transformation of higher education, the digitization of research activities, as well as the development of digital skills. Companies in the Republic of Croatia use the advantages of digital technologies to a great extent. Data show that the majority of companies in Croatia participate in active online trading, with 30% of small and medium-sized companies selling on the Internet, and 10% selling to other EU member states. This information is not surprising since Croatia has strong IT companies successful on a global scale. The Public Procurement Act, which made e-invoicing mandatory, affects the increase in the use of electronic invoices in Croatia (compared to 2018 and only 12 % of companies using them, in 2020, 43 % of companies use electronic invoices). Croatia strongly promotes digital technologies through applications for various programs coordinated by the EU. The National Plan for the Digital Transformation of the Economy for the period 2021 to 2027 and the Smart Specialization Strategy for the period 2021 to 2029 are being

drafted, as well as the National Plan for AI development. Green and digital transition is the fundamental developmental direction of the Croatian National Development Strategy for the period 2021 to 2030.

The implementation of the HR-ZOO project is underway with the aim to establish a computer and data cloud as a fundamental component of the national research and innovation e-infrastructure with the long-term purpose of providing the academic and research community with network connectivity and advanced computer and storage resources as a necessary prerequisite for future research and modern education and science. The project envisages the establishment of network headquarters in Zagreb, Rijeka, Split and Osijek. Easy access to the services of this project will be supported by e-scientists specialized in certain scientific branches. The basic infrastructure of SRCE (University Computing Center) consists of a computer and communication hall and data centers. To this infrastructure are added all systems necessary for operating the e-infrastructure of scientific and academic institutions. Trained professional staff and the aforementioned infrastructure constitute a unique resource in the science and education system. SRCE is hosting various systems of national importance, such as Isabella - the most important computer system for advanced calculations. In times of pandemic, SRCE ensured the maintenance and further development of key information, intermediary and data infrastructures. All these activities aim to expand the capacity of application and information systems that are being developed by SRCE for the needs of the scientific and educational community and institutions, as well as for the needs of society in general. Intermediary infrastructure of SRCE develops and maintains the Authentication and Authorization Infrastructure of the Science and Higher Education System (AAI@EduHr) and services for roaming access to the network - eduroam. By introducing a new monitoring system that monitors the operation of all system components, parent institutions can manage all AAI@EduHr data at their own institution, which contributes to reducing the exchange of documents in paper form and simplifies administration. SRCE is actively participating in the creation of a unique international virtual student card, which will also be available in the form of a mobile application.

Members of the academic and educational community most often use the SRCE data infrastructure in the maintenance and development of digital archives and data services. In education in general, it is important to collect, store and share data.

The study analyzes the use of digital technologies at universities. The technologies used are listed and defined below.

DABAR (Digital Academic Archives and Repositories) facilitates the establishment and maintenance of a large number of reliable and interoperable institutional and thematic digital repositories and archives. (available on https://www.srce.unizg.hr, Izvještaj o radu za 2021.godinu, accessed on 21.07.2022)

HRČAK is a web portal where more than 500 Croatian scientists and professional journals provide open access to their works.

POSTANI STUDENT is a web portal and part of the national information system for applying for admission to higher education institutions.

Administrativni e-repozitorij is a system for document storage within an individual higher education institution.

PUH is a system that enables users from the science and education system to temporarily store data on the SRCE storage system.

ISVU is the higher education institutions information system that monitors all teaching processes at higher education institutions, as well as the students' course of study.

MERLIN is an e-learning system used to hold online classes and communication with students, as well as in hybrid forms of teaching.

E-dnevnik is an application that enables students and parents to view grades, absences, obligations and schedule of written tests.

E-matica is a centralized system of the Ministry of Science and Education that enables the entry of data on students and teachers.

ZOOM is a software program that enables video communication used during the pandemic for remote teaching in real time, providing also the option of lecture recording.

MS TEAMS is a Microsoft program that enables video communication with the option of file storing used during the pandemic for distance learning.

WEBINAR is an e-learning technology available within Merlin which enables remote lectures and presentation sharing. It includes video, audio and text communication with participants.

3. Research methodology and analysis of research results

The research was conducted in June 2022, using an online questionnaire distributed via social networks and e-mail. The questionnaire consisted of 10 parent questions with the closed-end sub-questions. The survey was conducted on 154 respondents. Considering the method of questionnaire distribution, the sample obtained could be considered random but not necessarily representative of the area of the Republic of Croatia (since it did not cover respondents from all parts of the country). The results of the research were analyzed using various statistical methods; some of the more significant results were processed and visualized using MS Excel.

The structure of the respondents is as follows: 58.44% are students, 36.36% are university teachers and 6.4% are university administrative staff.

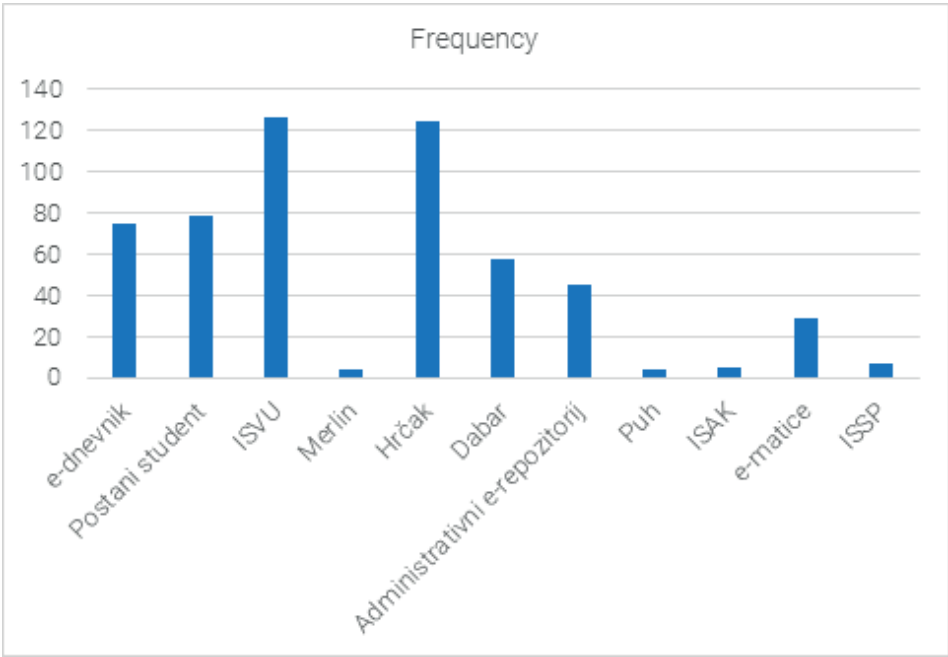

Figure 2. Frequency of use of digital technologies

Figure 2 shows the frequency of use of digital technologies at higher education institutions obtained by analyzing the results of the survey. The graphical representation shows that the most used system is the ISVU information system, used by both students and teachers and administrative staff in monitoring the students' course of study, which is expected, and the Hrčak web portal for the exchange of scientific papers, also used by students and teachers.

The average ratings of the use of the mentioned technologies are shown in table 1. The results show that the highest average rating received e-dnevnik, e-matica, web portal Postani student and the ISVU information system, as well as the Dabar digital archive and administrative repositories. It is visible from the table 1 that usually e-dnevnik was rated with the grade A, furthermore the grade B got portal Postani student and ISVU information system. The smallest deviation from the average rating has the portal Postani student which shows that the average rating is the best reflection of the movement of respondent's grades.

Respondents gave the highest ratings to the technologies and systems they use in their daily administrative activities at universities that speed up certain processes, which is understandable given the way of living and working during the pandemic. In times of pandemic, technologies have made living and working easier.

Table 1. Average ratings of the use of technologies

Technology	Average rating	Standard deviation	Mode
e-dnevnik	4,35	0,5025	5
Postani student	3,6	0,3207	4
ISVU	3,57	0,4309	4
Hrčak	3,44	0,4132	4
Dabar	3,49	0,4117	4
Administrativni e-repozitorij	3,41	0,48	4
Puh	3,11	0,3279	3
ISAK	3	0,2857	3
e-matice	3,46	0,4034	4
ISSP	3,55	0,2157	4
ISRHKO	2,83	0,1578	3

Table 2 shows the average ratings of the technologies used in the organization of distance learning during the pandemic. The software program ZOOM, which provided most capabilities and was the best substitute for presential classes, received the highest rating, but the usage had to be paid additionally, depending on the time of use and the number of users. Solutions available free of charge to all teachers, such as MS Teams, Merlin, Webinar and Merlin mobile, had some limitations that affected the lower average rating of respondents who were asked to give objective ratings.

ZOOM application is usually rated with the grade A, followed by the Merlin and MSTeams, given the grade B. The smallest deviation has the Merlin which is shown in the table 2, then followed by the ZOOM which means that the average ratings of ZOOM and Merlin applications best reflect the real movement of the applications' ratings.

Table 2. Average ratings of technologies used in distance learning

Technology	Average rating	Standard deviation	Mode
ZOOM	4,153	0,737	5
MS Teams	3,8	1,56	4
MERLIN	4,058	0,686	4

WEBINAR	3,325	1,18	3
MERLIN mobile	3,88	0,7456	3
Other	3,64	0,868	4

4. Conclusion

Digital technologies are an integral part of all parts of society and all spheres of life, especially education. Digital transformation is being implemented and will be implemented in the following years, and its implementation requires educated staff trained by the education system and universities. The education process is a leader in the use of new technologies, and such a trend should continue. The study showed that users want to use, accept well and are very satisfied with all forms of technology that speed up administrative procedures and promote transparency of the admission process, eliminating the human factor and intentional or unintentional errors. Technology, especially digital technology, should be used in a proper way. Respondents gave positive ratings and accepted the use of digital technologies in teaching, especially those that enable better interactivity in distance learning and imitate classroom teaching as faithfully as possible. The results of the research show that portal Postani student and ISVU information system are widely accepted and should be used in the future and improved as well. The Merlin system used for communication and e-learning is common among students as much as the ZOOM application and should still be used in hybrid forms of learning as well as in distance learning. During the pandemic, the Croatian education system, in contrast to the systems of the surrounding countries, quickly adapted and switched to distance learning. The University Computing Center SRCE is working on some good projects of the educational system digital transformation which should continue, and study shows that in addition to the application in the teaching process, work on storage, exchange and document sharing systems should also be continued.

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Ines Isaković[1] *Review paper*

DIAGNOSTIC INFORMATION SYSTEM IN HEALTH CARE INSTITUTIONS

Abstract

The purpose of writing this scientific paper is to point out the necessity of introducing dedicated information systems due to the changes in the character of business processes and to enable a faster way of working within health care institutions. This paper aims to point out the advantages of diagnostic information systems. The development of information systems in health care led to the integration of different modules into a single IT unit that would join all the functions of the hospital information system. Consequently, we have different types of laboratories in health institutions, and some of them are biochemical, haematological, microbiological, histopathological, and genetic research laboratories, as well as modules in radiology and family medicine, and for these reasons, we adopt information systems to their needs. The function of all laboratories is to analyse samples and, based on the analysis, provide information on the characteristics of those samples. Today, we have a large number of samples that we need to analyse, and for these reasons, information systems are being introduced because it is impossible to work with so much data without automating the analysis process. With the introduction of radiological information systems, we are computerizing and modernizing the work of the radiological centre and the transition from paper and film to fully electronic business and digital recordings. This way of doing business allows us to have available radiological data in the right place at the right time. Within the radiological information systems, we will also mention standards such as DICOM (Digital Imaging and Communications in Medicine), PACS (Picture Archiving and Communication System), and HL7 (Health Level Seven). Family medicine represents a different approach to primary health care through an orientation towards continuous preservation and improvement of the health of the population, with the patient at the centre of care. To improve population health care, we must improve the work of health professionals so that these information systems do not represent a burden on work but enable automation of business processes, such as the Electronic Medical Record (EMR). At the end of the paper, we will write a summary of all the advantages of introducing information systems within a health institution.

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Key words: *Laboratory Information Systems (LIS), Radiological Information System (RIS), Family Medicine Information System, Electronic Medical Record (EMR).*

1. Introduction

At a time when computers were a rare as occurrence, in that time primary data were taken from patients in healthcare, sorted, processed, and delivered to stakeholders on a daily basis manually, and only secondarily generated data was processed in Information computer centres (IRCs). Today, when informatics has reached its peak of development and use, IT processing of health data begins at the reception desks in clinics, so in that case we can talk about computer-based information systems (KBIS - CBIS - Computer Based Information System). A Computer-Based Information System (CBIS) is an information system that uses computer technology to perform part or all of a task in healthcare. Today, most information systems are computerized, although this is not always the case. For this reason, the term Information System (IS) is used as a synonym for Computerized Information System (CBIS).

The need to introduce an information system is reflected in the ability to cover all information flows in order to manage of a particular business system in the organization, in accordance with the nature and tasks performed in the system. Each information system aims to provide a basis for performing the various tasks and requirements that participants expect from the system. Thus, there is a need for introducing complex and efficient information technologies that are necessary for the construction and operation of information systems. Health information systems first began to be built in one health institution, and then expanded to other institutions with which they cooperate.

Figure 1 shows the main integrated components in healthcare, where a typical common network includes several components of the same type (for example, clinics, hospitals, family physicians, etc.). The connections between these components can be separate communication networks, such as the Internet, and can be connected by the physical distribution of the document. These systems in health care have existed independently for a long time, but the need to link them arose when the government, together with certain institutions, launched an initiative.

"Health information systems can be defined as a multifunctional information system that has elements of spatial, management, office and decision support systems." (Sivić, 2014)

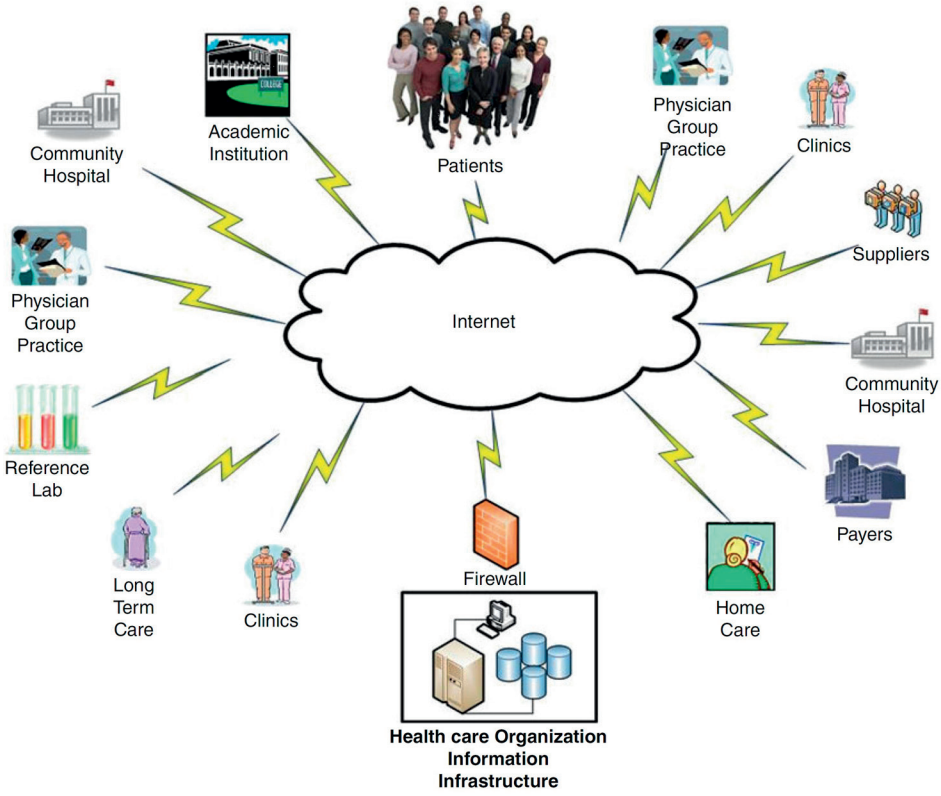

Figure 1. Integrated network of major components in healthcare
Source: Shortliffe & Cimino (2014)

2. Types of health information systems

We can classify health information systems according to different criteria, in that case we can make a division according to the scope and function they have in the health system (McGraw-Hill, 2007).

Local health information systems are used at the local community level, i.e., outpatient clinics or other health care units (in health centres or hospital wards). Local health information systems are used to support the work of health workers by assisting them in primary health care in outpatient clinics, laboratories or hospital beds where every health worker receives primary health information.

Institutional health information systems are used at the entire health institution, e.g., health centre, hospital, etc. Institutional health information systems are integrated systems that meet the needs of all health institution staff.

Regional health information systems are systems that exist in the region and are used in health centres, hospitals, pharmacies, health care institutes, health insurance institutes, etc. The tasks that we required of regional health information systems are (Petković & Sivić, 2008):

- for health care,
- to study health phenomena in society,
- to improve the efficiency and cost-effectiveness of health work, and
- for planning, programming and decision-making in the health sector.

Regional health information systems are integrated information systems that enable systems to be managed at the regional level, and are used for planning, programming, financing, monitoring, evaluation and coordination of health care programs.

National health information systems are systems that are implemented at the level of one country. The function of national health information systems is to retrieve data and information from lower-level systems. These health information systems connect regional health information systems and, based on data from all regional health information systems, they plan and program health care and conduct health policy at the national level.

International health information systems are systems that are used at the level of international organizations and thus use data and information from national systems. Those systems are applied in the World Health Organization and some United Nations organizations that are important for health care. The example of such information system is information system that collects data in the well-known database HFA-DB (Health for all) of the World Health Organization (Aldred, 1997).

Some of the diagnostic information systems we will discuss in this paper.

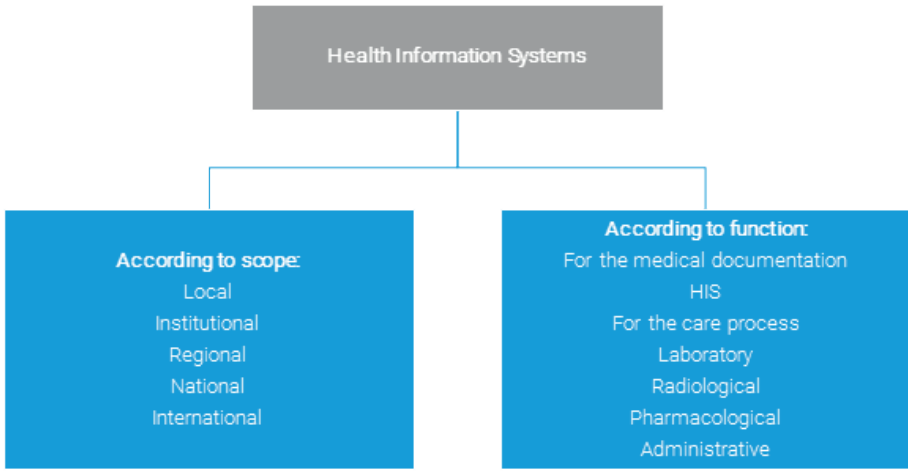

Figure 2: Division of health information systems
Source: Sivić (2014)

3. Content of health information systems

Constant progress in the development of both social sciences and medical science has led to a sudden increase in the amount of information in healthcare institutions, which has also led to the burden of healthcare workers with administration and piles of documents.

The health information system works for the past, present and future (Sivić, 2014):

- for the past, because past events are used to assess developments in health care,
- for the present, because it serves for planning and organizing the implementation of health activities and
- for the future, because it serves the needs of planning the development of healthcare.

4. Functions and scope of health information systems

Health information systems should be viewed as systems used by management to make decisions and achieve health goals. When designing health information systems, the development team should respect the opinion and needs of the system customer, who want to benefit from the mentioned systems.

5. Specifics of the tree of the health information system of Bosnia and Herzegovina

The tree of the health information system of BiH represents the basic data base which are formed in (Sivić, 2014):

- the registry office of the municipality and the Ministry of Interior (records of births, deaths, immigrants, emigrations, etc.),
- primary health care units, polyclinics, hospitals (records of first and second visits, illness, incapacity, disability, hospitalization),
- management of health institutions (facilities, equipment, personnel, depreciation, schools),
- health insurance fund (total funds for health care, health insurance funds, personal and material consumption funds, investments),
- pharmaceutical production and consumption (vaccines, essential medicines, galenic medicines),
- hygienic and epidemiological services (infectious diseases, epidemics, immunization programs, intrahospital infections, control of environmental risk factors, water, air, food and ionizing radiation),
- consequences of disasters,

- "Health for all 21" indicators for the assessment of set goals that must be submitted to the World Health Organization's HFA DB (Health for all database),
- bioinformatics in medicine (domestic publications, foreign publications, magazines, scientific reports, expert studies).

6. Laboratory information system

As globalization has entered all pores of our lives, so in laboratories when there were fewer samples, we were able to process them manually. However, in medium-sized or large health laboratories, up to 1,000 samples are processed daily with tens of thousands of analyses and the same amount of data. Such a large amount of data is impossible to process with a good quality without a good information system. In that case, the possibility of errors, which are very common in the laboratory, and which can be fatal, is minimized, especially with modern devices that generate data directly into the information system (Sepulveda & Young, 2013).

Laboratory Information System (LIS) is a program that enters, processes and stores data which arising from the results of laboratory tests. However, the term LIS generally includes the computer equipment required to run all processes, databases, related automated analyser programs, and programs that can communicate between the analyser and the LIS. The laboratory information system supports all segments of work in laboratories. Laboratory work in addition to taking a sample; fill in data on the sample, its properties, control data, etc. The entry of these data into the information system is precisely defined so that the possibility of errors is minimal.

The work of the laboratory information system has its own procedures, and they are (Sivić, 2014):

- laboratory information systems receive their tasks from superior health information systems, where all protocols are created by default, e.g., for example processing sample and creation of data and creation of worksheets,
- laboratory information systems work with different types of analysers, managing and control of the correct operation of the apparatus, filling of input data into the analyser and acceptance of the resulting data of the analysis,
- laboratory information systems are checking the results and generate reports or findings
- delivers verified findings to the superior health information system so that they are available to all those who are needed in solving a health problem.

The introduction of hardware and software solutions such as expert systems have enabled the automation of laboratory processes. Laboratory information systems, in addition to the analysis of the sample itself, in these

information systems we can find analyses and data such as records of material consumption, number of analyses performed, laboratory operations and statistical calculations for management or scientific research. The main purpose of introducing laboratory information systems is because the employees spent a lot of working time copying the results from the analyser into the forms, also if we add to that a large amount of analysis during the day. This way of working requires automation of working process.

7. Information system and quality control

In order to have a quality health service, we must have the technologies that is related to a particular health service. What we should be taken into account is that there is no misuse of available technologies because in order to ensure quality, sometimes health workers start behaving comfortably and irrationally and unnecessarily do diagnostic tests or therapeutic procedures when they have already defined or remedied the previous procedures.

Today's successful and quality business is impossible without the use of information systems. When we talk about quality management, information systems are those that allow us to monitor all relevant data on business, preparatory, production and service processes, enable production with lower costs as well management and control of these processes. In laboratory information systems, quality and accurate diagnostic analysis play a key role in providing quality and safe health care.

8. Radiological information system

The development of information technologies has led to the development of a number of digital systems that today have an irreplaceable place in diagnostic medicine. Previously, were used analog radiography, which are suppressed by the use of digital tomography. First, X-ray-based systems were used in radiology, and then new digital technologies such as magnetic resonance imaging, positron emission tomography, and a range of ultrasonic diagnostic technologies were introduced. Digital technologies consist of both hardware and software, i.e. they are based on information technologies and information systems. However, with the development of digital systems, there is a problem with difficult communication and analysis between digital systems due to the fact that many non-compliant digital systems from different manufacturers are praised. To address this, the American College of Radiology (ACR) and the National Electrical Manufacturers Association (NEMA) have joined forces to create a universal standard for all digital systems known as DICOM (Digital Imaging and Communications in Medicine). In addition to the above standard used for the exchange of digital images between systems, there was a need to create a

system for receiving, transporting and storing medical images in diagnostic cabinets known as PACS - Picture Archiving and Communications Systems. The problem with PACS is downloading images from other devices. There are 3 possibilities to download images from other systems, which of course depends on the equipment of the device that produces images:

1. using communication protocols,
2. for analog cameras, images / videos are downloaded with high-resolution "frame-grabber"[2] video cards and
3. for analog devices without video output, a special hardware solution is installed depending on the device with the use of special CCD (charge-coupled device) cameras.

The images created in these systems require analysis by radiologists, which requires high-performance computers, which allow the work and manipulation of multidimensional images such as 2D, 3D and 4D views. In addition to working with digital images / video, radiological information systems enable the creation and updating of digital patient records, protocol books, data on health professionals and their authorizations, surgeries, types of examinations, procurement and consumption of medical materials, as well as all necessary codebooks.

With their automation, radiological information systems enable shortening of the patient's processing time from the moment the patient arrives until the diagnosis is made, and an important segment in the work is the functioning of PACS, monitoring the course of examination and archiving findings. The radiological information system is considered as one module within the health Enterprise Relationship Planning (ERP) system.

4. Health information system in the field of FBiH

The current way of using information is extremely inefficient because health information, at the time when it is used, are largely outdated. The information system that exists in health care in the FBiH could rather be called a health-statistical information system based on current registration in health care institutions. Except in part of health insurance funds, there is no computerized information system or computer network at the cantonal level, and thus in the FBiH. During 2011, the Federal Ministry of Health tried to introduce a single database of patient statistical data sheets, which health institutions are obliged to fill in and send monthly for processing to the Institutes of Public Health. Although well thought out, the attempt failed because of resistance, as they saw it as an attempt to centralize and lose valuable information.

The attitude of a large part of health professionals as well as health managers towards health information and its importance is quite negative,

2 A piece of hardware inside a computer.

which could be an important reason for the poor functioning of the information system and lack of interest in developing a real health information system based on modern information technologies. In modern health care, services are characterized by a high level of specialization and division of labour. At the same time, patient needs require that all health professionals have access to relevant information. These facts show that resistance is present, mainly due to the lack of a unified strategy, which may exist on paper, but implementation is hampered by actual non-compliance with all relevant factors. Assessing the quality of work in family medicine, without proper computerization, will always be expensive, time consuming, unreliable and of dubious value.

5. Information system in family medicine

In the 21st century, the World Health Organization predicts that people in the region should have better access to family and community-oriented primary health care that is supported by a flexible and appropriate hospital system.

Preference is given to the principle of "prevention is better than cure", so the focus is on patient counselling, early detection of the disease and timely treatment. Family medicine makes the first contact with the patient within the health care system, providing open and unrestricted access for its users, solving all health problems regardless of age, gender or any other characteristic of the patient. The family medicine team coordinates health care, working with other professionals in primary health care, representing the patient in further contacts with other specialists. In its work, the family medicine team is focused on the patient, his family and the community in which he lives.

The new payment model for doctors is based on the introduction of individual consultations with family medicine doctors. Each family doctor will have a special contract for a specific number of registered patients, who have opted for him. In this way, the doctor who registers a larger number of patients will be able to earn more. This should stimulate doctors to fight for each patient, to pay maximum attention to each patient and to provide better services.

The information system in family medicine should be the basic, initial and final component of the information health system. Developed countries have long ago recognized all the advantages of connecting a complete information system in health care. So, we can have a perfect system in family medicine and (or) in a hospital. However, if there is no communication between them, they represent separate silos of information that are an end in themselves.

Because of that it is important to build an information system in family medicine that will support health care staff, not be a burden to them. Such

an information system must meet all prescribed standards and norms. An important and integral part of the information system in family medicine is the Electronic Medical Record (EMR).

6. Electronic medical record (EMR)

The basics of health information system is an electronic medical record, a record about the patient or the user of health care, which should contain all the health data of the person from birth to death. Of course, this does not mean that the record must be on one computer in one health institution, it can be dislocated, distributed within the network. For what matters, there must be the ability to link all parts of the record that belong to one person. There must be a unique identifier of the person such as a unique ID number. The structure of the electronic medical record must follow an international standard, for example EN 13606. A well-designed and appropriate data structure in the medical record is one of the conditions that can ensure quality decision-making by physicians.

The electronic medical record has survived and is still undergoing changes and adjustments. However, a complete electronic record of patients in primary health care is an essential component of the national health information system strategy. On the other hand, the classification is an essential element of a quality medical record (e.g., QMR-10)[3].

7. Conclusion

Diagnostic information systems in healthcare institutions provide tremendous opportunities to reduce clinical errors such as medication errors and diagnostic errors and support healthcare professionals by offering up to date patient information. They promise to improve workflow and efficiency of care, thus boosting the overall quality of healthcare. The advent of HIS has revolutionized patient care based on more efficient diagnosis and treatment of illnesses in the healthcare centre. By analysing the literature on information systems integration, it was concluded that working on building an information platform and making it compatible with different systems will contribute positively and decisively to amplifying data and the mechanism of its sharing. Therefore, the work to develop the integration of information systems to provide medical services at all levels deserves to be advocated and promoted. However, there are still many hurdles to overcome. Evaluation studies, especially in the field of information technology in healthcare, point out that they require a lot of time, knowledge, and

3 International classification of diseases and related health problems, 10 revisions; abbreviated: ICD-10; an English abbreviation is also in use ICD-10, according to the original title: International Statistical Classification of Diseases and Related Health Problems) represents the classification and coding of diseases, as well as symptoms, bad findings, complications, social and external conditions for the emergence and development of diseases and disorders compiled and published by the World Health Organization (WHO).

resources. This framework should represent the discovery of appropriate methods and means for improving patient health care.

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Preliminary communication

THE CHURCH IN CROATIAN INTERNET PORTALS

Abstract

Today's culture of communication is influenced by the internet and social networks. Therefore, being virtually present on social networks and internet portals has become an imperative of everyday life. In this regard, the authors analyze the status of the Catholic Church on the most widely read secular and religious internet portals by exploring their relationship to the Catholic Church. The main goal of the research is to examine and determine whether the status of the Catholic Church in the period that was the subject of the research was negatively or positively intoned on the researched internet portals. The authors try to find the answer to the research questions by analyzing the content of articles on the topic of the Catholic Church published on six internet portals and shared on the official Facebook pages of these media. Descriptive statistics in the paper present the results of the research. The obtained results lead to the conclusion that the articles placed in the media about the Catholic Church are mostly positively intoned. However, the negative article placed by the secular media on social networks has a greater impact and thus seemingly creates the image that the negative media connotation of the Catholic Church is predominantly represented. The results obtained in the conducted research can be used for further research and further shed light on the topic of the media's attitude towards the Catholic Church.

Key words: *Catholic Church, Social Networks, Internet, Communication.*

1. Introduction

The Internet as a new media has a kind of direct influence on the communication culture, so that people spend most of their leisure time on the social media and web portals. Bogešić has defined the Internet as the medium

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which 'forms the opinions and attitudes of the people in society, whereas its virtual world becomes more challenging and attempting than the reality and distances the individual from the real world. The Internet has increased its influence in the Church media activities and spreading of the Bible and Christian messages to the general public. In Croatia all denominations are in a way involved in the Internet communication, most frequent by the use of the websites. '(Bogešić, 2019:105).

The social media, such as the *Facebook,* enable the two-way communication, effective content-sharing, so that the Catholic Church has the evangelization opportunity by the use of these communication channels. But, on the contrary, the 'opponents' of the Church commitments, i.e., those who perceive it as a negative social force, have also got the platform for effective negative content-sharing about the Catholic Church. The main objective of this research and paper is to enquire and examine whether the majority of contributions about The Catholic Church had a negative tone on secular web portals and positive one the Catholic web portals, i.e., whether the status of the Catholic Church during the assessed period had a positive or negative position on the required internet portals. Conducting research by focusing on articles in which the Catholic Church was the dominant topic in the observed period on the Internet portals of Croatian secular and religious portals, analyzes the presence of sensationalism in the titles of articles published on Internet portals, as well as the use of sources in published articles on the Catholic Church. Furthermore, the authors try to research the attitudes of the certain secular and religious portals about the Catholic Church, i.e., whether they publish just the most-read sensational content or also share the Catholic Church. positive stories and actual news. Since this paper analyses the status of the Catholic Church on the web portals and questioning of the web portal relationship with the Catholic Church, the comparative content analysis and implementation of the quantitative research approach has been chosen as the research methodology. The research implemented in this paper provided certain conclusion on the relationship of the web portal with the Catholic Church. Accordingly, the main aim of this paper is to question and specify whether the status of the Catholic Church was negative or positive positioned on the referred web portal during the period considered.

2. Theoretical Framework

Recently the web portals power has become crucial in creating of public opinion. However, media are not just the means of public information, but also the main creators of changes at each area of social, private and family lives of many people. The present media role is various: combined with the entertainment component, there are also educational and long-term public change creation components. In this context, some authors emphasize that Croatian media is often represented in a negative context, as the 'social parasite which just takes and gives nothing' by applying 'the strategy of

creating mistrust '(Šola, 2017: 464). If so, we could wonder why the media try to influence on the public opinion by creating the negative perception of the Catholic Church. As noted by some authors, the answer might be that the media are interested only in the 'conflict matter, especially if it has been connected with the Church hierarchy. The narrow religious topic is on the edge of the media interests, while the close attention is given to the other area: politics, sport, leisure time and entertainment' (Bogešić, 2019:103). Moreover, several Catholic prelates complain of the negative image of the Church, 'in order to achieve the greater circulation, but also to decrease and diminish its social influence' (Sladoljev, 2003:11, according to: Mikić, Novak, 2019).

In their paper Skoko and Bajs quoted the sentence of the American president Thomas Jefferson in 1807: 'Nothing can now be believed which is seen in a newspaper. Truth itself becomes suspicious by being put into that polluted vehicle (…) The man who never looks into a newspaper is better informed than he who reads them; inasmuch as he who knows nothing is nearer to truth than he whose mind is filled with falsehoods and errors.' (Skoko, Bajs, 2007:95). Judging by the part of audience, as seen in the web portal articles' comment sections, together with certain media and social processes analysts, these quotes highly reflect the content posted by some web portals. Due to the great influence of the media on society, more authors stress the social responsibility (Skoko, Bajs, 2007, Valković, 2013). 'The public has become merely audience', while main actors are media as the public opinion creators (Peruško-Čulek, 1999:59, according to Labaš, Vizler, 2005:282).

3. Social media and Catholic Church

In the digital time social media have become the main virtual means of communication. These are defined as 'a network of people, although it may sometimes be a network of groups of people. They form the vertices of the network and the edges represent connections of some kind between them, such as friendship.' (Newman, 201; according to Vidak 2014:49). The combination of technical improvement with the people communication needs creates the space for the unity marked with fast communication, interactivity and dynamics' (Strujić, 2016:443). One of the most popular internet social communication channels is certainly the *Facebook*. Authors Kovačić and Others define the *Facebook* as one of the most famous social networks in Croatia, which media use to 'promote their contents, interact with users and increased the followers. The users have the option to rate content by emotional expressions, commenting, participating in discussions and sharing the content.' (Kovačić, Musa, Tomić, 2019:16). The latter authors in their paper *Online Media and Journalism on Social Networks- Case Study Social Network Facebook* researched editorial policies of ten most read Croatian *news* portals on the *Facebook* social network in September 2019. They recognized that social networks are the 'crucial communication channel

between the *news* portals and followers and also the important source of information for both social network users and journalists who often base their texts on the social media posts' (Kovačić, Musa, Tomić, 2019:25). Having considered the daily use of the Internet in everyday life, many authors define it as the 'seventh continent' (Strujić, 2017:476). By growing influence of technologies in the present, the everyday media contents shape and form our attitudes (Alić, 2009:273). As mentioned, the most attractive themes are delicate and sensational stories because they are best-sellers. The culture of reading positive stories has almost disappeared, while the negative content is the most sought after. Kovačić and Others notice this and find that the main culprit for unethical online content is the lack of sustainable business models and fighting for every advertisement or PR. The online journalism is forced to distribute content which is not in accordance with the ethical principles; instead, thy follow the social media principles where the post publications., number of comments and likes are set as the main journalism measures (Kovačić, Musa, Tomić, 2019:25). Digital era and modern means of communication, especially social media, have entered the Catholic Church by creating a new dimension of communication (Ančić, 1995:408). Having considered the relationship between the Internet and Catholic Church, Henderson suggested some advantages of the use of the Internet for religious purposes and emphasized (Henderson, 2000 according to Duvnjak, 2015:59):

- 'fast and simple access to information about religious communities, their institutions and organisations and religious texts and documents,
- great potential for introduction, as well as advanced studies of religious topics from lowest to highest levels,
- online religious contents are presented in a modern and interactive way within the sophisticated technological environment, which has effect on the overall experience'.

Nowadays, the use of the Internet and social media has been recognized as the main means of fast information exchange. However, it should be pointed out that besides positive aspects, there are also negative ones, e.g., increased manipulation of information.

4. Case study and methods of empirical research

The main objective of this research and paper is to enquire and examine whether the majority of contributions about The Catholic Church had a negative tone on secular web portals and positive one the Catholic web portals, i.e., whether the status of the Catholic Church during the assessed period had a positive or negative position on the required internet portals, as well the use of sources throughout the published contributions about the Catholic Church.

According to the research goal, the initial hypotheses are:

H_1: *Most of the articles about the Catholic Church on the secular web portals have negative value orientation.*

H_2: *The articles about the Catholic Church on the Catholic web portals have mostly positive value orientation.*

H_3: *The articles about the Catholic Church on the secular web portals are frequently sensational headlined.*

H_4: *The articles about the Catholic Church on the Catholic web portals do not have sensational headlines.*

The science research methodology is based on the scientific method od the comparative content analysis applying the quantitative research approach. The content analysis is considered the appropriate method of information gathering and has great heuristical usefulness. The quantitative content analysis is also known as frequency one, because it is used to denote the frequency and volume of the content of the message. (Tkalac Verčić, Sinčić Ćorić, Pološki Vokić, 2014:92-94). The comprehensive analysis of the content of articles about the Catholic Church published on 6 web portals and shared on the official *Facebook* pages of these media lasted from the 1st to 31st January 2021. The published articles were examined in order to find the answer to the question whether the status of the Catholic Church during this period was positively or negatively toned, the contexts of editing of the articles on these secular and religious web portals combined with the headline's sensationalism connected with the Catholic Church. The analysis unit was the article about the catholic Church on the secular and religious web portals. The three most-read articles were chosen from both secular and religious web portals in the previous year, according to the Reuters and Similar Web research (Picture 1 and Picture 2).

Indeed, the most-read secular web portals in 2020 were Index.hr, 24sata.hr and Jutarnji.hr, while the most-read religious portals were Bitno.net, Medjugorje-info.com and Hkm.hr (Jw.org was not analysed, because it is the web portal of other non-Catholic denomination, Jehovah's Witnesses). As the Catholic web portals have more posts about the religious topics on both their websites and *Facebook* pages than the secular portals, the posts published on the religious portals on every fifth day in January were analysed. For secular portals all posts about the Catholic Church published from 1st January were analysed. According to the predetermined criteria, all web articles about the Catholic Church which were published on the abovementioned web portals and shared to their official *Facebook* pages during the specified time period were analysed.

The research matrix was taken from the *Religious Topics in Croatian Media Space* project held by the Department of Communicology of the Catholic University of Croatia which was subsequently tailored for the research goals. The matrix contained 16 question categories. The sample of the content analysis was specified by the one-month time period and the content

analysis unit were every article published about the Catholic Church and its activities on the above-mentioned web portals and shared on their official *Facebook* pages. The statistical data treatment was processed throughout the statistic software SPSS. The descriptive statistics was used in order to data analysis.

Picture 1. Most-read secular web portals in 2020
Source: https://www.similarweb.com/top-websites/croatia/category/news-and-media/

Picture 2. Most-read religious web portals in 2020
Source: https://www.similarweb.com/top-websites/croatia/category/community-and-society/faith-and-beliefs/

The indicator of the value orientation specification is set up by the (non) disclosure of the author's point of view in the article about the Catholic Church; positive denotes approval and affirmation, negative critic and judgements and neutral general description without the author's a clear attitude on the value orientation scale (Mikić, Novak, 2019:180). The variables were coded for the portal name, article type, author of the article, type of headlines, article value orientation and graphic design of images.

5. Research results

Table 1. The distribution of web portal articles (N=284)

WEB PORTAL NAME	NUMBER OF ARTICLES	PERCENTAGE	CUMULATIVE PERCENTAGE
Hkm.hr	108	38.0%	38.0%
Medjugorje-info.com	67	23.6%	61.6%
Bitno.net	85	29.9%	91.5%
Jutarnji.hr	7	2.5%	94.0%
24sata.hr	7	2.5%	96.5%
Index.hr	10	3.5%	100.0%

There were 284 articles about the Catholic Church published on the above-mentioned web portals and shared on their official *Facebook* pages considered for this research. Of the total number of analysed articles most were posted on the official *Facebook* pages of the Catholic web portals: 38.0 % at Hkm.hr, 23.6 % on Međugorje-info.com and 29.9 % on Bitno.net. On the contrary, the secular web portals, even after the analysis was narrowed to every fifth day, had far less posts during this period: 2.5 % on Jutarnji.hr, 2.5 % on 24sata.hr and 3.5 % on Index.hr. As aforementioned, in order to reduce the imbalance between the number of shared posts, religious portal posts published only on every fifth day of January were analysed, from the 1st January 2021.

Table 2. Number of sources of information in the article about the Catholic Church

	ANSWERS	PERCENTAGE
Provided three or more information sources	33	11.7%
Provided two sources	22	7.7%
Only one source provided	189	66.5%
Without sources of information	40	14.1%
Total	284	100.0%

Read from Table 2 about the sources of information used in articles, so the most articles used only one source (66.5 %) followed by those without any source of information (14.1%). The least are articles with two sources of information (7.7 %), then those with three or more (11.7%).

Table 3. Number of sources of information in the article about the Catholic Church

NUMBER OF SOURCES		Index.hr	24sata.hr	Jutarnji.hr	Bitno.net	Medjugorje-info.com	Hkm.hr	Total
Without sources of information	Number of articles	2	0	0	5	22	11	40
	Percentage	20.0%	0.0%	0.0%	5.9%	32.8%	10.2%	14.1%
Only one source provided	Number of articles	8	6	6	55	36	78	189
	Percentage	80.0%	85.7%	85.7%	64.7%	53.7%	72.2%	66.5%
Two sources provided	Number of articles	0	0	1	10	2	9	22
	Percentage	0.0%	0.0%	14.3%	11.8%	3.0%	8.3%	7.7%
Provided three or more sources of information	Number of articles	0	1	0	14	7	10	32
	Percentage	0.0%	14.3%	0.0%	16.5%	10.4%	9.3%	11.3%
Total	Number of articles-total	10	7	7	85	67	108	284
	Percentage	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

The table 3. summarises the representation of the number of the sources of information on each web portal. From the mentioned table it is obvious

that 20.0 % of articles on Index.hr do not have any sources of information, while other two secular portals do not have those types of articles. Among the religious portals most articles without any source of information are published on Medjugorje-info.com (32.8 %), followed by Hkm.hr (10.2 %) and Bitno.net (5.9 %). If articles with no or one source of information are put together, they represent slightly more than 80% of analysed articles. The secular web portals are leading: Indeks.hr with 100 %, both 24sata.hr and Jutarnji.hr with 87.7 % of analysed articles. Among the religious web portals, most articles with no or one source of information has Medjugorje-info.com (86.5 %), followed by Hkm.hr (82.4 %) and Bitno.net (80.6 %). The most articles with three or more sources of information were published on 24sata.hr (14.3 %) of secular portals and Bitno.net (16.5%) of religious portals, followed by Medjugorje-info.com (10.4 %) and Hkm.hr (9.3%), whereas the Index.hr and Jutarnji.hr do not have articles with three or more sources of information. Overall, there is a conclusion that the majority of secular web portals rarely provide more sources of information in their posts and articles: these are mainly the articles shared or written on the basis of their own resumes and the use of only one source of information. Among the religious portal special emphasis is given to Medjugorje-info.com with 32.8 % articles without any source of information, which is a large percentage compared with other secular and religious web portals.

These results confirm the research finding of some previous papers in which there were a few newspaper articles with two, three or more sources of information used, which is advisable f or the journalistic ethics and professional integrity. The low representation of more sources of information on the Catholic web portal is partly due to the facts that the texts with prayers and spiritual contents were also analysed.

Table 4. The type of headlines

	ANSWERS	PERCENTAGE
Difficult to determine	3	1.1%
Motivating	3	1.1%
Neutral	43	15.1%
Critical	1	0.4%
Sensational	24	8.5%
Informative	210	73.9%
Total	284	100.0%

While the previous tables show the number of the source of information in the articles, this table shows the total percentage of the types of headlines. It is obvious that the most articles are with informative headlines (73.9%), followed by neutral (15.1 %) and sensational (8.5 %). In order to elaborate

more about the percentage of sensationalism in web portal headlines, it is necessary to study the representation of these headlines on each portal type, as shown in table 5.

Table 5. The type of headlines on web portals

TYPE OF HEADLINES		Secular	Religious	Total
Informative	Number of articles	12	198	210
	Percentage	50.0%	76.2%	73.9%
Sensationalistic	Number of articles	10	14	24
	Percentage	41.7%	5.4%	8.5%
Critical	Number of articles	1	0	1
	Percentage	4.2%	0.0%	0.4%
Neutral	Number of articles	1	42	43
	Percentage	4.2%	16.2%	15.1%
Motivating	Number of articles	0	3	3
	Percentage	0.0%	1.2%	1.1%
Difficult to determine	Number of articles	0	3	3
	Percentage	0.0%	1.2%	1.1%
Total	Number of articles	24	260	284
	Percentage	8.5%	91.5%	100.0%

The segmented data by the web portal types shown in Table 5 represent that cumulative high percentage of informative (73.9%) and low percentage of sensational headlines (8.5%) are differently placed on the secular and Catholic web portals. Indeed, there are only half of the informative headlines among the secular portals (50%), followed by not even 10 % less of sensational headlines (41.7%). Among the religious portals the percentage of informative headlines is slightly more than ¾ (76.2 %) and only 5.4 % of the sensational headlines. Having considered the fact that the analysed secular web portals are most-read portals in general and exceed the religious web portals by far, as shown in Pictures 1 and 2, it is easier to get the readers' distinct impression that the sensational headlines are predominant among the web portals.

Hereafter, in Table 6., there are shown the types of headlines of the analysed articles on the specified web portals.

Table 6. The type of headlines shown by specified web portals

HEADLINES		Index.hr	24sata.hr	Jutarnji.hr	Bitno.net	Medjugorje-info.com	Hkm.hr	Total
Informative	Number of articles	5	4	3	64	48	86	210
	Percentage	50.0%	57.1%	42.9%	75.3%	71.6%	79.6%	73.9%
Sensational	Number of articles	5	2	3	6	7	1	24
	Percentage	50.0%	28.6%	42.9%	7.1%	10.4%	0.9%	8.5%
Critical	Number of articles	0	1	0	0	0	0	1
	Percentage	0.0%	14.3%	0.0%	0.0%	0.0%	0.0%	0.4%
Neutral	Number of articles	0	0	1	12	11	19	43
	Percentage	0.0%	0.0%	14.3%	14.1%	16.4%	17.6%	15.1%
Motivating	Number of articles	0	0	0	1	1	1	3
	Percentage	0.0%	0.0%	0.0%	1.2%	1.5%	0.9%	1.1%
Difficult to determine	Number of articles	0	0	0	2	0	1	3
	Percentage	0.0%	0.0%	0.0%	2.4%	0.0%	0.9%	1.1%
Total	Number of articles	10	7	7	85	67	108	284
	Percentage	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

As can be observed from Table 6, the results show that most informative headlines among secular web portals are posted on 24sata.hr (57.1 %), followed by Index.hr (50.0 %) and Jutarnji.hr (42.9 %), whereas among the religious web portals have greater percentage of informative headlines: Hkm.hr 79.6 %, Bitno.net 75.3% and Medjugorje-info.com 71.6 %.

Among the secular web portals most sensationalistic headlines are posted on Index. Hr (50.0 %), while among the religious web portals most sensa-

tional headlines are posted on Medjugorje-info.com (10.4%). It is important to stress that neutral headlines were not posted on Index.hr and 24sata.hr, although they are presented by other portals (around 15 %).

Table 7. The contexts of the Catholic Church topics broken down by portals

CON-TEXT		Index.hr	24sata.hr	Jutarnji.hr	Bitno.net	Medjugorje-info.com	Hkm.hr	Total
Religious	Number of articles	1	0	1	62	55	82	201
	Percentage	10.0%	0.0%	14.3%	72.9%	83.3%	75.9%	71.0%
Political	Number of articles	1	0	0	1	0	0	2
	Percentage	10.0%	0.0%	0.0%	1.2%	0.0%	0.0%	0.7%
Social	Number of articles	3	4	3	12	4	7	33
	Percentage	30.0%	57.1%	42.9%	14.1%	6.1%	6.5%	11.7%
Economic	Number of articles	0	0	0	0	0	1	1
	Percentage	0.0%	0.0%	0.0%	0.0%	0.0%	0.9%	0.4%
Humanitarian	Number of articles	3	1	1	5	4	15	29
	Percentage	30.0%	14.3%	14.3%	5.9%	6.1%	13.9%	10.2%
Cultural	Number of articles	0	0	0	0	0	2	2
	Percentage	0.0%	0.0%	0.0%	0.0%	0.0%	1.9%	0.7%
Neutral	Number of articles	0	0	1	3	3	1	8
	Percentage	0.0%	0.0%	14.3%	3.5%	4.5%	0.9%	2.8%
Other	Number of articles	2	2	1	2	0	0	7
	Percentage	20.0%	28.6%	14.3%	2.4%	0.0%	0.0%	2.5%
Total	Number of articles	10	7	7	85	67	108	284
	Percentage	100.0%	100.0%	100.0%	100.0%	100.0%	100.%	100.0%

The context of the Catholic Church topic among the analysed articles is shown in Table 7. Among secular web portals, the Catholic Church is most-

ly mentioned in social and somewhat humanitarian context, i.e., secular web portals primarily perceive the Catholic Church as a social organisation (24sata.hr by 57.1. %, Jutarnji.hr by 42.9 % and Index.hr by 30% of articles) and not as a religious one. The following are the articles with the topic about the Catholic Church in a humanitarian context: Index.hr by 30 %, both Jutarnji.hr and 24sata.hr by 14.3 % articles each. Among the secular web portals, the Catholic Church is presented in a religious context on Jutarnji.hr (14.3%) and Index.hr (10.0 % of articles), whereas there are no such articles posted on 24sata.hr. Just as expected, most articles posted on the catholic web portals represent the Catholic Church in religious context, on Medjugorje-info.com at most (83.3 %), followed by Hkm.hr (75.9 %) and Bitno.net (72.9 %). After religious context, the majority of the religious web portal articles represent the catholic Church in a neutral context: both Medjugorje-info.com and Bitno.net (37.5 % each) and Hkm.hr (12,5 %).

Table 8. The value orientation of the articles

	ANSWERS	PERCENTAGE
Difficult to determine	1	0.4%
Neutral (generally descriptive)	19	6.7%
Both positive and negative attitude equally represented	2	0.7%
Negative	8	2.8%
Positive	254	89.4%
Total	284	100.0%

The general value orientation of articles is presented in the Table 8 and it is obvious that the positive value orientation is highly dominant (89.4 %) and followed by the neutral (6.7 %) and negative with only 2.8 %. Furthermore, these data are rather different between secular and religious web portals, as seen in Table 9.

Table 9. The value orientation of the articles broken down by the types of web portals

VALUE ORIENTATION		Secular	Reli-gious	Total
Positive	Number of articles	10	244	254
	Percentage	41.7%	93.8%	89.4%
Negative	Number of articles	6	2	8
	Percentage	25.0%	0.8%	2.8%
Both positive and negative attitude equally represented	Number of articles	2	0	2
	Percentage	8.3%	0.0%	0.7%
Neutral (generally descriptive)	Number of articles	5	14	19
	Percentage	20.8%	5.4%	6.7%
Difficult to determine	Number of articles	1	0	1
	Percentage	4.2%	0.0%	0.4%
Total	Number of articles	24	260	284
	Percentage	100.0%	100.0%	100.0%
	Total	8.5%	91.5%	100.0%

As shown in Table 9., the analysis of the value orientation of the web portal articles about the Catholic Church displays that the most contain positive value orientation: secular web portals by 41,7 % and religious web portals by full 93.8 %. However, the percentage of the negative value orientated in relation to total shown in the Table 8 is only 2.8 %. Furthermore, secular web portals published far more negative orientated articles, up to ¼ (25 %), neutral articles, based on general description, around 1/5 (20.8 %), and the articles with equally represented both positive and negative attitude (only 8.3 %).

Among the religious web portals, the vast majority of articles about the Catholic Church is positively orientated (93.8 %). There are less than 1 % negatively orientated articles and only 5,4 % of neutral articles. From the

foregoing facts it is easy to conclude that the majority of the media articles about the Catholic Church have positive value orientation, but in secular web portal there are 25 % articles with negative value orientation. Some web portals have higher percentage of negative value orientated articles, as shown on The Table 10.

Table 10. The value orientation broken down by web portals

VALUE ORIENTATION		Index.hr	24sata.hr	Jutarnji.hr	Bitno.net	Medjugorje-info.com	Hkm.hr	Total
Positive	Number of articles	3	3	4	71	65	108	254
	Percentage	30.0%	42.9%	57.1%	83.5%	97.0%	100.0%	89.4%
Negative	Number of articles	3	1	2	1	1	0	8
	Percentage	30.0%	14.3%	28.6%	1.2%	1.5%	0.0%	2.8%
Both positive and negative attitude equally represented	Number of articles	1	1	0	0	0	0	2
	Percentage	10.0%	14.3%	0.0%	0.0%	0.0%	0.0%	0.7%
Neutral (generally descriptive)	Number of articles	3	1	1	13	1	0	19
	Percentage	30.0%	14.3%	14.3%	15.3%	1.5%	0.0%	6.7%
Difficult to determine	Number of articles	0	1	0	0	0	0	1
	Percentage	0.0%	14.3%	0.0%	0.0%	0.0%	0.0%	0.4%
Total	Number of articles	10	7	7	85	67	108	284
	Percentage	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

The analysis of the value orientation of articles about the Catholic Church broken down by web portals, as shown in the Table 10, displays that the majority of the published articles on the web portals have positive value orientation. However, among the secular web portals only Jutarnji.hr has the majority of positive orientated articles (57.1 %). Other two web portals have less percentages: 23sata.hr by 42.9 % and Index.hr by 30.0 %. Among the religious web portals, the highest percentage of the positive orientated articles has Hkm.hr with the highest 100.0 %, followed by Medjugorje-info.com (97.0 %) and Bitno.net (83.5 %). The most articles with the negative value orientation among the secular web portals were published on Index.hr (30.0 %), followed by Jutarnji.hr (28.6 %) and 24sata.hr (14.3 %). Overall, the articles with both positive and negative attitude equally represented were published only on secular web portals 24sata.hr (14.3 %) and Index.hr (10.0 %). The articles with neutral value orientation were also published on secular web portals: Index.hr (30.0 %), 24sata.hr (14.3 %) and Jutarnji.hr (14.3 %).

6. Conclusion

The conducted research was focused on the articles about the Catholic Church. i.e., the Catholic Church was the dominant topic of the articles published on the most-read secular and religious web portals and shared on the official *Facebook* pages during January 2021. Among these articles, the majority are those with no or one provided source of information, whereas two or more source of information were provided in less than 1/5 of articles. When these provided sources of information were broken down by portals, it is obvious that the most of articles without any provided source of information were published on Index.hr (20.0 %) and Medjugorje-info.com (32.8 %) of religious portals. Having regard to the fact that the articles with two or more provided sources of information are more relevant. This result implied that the vast majority of secular portals rarely provide sources of information in their articles, as well as some religious portals, especially Medjugorje-info.com.

The conducted research results have shown that of all articles, the most were informative headlined (73.9 %), followed by neutral (15.1 %) and sensational (8.5 %). When the sensational headlines were broken down by both types of portals, it was clear that these headlines made 41,7 % of secular and only 5.4 % of Catholic religious' web portals. This confirmed the H_4 hypothesis – *The articles about the Catholic Church on the Catholic web portals do not have sensational headlines.* Furthermore, the most sensationalistic headlined articles were published on Index.hr (50.0 %) and Jutranji.hr (42.9 %). This partially confirmed the H_3 hypothesis – *The articles about the Catholic Church on the secular web portals are frequently sensationalistic headlined.*

Among the religious web portals, the majority of sensational headlines were published on Medjugorje-info.com (10.4 %) and Bitno.net (7.1 %). There is a difference between the web portals- on secular web portals the sensational headlines were negatively connotated (e.g., *'Priest Mirko from Slavonia Once Again in Love with his Wench on the Wrong Grange').* On the contrary, on the religious web portals the sensational headlines were positively connotated emphasising the evangelisation based on personal experiences (e.g., 'At *Križevac Hill I Was in Tears Praying for my Son, and Then God Asked Me a Question').*

The context of the topics about the Catholic Church was mostly social, somewhat humanitarian on the secular web portals and least religious. Among the Catholic portals the prevailing context was mostly religious, as expected.

The most common value orientation of articles was the positive one (89.4 %), followed by neutral (6.7 %) and negative (barely 2.8 %). Among the secular web portals, 41.7 % articles were positively orientated with 25.0 % negative, whereas among the religious web portals the ratio was greater: 93.8 % positive with only 0.8 % negative, as expected. The aforementioned means the articles about the Catholic Church were mostly positively orientated. However, the negative article published on the secular web portal had bigger media impact, so it gave wrong impression that the Catholic Church was mainly represented by articles with negative value orientation. This means the H_1 hypothesis – *Most of the articles about the Catholic Church on the secular web portals have negative value orientation* – was disproved, as the H_2 hypothesis – *The articles about the Catholic Church on the Catholic web portals have mostly positive value orientation* – was completely confirmed.

After all, it is necessary to be prudent with general conclusion about the representation of the Catholic Church by secular web portals. Therefore, in the continuation of this research the articles would be further analysed, particularly the value orientation criteria are to be applied to more categories, such as the article type and length. Total number of articles with either positive or negative value orientation is not the only relevant criteria to evaluate the certain media attitudes towards a certain topic, likewise the Catholic Church thematic.

The conducted research on the applied pattern could be used for further case studies, in order to shed more light on the topic of media attitudes about the Catholic Church. This paper gives methodological guidelines and analyses which could be used for further case studies and scientific verifications of this field of science. If statistically strengthened, these could also be used for broader and more profound conclusions about the representation of the Catholic Church on web portals and other media.

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Review paper

BENEFITS AND RISKS OF FOSS STRATEGIES

Abstract

According to some research on information systems in local governments in Bosnia and Herzegovina, there is an absolute dominance of proprietary software - very low prevalence of Free and open-source software (FOSS). Experiences of migration to FOSS in European Union countries show that, given the user needs and requirements, it is possible to replace part of the commercial software with appropriate FOSS software alternatives while maintaining the same level of efficiency. In this paper, we present some of benefits and risks of FOSS solutions from the technical, economic and legal side, which is important to consider when making decisions about migration.

Key words: *FOSS, Information Systems, Benefits, Risks.*

1. Introduction

Open source development is an approach to software development in which the source code of a software system is published and volunteers are invited to participate in the development process. Its roots are in the Free Software Foundation, which advocates that source code should not be proprietary but rather should always be available for users to examine and modify as they wish. There was an assumption that the code would be controlled and developed by a small core group, rather than users of the code. Open source software extended this idea by using the Internet to recruit a much larger population of volunteer developers. Many of them are also users of the code. In principle at least, any contributor to an open source project may report and fix bugs and propose new features and func-

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tionality. However, in practice, successful open source systems still rely on a core group of developers who control changes to the software (Sommerville, 2015).

For a company involved in software development, there are two open source issues that have to be considered:

1. Should the product that is being developed make use of open source components?
2. Should an open source approach be used for the software's development?

The answers to these questions depend on the type of software that is being developed and the background and experience of the development team (Sommerville, 2015).

When it comes to business customers of software solutions, they also have some questions related to Free and open-source software - FOSS, which should be considered when choosing a business model that will rely on: proprietary software, FOSS, their combination or some other option.

Free and open-source software (FOSS) is becoming increasingly important in all sectors of economic activity and personal life. The best-known open source product is, of course, the Linux operating system which is widely used as a server system and, increasingly, as a desktop environment. Other important open source products are Java, the Apache web server, and the mySQL database management system. Major players in the computer industry such as IBM and Sun support the open source movement and base their software on open source products. There are thousands of other, lesser known open source systems and components that may also be used (Sommerville, 2015).

What most obviously distinguishes FOSS from proprietary software is its legal environment, in particular the rights and "freedoms" granted by distributing and using licenses for "free software" or "open source software" licenses. It is important to note that when free software developers talk about free software in this context, it does not mean free, but refers to the fundamental freedoms that are transferred by the software. Or as the FSF illustrates - "Free software" means software that respects users' freedom and community. Roughly, it means that the users have the freedom to run, copy, distribute, study, change and improve the software. Thus, "free software" is a matter of liberty, not price. To understand the concept, you should think of "free" as in "free speech," not as in "free beer" (FSF, 2021).

Research results published in 2017 show that „key obstacles for higher FOSS usage at secondary schools in Bosnia and Herzegovina are: insufficient number of computer course classes; gymnasium syllabus requires usage of commercial software; lack of knowledge and popularity of FOSS and lack of activities by local ministries of education to introduce FOSS in schools. As a result of obstacles mentioned above commercial software

is preferred by most of teachers.". (Pezer et al.,2017) In 2019, a research was conducted in Bosnia and Herzegovina that showed the absolute dominance of proprietary software in BiH local government information systems, low representation of free and open source software, but the willingness of most local IT experts to use more free and open source software (Pezer, Odak, 2019). The situation is largely similar in other business sectors in our country.

In this paper, we will summarize some of benefits and risks of open source development and licensing models from a technical, economic and legal perspective based primarily on WIPO analysis (WIPO, 2022), which can be useful for BiH companies when considering a possible transition to FOSS solutions.

2. Technical benefits and risks

When it comes to the technical benefits of open development itself and this model of licensing, it is an issue that has often been discussed in the professional community and most often includes the following benefits (WIPO, 2022),:

- Quality and reliability
- Faster development and deployment
- Security
- Auditability
- Sharing
- Interoperability and standards
- Customizability
- Technological independence

For each of the above items WIPO´s material provides a more detailed explanation, and below we quote some of them.

For example for benefits Quality and reliability, professional literature states, among other things, that „FOSS tends to be very reliable as it is produced in a peer community that often highly values clean design, reliability and maintainability". In addition, it is emphasized by the same that „...FOSS benefits from the contributions of numerous experts who are not bound by a commercial approach or vision. Hence, developers can focus on developing quality and reliable solutions, harvesting the potential of a wide spectrum of peer reviews..." (WIPO, 2022).

In the context of the above, we would like to point out that although this sounds good on a theoretical level, it does not necessarily mean that all FOSS projects are based on the above principles - either for objective or some other reasons.

Regarding the benefits Security, the same source points out that „Providing access to source code to everyone allows other developers to examine software for security flaws in a continuous and broad peer-review approach. FOSS is a good method of finding flaws through the power of crowdsourcing, since it is possible to easily and quickly identify potential security problems and correct them" (WIPO, 2022).

A similar remark applies in this case as well - it sounds theoretically good, but either for objective or some reasons, not every FOSS project will be the subject of detailed consideration by the community or professional individuals at all times and at the right time.

For benefit of Auditability, that is in a certain way also security-related, is stated that „Open-source software is also much easier to audit from a technical standpoint because the source code is available. The user community has the opportunity to audit for security and the absence of backdoors ..." (WIPO, 2022).

Although the user community has the opportunity to audit for security and the absence of backdoors, it does not necessarily mean that every FOSS project will be subject to quality and timely audit, but in any case it is a much better basis for finding security "traps" than in the case of closed code.

FOSS can also provide a solution to problems known as vendor lock-in, which refers to a situation where the cost of switching to a different vendor is so high that the customer is essentially stuck with the original vendor, and thus in some way realize the benefit of technological independence.

Although one of the advantages of FOSS solutions is the fact that unlike proprietary software, FOSS allows access to source code, where theoretically and in case of abandoning the project, the user of FOSS solutions would be able to continue to maintain and further develop solutions for their own needs, the question is to what extent this is realistically possible especially for average BiH company or institution.

In the context of the issue of access rights to source code, we consider it important to state that even in the case of proprietary software is known a legal mechanism that allows access to source code under certain conditions defined through a tripartite escrow agreement. Under the escrow agreement, the software source code is placed in a secure escrow account controlled by an independent trusted third party – Figure 1. This means that if in the future the software developer is unable to support the software product for the reasons stated in the contract, the legal user of the software product will be able to gain access to the source code needed to perform its activities and use critical software applications. However, it should be borne in mind that the option of an additional guarantee through an escrow contract can generally be found in the procurement of software by contracting software development between the customer and the supplier, while it is unlikely in the procurement of generic software products. In

addition, some authors draw attention to the fact that as a practical matter, access to source code is greatly overestimated as an advantage for the software buyer. The fact is that even with decent documentation, the cost of downloading someone else's code and continuing to maintain it can be significantly higher than programming from scratch. In addition, if escrow deposits are not regularly updated and verified or source code access events are not clear enough, these arrangements can be costly ventures and give a false sense of security. (Hamidović, 2022)

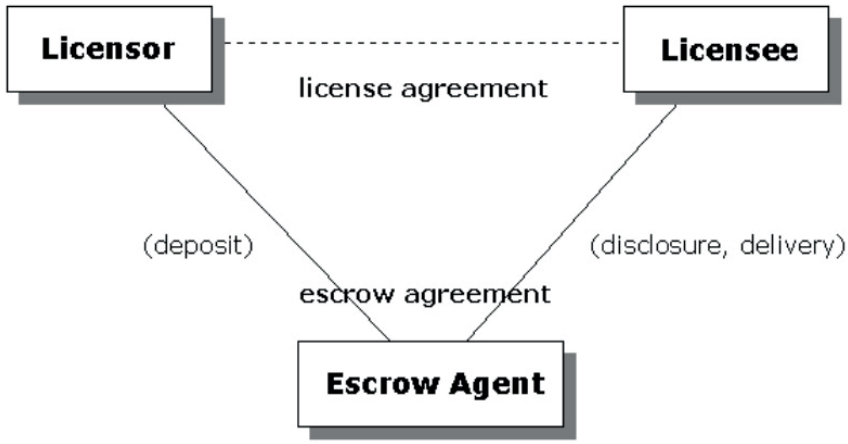


Figure 1. General relationship of parties in escrow arrangements
Source: Paganini (2015)

In order to obtain a realistic overview of the situation related to entering into certain business arrangements, it is necessary to consider, in addition to the positive aspects of individual solutions, what are the potential risks associated with the same. When it comes to technical risks related to FOSS solutions, the professional literature lists, amongst others, the following potential risks (WIPO, 2022):

- Immaturity of some FOSS products,
- Project stability and evolution,
- FOSS complexity.

For each of the above items WIPO´s material provides a more detailed explanation, and below we quote some of them.

„Although there are some FOSS technologies that are more than 25 years old with many stable releases and contributors, there are also thousands of new, young, and "immature" FOSS projects available online, many of them in "Beta" stage – i.e. untested, with source code that is still immature and with a development base that is still being built. To mitigate the risk of using immature projects, the FOSS repositories themselves often indicate the degree of progress of the project and there are several "open-source

maturity models", which are analytical frameworks allowing potential users to study and verify the maturity and quality of open-source projects. The maturity levels are defined by criteria such as number of participants, standardization degrees, licensing terms, ease of configuration, documentation, quality assurance, etc." (WIPO, 2022).

Some authors also draw attention to the fact that „working on FOSS projects is mainly voluntary, and there is no guarantee that (further) development will take place. Many projects are abandoned or left in the hands of one or just a few developers, which may compromise their progress. To mitigate the problem of abandoned projects, many larger FOSS projects have been supported by dedicated foundations or companies who provide commercial services relating to the software for "enterprise" level users, i.e., on software or whole systems aimed at professional users who have budgets to pay for support and product evolution" (WIPO, 2022).

It is interesting to mention that examination group from the field of secondary education in Bosnia and Herzegovina states, among other things, the following important reasons against using FOSS: lack of books and training regarding FOSS and teachers do not have enough knowledge about FOSS, lack of customer support and IT specialist on local market, incompatibility to commercial software formats etc. (Pezer et al.,2017).

3. Economic benefits and risks

The professional literature states that FOSS licensing also offers important economic benefits, through (WIPO, 2022):

- Lower initial cost,
- Lower total cost of ownership,
- Low-cost adaptation,
- Economic and strategic independence,
- New business models,
- Diffusion and access to ICTs,
- Generative and participatory learning,
- Skills development.

For each of the above items WIPO´s material provides a more detailed explanation, and below we quote literally one of them, which refers to the benefit of lower initial costs:

„The most obvious benefit is a reduction in the initial cost of the license. FOSS costs little (marginal cost) or nothing, unlike the initial license fees, support, ongoing upgrades and the costs arising from being locked in proprietary technological solutions, that is, foreclosing additional development opportunities and the positive impact generated when in-house users acquire skills.

This becomes a benefit for (WIPO, 2022):

- end users of the software, members of the public, corporations, entrepreneurs and governmental bodies,
- members of the supply chain, such as ICT service providers and consultants, who may design innovative support programs improved by access to source code, and
- the education sector and research and development organizations (schools, universities, R&D centers) in all areas (and not just ICTs: primary and secondary education, life sciences, economics, etc.) whose members can not only use the software, but also study and adapt it to their needs".

It is interesting to mention that the lower cost price was mentioned as the primary advantage of the FOSS solution in the examination group from the field of secondary education in Bosnia and Herzegovina: „The main reasons for using FOSS are the following: it is free, it is available and quality of FOSS software. Reasons like openness of its source code and security have no or low importance for respondents" (Pezer et al.,2017).

In addition, WIPO states that FOSS might give rise to important economic benefits in the longer term, especially in developing countries, through (WIPO, 2022):

- Access to advanced ICTs
- Participation in development
- Start-ups

„While FOSS offers potential financial savings, certain aspects could have a negative economic impact if not properly managed, such as:

a) The main economic risk of adopting FOSS is the failure of the background or main FOSS project in itself.

b) Technical support may also entail economic risks. The first level of risk arises from the selection of technical support providers, namely the choice that needs to be made between community level or professional support. Secondly, the overall cost of technical support needs to be considered when calculating the TCO of a project. Support of FOSS can indeed be for free (if offered for free at a collaborative and community-based level). However, if prompt support is required, especially for mission-critical software, professional support must be sought from commercial entities or collaborators, who provide the required product warranties on FOSS with associated support levels for a fee.

c) Economic impacts may arise from ineffective IP management or infringement of IP rights, such as failing to comply with open-source licensing terms in derivative works." (WIPO, 2022)

4. Legal benefits and risks

When it comes to legal benefits some of them can be seen through (WIPO, 2022):

- Set of standard and simplified licensing terms and conditions that are transparent, accessible and easy to use.
- The possibility of reducing infringement of IP because there is simply less of a need to copy and use software illegally, as open-source software is readily available, generally completely free of charge or has a low (marginal) cost.
- And from the aspect of end users and through the granting of certain rights that proprietary licenses try to limit often and above the level that is given to end users - buyers of a copy of a certain software product through copyright laws.

The legal risks associated with FOSS are commonly viewed through considerations of issues related to:

- Ownership and protection,
- The issue of IPRs and product warranties,
- Patent infringement,
- Compliance with open software licenses.

For each of the above items, WIPO´s material provides a more detailed explanation, and we will only provide a comment regarding one of them, stating that open-source software is often licensed on an "as is" basis. This means no warranties are provided as to the conformity or quality of the software. Figure 2 gives an example of a typical example of Disclaimer of Warranty and Limitation of Liability.

15. Disclaimer of Warranty.

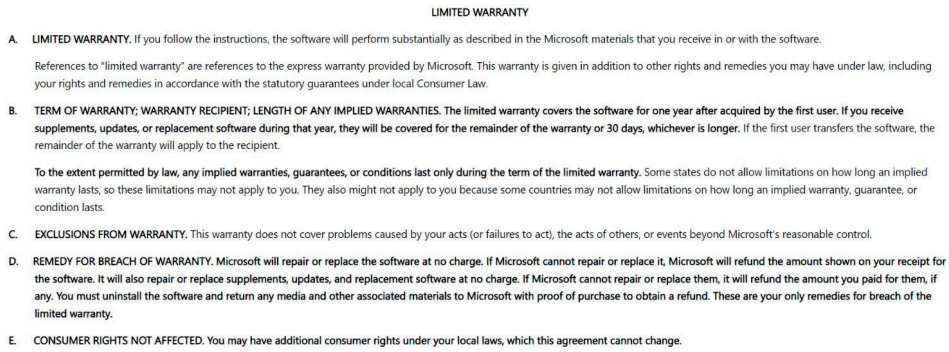
THERE IS NO WARRANTY FOR THE PROGRAM, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE PROGRAM "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE PROGRAM IS WITH YOU. SHOULD THE PROGRAM PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.

16. Limitation of Liability.

IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MODIFIES AND/OR CONVEYS THE PROGRAM AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PROGRAM (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE PROGRAM TO OPERATE WITH ANY OTHER PROGRAMS), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Figure 2. GNU General Public License - Disclaimer of Warranty and Limitation of Liability
Source: FSF (2022)

But you should also keep in mind that proprietary software is also distributed with a limited warranty that is often contractually restricted to defects in the distribution medium and an offer to supply a new copy of the software.



LIMITED WARRANTY

A. **LIMITED WARRANTY.** If you follow the instructions, the software will perform substantially as described in the Microsoft materials that you receive in or with the software.

References to "limited warranty" are references to the express warranty provided by Microsoft. This warranty is given in addition to other rights and remedies you may have under law, including your rights and remedies in accordance with the statutory guarantees under local Consumer Law.

B. **TERM OF WARRANTY; WARRANTY RECIPIENT; LENGTH OF ANY IMPLIED WARRANTIES. The limited warranty covers the software for one year after acquired by the first user. If you receive supplements, updates, or replacement software during that year, they will be covered for the remainder of the warranty or 30 days, whichever is longer.** If the first user transfers the software, the remainder of the warranty will apply to the recipient.

To the extent permitted by law, any implied warranties, guarantees, or conditions last only during the term of the limited warranty. Some states do not allow limitations on how long an implied warranty lasts, so these limitations may not apply to you. They also might not apply to you because some countries may not allow limitations on how long an implied warranty, guarantee, or condition lasts.

C. **EXCLUSIONS FROM WARRANTY.** This warranty does not cover problems caused by your acts (or failures to act), the acts of others, or events beyond Microsoft's reasonable control.

D. **REMEDY FOR BREACH OF WARRANTY. Microsoft will repair or replace the software at no charge. If Microsoft cannot repair or replace it, Microsoft will refund the amount shown on your receipt for the software. It will also repair or replace supplements, updates, and replacement software at no charge. If Microsoft cannot repair or replace them, it will refund the amount you paid for them, if any. You must uninstall the software and return any media and other associated materials to Microsoft with proof of purchase to obtain a refund. These are your only remedies for breach of the limited warranty.**

E. **CONSUMER RIGHTS NOT AFFECTED. You may have additional consumer rights under your local laws, which this agreement cannot change.**

Figure 3. Example of Limitation of warranty for proprietary software
Source: Microsoft (2016)

5. Conclusion

There is currently no formal state FOSS strategy in Bosnia and Herzegovina. Taking insight into the last adopted policy of development of the information society of our country, we find several goals that could be achieved through greater use of FOSS resources, such as:

a) strengthening digital literacy, skills and inclusion of all ICT users,

b) ICT has a huge potential that is used every day in solving many problems and social challenges. It is therefore essential that ICTs be made available to "everyone and everywhere". etc.

The results of some research show that the absolute dominance of proprietary software in the information systems of local government in BiH, low representation of free software, but the willingness of most local IT experts for greater use of free software, and a similar situation is most likely in other business sectors.

Experiences of migration to FOSS in the countries of the European Union show that, given the user needs and requirements, it is possible to replace part of the commercial software with appropriate alternatives free software while maintaining the same level of efficiency. Past practice has shown that full migration is rare, and successful full migration is even rarer, and that switching to free software actually means a symbiosis of proprietary and free software.

FOSS can definitely bring many benefits to businesses, but there are also certain risks, all of which need to be kept in mind when making business decisions of transition.

World Intellectual Property Organization states that policies to support FOSS have also been implemented in Developing and Least Developed Countries. Interesting examples in Brazil, India and Cambodia seem to indicate the positive impact of these policies in local economies, particularly through awareness and educational and training activities, and the reuse of public sector software across public administrations. In the next period, we would recommend that an analysis of case studies from these countries be carried out with the aim of using good practices in our environment.

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Dr. sc. Siniša Franjić, dipl. iur.[1] *Review paper*

BRIEFLY ABOUT CLOUD COMPUTING

Abstract

Cloud computing is a paradigm of information technology that describes the provision of IT infrastructure such as storage space or application software as a service over the Internet. In technical terms, it describes access to IT infrastructure available over a computer network without the need to install on a personal computer. Cloud computing allows users to focus on their core business instead of spending money on computing infrastructure and maintenance. Proponents note that cloud computing allows companies to avoid or minimize infrastructure costs. Proponents also argue that cloud computing allows companies to test their applications faster, improved manageability and less maintenance, and that it allows these IT teams to more quickly tailor resources to fluctuating and unpredictable requirements. Cloud computing is a paradigm of information technology (IT) that describes the provision of IT infrastructure such as storage space or application software as a service over the Internet. It can be explained as a technology that enables the use of various IT services on physically remote servers with the help of network infrastructure and appropriate Internet protocols. This type of computing provides an opportunity to reduce the initial investment in equipment and applications and to adapt them to our needs in a quick and easy way. Also, in this way, the IT sector can more easily and quickly control applications and respond to increasing and often unpredictable business demands. Every few years, a new technology appears that almost completely changes the way we worked until then. It is quite certain that cloud computing is a technology of that kind that is yet to reach its peak of development. In technical terms, cloud computing describes access to IT infrastructure available over a computer network without the need to install it on a personal computer. Cloud computing has found its application in practice. The basic scientific evidence for this is everyday application in different situations.

Key words: *Cloud Computing, Internet, CPS, Virtualization, Security.*

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1. Introduction

Cloud computing is anywhere (Smith et al., 2020). Governments, business and not-for-profit businesses all make use of cloud computing for offsite data storage or to get right of entry to 'on call for' computing power while ability is required, through offerings including Amazon Web Services, Microsoft Azure and Google Cloud. Individuals too use cloud computing offerings once they get right of entry to social media including Facebook or WhatsApp.

Cloud computing is defined via way of means of the National Institute of Standards and Technology (NIST) as 'a model for allowing ubiquitous, convenient, on-demand community get right of entry to a shared pool of configurable computing sources… that may be unexpectedly provisioned and launched with minimum control attempt or provider company interplay'.

Cloud computing adoption has also been driven via way of means of the convenience that it provides for the consumer and the provider. Cloud era approach that customers now no longer want to make certain that their hardware is robust sufficient to function the software program. The consumer can rely upon the dealer to be accountable for the entirety. That sits at the back of the provider ate up through a tool, and all of the consumer is confronted with is coping with their internet/network get right of entry to and the device itself. Equally, from the companies' point of view, there's much less subject over making sure their service works while deployed regionally on a extensive variety of hardware configurations, that means much less time and sources are spent on checking out and compatibility checks. However, it's miles really well worth noting that cloud providers do encounter challenges as a result of the changing nature of the numerous browser technology. This has caused a burgeoning enterprise in cross-browser checking out. As it's miles crucial that cloud merchandise will carry out on multiple browsers and new variations of these browsers.

Customers at the moment are capable of get right of entry to a multitude of IT services from any laptop connected to the internet/network (whether or not a desktop PC or a cellular tool – of which about four billion at the moment are in international use). Gone are the days of being limited to the usage of regionally installed software program and being depending on the ability of storage and processing power inside their local computer network.

Cloud computing is without a doubt not anything extra than the abstraction of computing infrastructure (be it storage, processing power, or application hosting) from the hardware system or users (Oram et al., 2009.). Just as you don't understand wherein your photo is stored physically after you upload it to Flickr, you may run a whole enterprise on a service this is free to run it on any system it chooses. Thus, element or all the software program runs somewhere "in the cloud." The system components and the system users don't want to understand and frankly don't care wherein the

real machines are located or wherein the data physically resides. They care approximately the functionality of the system rather than the infrastructure that makes it possible, in the same way that average telephone users don't care which exchanges they're routed via or what sort of cable the signal travels over in order to speak to their nanas.

But even though cloud computing is a natural extension of different sorts of online offerings and hosting services, it's a very crucial improvement withinside the history of the global network. Cloud computing democratizes the availability of computing power to software program creators from virtually all backgrounds, giving them supercomputers on-demand, which could power ideas into reality. Some may also say that is a go back to the old days when all users could schedule time at the mainframe and that cloud computing is not anything new, but that's hardly ever the point. The point is that this very day, supercomputers are available to anyone who has access to the Internet. Web services are standards-based architectures that expose sources (usually discrete portions of application functionality) independently of the infrastructure that powers them.

Web services permit many sites to combine their packages and records economically via way of means of exposing functionality in standards-primarily totally based codecs and public APIs. SOAs are units of internet offerings woven collectively to offer units of capability and are the catalyst this is permitting us to connect (withinside the old days we may also have said "wire together") effective computing infrastructure with software program capability, records, and customers.

Cloud Computing is the distribution of computing services including database, storage, applications, and analytics, over the Internet (Alexandrou, 2022.). Cloud computing provides business and people round the world flexibility, financial savings in price, time, and sources, allowing less reliance on traditional records centers and support teams. However, a extremely good subject with cloud computing has been the problem of safety and data privacy. Depending at the cloud computing version used, records may also now no longer belong absolutely to a enterprise or individual. The cloud service provider stores the user's data on its very own servers and has complete get right of entry to to the records, confidential or not. Additionally, physical storage of the records often spans multiple servers in different countries, making it easier for cyber criminals to manipulate the connection to the cloud or assault the data centers.

2. CPS

In the wake of the speedy trends in computer and communication technology, network-based communication and control technology have performed crucial roles in lots of business manage applications, including production plants, power plants, automobiles, aircrafts, robotic manipulators, and so on (Zhang et al., 2022.). The cyber-physical systems (CPSs) are

new class of networked embedded structures, and tightly combine computation, networking, and physical processes. Different from the traditional point-to-point system architecture, CPSs are spatially disbursed structures, and the signals among the system components are transmitted through a communication network, including the remote control of numerous cellular units, arrays of micro-actuators, and underwater acoustics.

In order to address the uncertainties, complexities and resource limitations of network communications in practical applications, the co-design among manage and communication should be taken into consideration. Networked control and event-triggered control are the two popular control approaches in CPSs. Although fruitful outcomes on networked control and event-triggered control may be determined in current publications, there are still a lot of spaces for further research via way of means of considering complexity of CPSs in applications, and its miles essential to continue in-depth research at the CPSs.

CPS depicts virtual systems relating computations tightly associated and coupled to the physical world in which people live, together with the physical data that form the core component that propels and fuels that computation (França et al., 2021.). Even so, CPS has a limited aspect, concerning computation and storage properties, concerning their tiny size and the use embedded into large structures. However, with the emergence of cloud computing, there are possibilities to extend their capabilities via way of means of utilising the benefits of cloud sources concerning the remote brain, huge data manipulation, and virtualization. Where cloud computing has brought a major revolution with tremendous price reductions related to the domain of non-real-time software program development and therefore its execution.

There are cloud computing tools available that analyze, generate, and extract actionable intelligence out of your data set. In the same way that to store and process the data, the usage of cloud computing technology in CPS will become a natural choice, wherein CPS joined Cloud, are taken into consideration the core technology of industry 4.0. Due to the primary characteristic of cloud computing is the isolation of the application software program from the underlying hardware infrastructure. Where software program components may be executed flexibly on extraordinary hardware configurations, and in a scalable way.

Monitoring the traffic flow or power consumption in a large housing society, or monitoring the air quality of a large city, requires a robust IT infrastructure. Where the properties Cloud computing gives the possibility of unexpectedly build, modify and provision CPS consists of a hard and fast of cloud computing based sensors, processing, control, and records services that permit the creation of such desired infrastructure. Cloud has abundant sources, basically resource scarcity of physical worlds, permitting to store and to system records, wherein have been quite successful in integrating numerous applications areas comprise resource virtualization, on-demand

records centers, storage, remote processing, or even huge records analytics. As well as offering different categories of services to end-users, making both Cloud computing and CPS technology complement every other with synergy and Harmony.

Thus, there was an increasing interest in aggregating the Cloud properties into CPS technology. What has led to the emergence of recent studies areas including cloud robotics, sensor clouds, and even vehicular clouds. Bringing benefits of CPS with Cloud Computing withinside the efficient use of sources, speedy development, and scalability in addition to clever adaptation to the environment at each scale.

3. Big Data

Big Data consists of 3 Vs being Volume, Velocity, and Variety, because of the need to work with an infrastructure that allows the storage and retrieval of data of numerous formats at a high scale (França et al., 2021.). Being a technology that makes use of solutions based on algorithms that capture and cross-data organized, regardless of systems such as ERP (Enterprise Resource Planning) that deal with business management, CRM (Customer Relationship Management) that do customer relationship management, BI (Business Intelligence) relating business intelligence. That is, reaching data not structured as content in numerous formats, including videos, images, photos, which can be produced mainly by social networks.

Cloud Computing consists of being the version that offers a set of computing sources conveniently, with on-demand access to the network and that may be quickly provisioned and released with management or interaction of the provider company. In easy phrases is the offer of "computing as a service", it isn't always essential to have a computer to be able to process and store data, that is the basis of the concept of Cloud Computing. If it is a technology that allows the creation and storage of data, online packages (in the cloud), being extra advantageous for the user insofar as it is a scalable service, which is provided on demand, i.e., is used as it does require.

The relationship among Cloud Computing and Big Data is narrow, wherein the primary is the infrastructure that, in a corporate environment, supports the second, which has enough capacity to process data in large numbers. The connection among those concepts is because to deal with Big Data, an infrastructure is needed that allows the storage, processing, and retrieval of the most varied types of data on a big scale, this is, it has a constant growth. As is well known, there are significant advantages in adopting Cloud Computing concerning traditional physical deployments. However, cloud structures have numerous structures and sometimes want to be incorporated with traditional architectures, because depending on the provider, its services computing works differently.

The processing and garage of a large amount of data require a very good infrastructure, which is likewise able to change this data into valuable information for the company, wherein a great deal of the Big Data applications interact with the data this is generated and stored online. The more Cloud Computing improves, the more it is a precursor and facilitator for the advent of Big Data, wherein although technology provides efficient data storage, collection, sharing, research, analysis, or even visualization.

So, the advantage of making use of the two standards simultaneously in business operations is they assist to reduce charges since cloud platforms are growing at an accelerated pace. Also, see an explosion in data generation wherein humanity has in no way generated a lot of data as in modern and current days, and the increase of data volume is exponential and constant. And so Big Data is the intelligence to search in that deep and extensive sea of information this is present in the cloud (Internet), being that the Cloud Computing is the cloud itself, having its devices dispersed at some point of the planet for persistence and storage of the data being able to host information in numerous digital formats. Finally, Cloud Computing and Big Data are an ideal combination because together they provide a solution this is scalable and adaptable to big data sets and business analysis. In this sense, provided the advantage of the analysis brings a great benefit to the company, mountain climbing because the needs of the business itself, avoiding unnecessary charges.

4. Types

There are many forms of cloud computing, often referred to by acronyms ending in 'aaS', that means 'as a service' (Smith et al., 2020). Three examples are the provision of software program (SaaS), platform (PaaS) and infrastructure (IaaS). All are IT sources provided as services hosted remotely from a user's computing tool and accessed via a network connection – very often a user's internet browser – rather than being installed locally on a customer's computer.

To elaborate at the three forms of services above:

- SaaS refers to the provision of software applications that formerly might have been installed on a desktop or network, in the cloud.
- PaaS refers to the provision in the cloud of services that enable customers to deploy applications created using programming languages and tools supported by the supplier.
- IaaS refers to services in the cloud that provide computer processing power, storage space and network capacity – enabling customers to run arbitrary software (including operating systems and applications). The most well-known are Amazon Web Services (AWS), Microsoft Azure and Google Cloud. IaaS is the platform upon which PaaS and SaaS are frequently built.

5. Contracts

Like cloud computing models, cloud computing contracts appear in a wide variety of forms (De Silva et al., 2020.). These can range from easy standardised click-wrap agreements to framework and multi-layered sets of phrases and conditions. However, there are a set of core contractual issues that a customer should consider in any cloud computing contract as a part of its procurement exercise.

There are a few points of terminology that we want to make clean on the start:

- When we refer to 'cloud computing contracts', we mean contracts in relation to Software as a Service (SaaS) solutions.
- The service providers that are providing the cloud services are referred to as 'cloud providers'.
- The organisation this is procuring the cloud services from the cloud provider is referred to as the 'customer'.

A customer may also decide that, for non-strategic applications or wherein private data or different sensitive data aren't involved, the time and charges of negotiating a cloud provider's standard terms aren't worthwhile. This may be a reasonable approach to adopt. However, for applications that are fundamental for the ongoing business of the customer and/or wherein private data are involved, a customer should consider negotiating the cloud computing contract with the cloud provider.

The extent to which a customer may also need to negotiate the cloud computing contract will obviously depend on how a great deal relative control the particular system's design affords users and cloud providers over users' applications or data, and how 'customer friendly' a cloud provider's standard phrases are. With paid-for services, providers are usually more willing to accept liability (or greater liability) and agree other user-requested commitments or measures than with free services. It appears that the more the cloud providers are paid, the more they are willing to concede.

However, it can be the case that the cloud provider simply refuses outright to negotiate on its phrases and conditions. As with any business agreement, a great deal depends on the relative bargaining power of every party. Large cloud providers generally decline any changes to their standard phrases, insisting their services are provided on a 'take it or leave it' basis. In this case, the customer has only options: either signal and accept the risks inherent with the cloud provider's phrases and conditions or walk away.

6. Virtualization

Virtualization basically means developing something digital and now no longer actual (Thuraisingham, 2016.). It might be hardware, software program, memory, or data. The perception of virtualization has existed for

many years with respect to computing. Back in the 1960s, the idea of digital reminiscence was introduced. This digital reminiscence offers the application program the illusion this is has contiguous running memory. Mapping is developed to map the digital memory to the actual physical memory.

Hardware virtualization is a fundamental perception in cloud computing. This basically creates digital machines hosted on a real computer with an OS. This means while the actual machine may be running a Windows OS, through virtualization it can provide a Linux machine to the users. The actual machine is called the host machine, at the same time as the digital machine is known as the guest machine. The time period digital machine monitor, also known as the hypervisor, is the software program that runs the digital machine at the host computer.

Other forms of virtualization include OS level virtualization, storage virtualization, data virtualization, and database virtualization. In OS level virtualization, a couple of digital environments are created inside a single OS. In storage virtualization, the logical storage is abstracted from the physical storage. In data virtualization, the data is abstracted from the underlying databases. In network virtualization, a digital network is created.

At the heart of cloud computing is the notion of hypervisor or the digital machine monitor. Hardware virtualization strategies permit a couple of OSs (known as guests) to run concurrently on a host computer. These multiple OSs share virtualized hardware sources. Hypervisor is not a new term; it was first used in the mid-1960s withinside the IBM 360/65 machines. There are different forms of hypervisors; in one type, the hypervisor runs at the host hardware and manages the guest OSs. Both VMware and XEN, which can be famous digital machines, are primarily based totally in this model. In every other model, the hypervisor runs inside a conventional OS environment. Virtual machines also are incorporated into embedded systems and cellular phones. Embedded hypervisors have real-time processing capability.

Virtualization is a core technology supporting cloud computing and abstracts actual hardware as digital computer systems (Liu et al., 2021.). Virtualization allows multiple operating systems to run on a computer system simultaneously and optimizes the usage of computing and storage sources. Practically, cloud computing virtualizes computer sources and manages them in a resource pool to provide computing services over the network, reducing the idle time of sources including CPU, RAM, network, and storage. Public clouds (e.g., Amazon AWS, Microsoft Azure) are open to the public, who pay to use them. On the other hand, a private cloud is delivered via a secure private network and usually shared amongst humans in a single organization. Cloud computing provides the smart city with the computing capability to store and access data and applications outside local computing environment via computer networks.

The proliferation of IoT enables smart cities to collect a big number of records and deploy a lot of applications at the edge to utilize these records.

The records and applications also produce challenges of near-real-time reaction, privateness, and massive numbers of records for network transmission. Cloud computing alone is not sufficient to address such challenges. A new computing paradigm, edge computing, which shifts the records storage, processing, and analyses to the end of the network, as near as possible to the devices, is deployed. With the resource of edge computing, the edges of network become records producers as well as records processors, addressing the challenge of reaction time, bandwidth, records safety, and privateness. Edge computing gives some of benefits, together with allowing services to continue to operate when there is no connection to the Internet, and processing records locally. This significantly reduces the network load with only processing results (which are usually smaller in volume than raw records) being transmitted throughout the network.

7. Storage

In a cloud storage model, the provider companies store massive amounts of records for customers in records centers (Thuraisingham, 2016.). Those who require storage space will lease the storage from the service providers who're the hosting companies. The actual location of the records is transparent to the users. What is presented to the users is virtualized storage; the storage managers will map the digital storage with the actual storage and manage the records sources for the customers. A single object (e.g., the entire video database of a customer) can be stored in multiple locations. Each location may also store objects for multiple customers.

Virtualizing cloud storage has many benefits. Users need not buy expensive storage devices. Data might be positioned everywhere withinside the cloud. Maintenance including backup and restoration are provided via way of means of the cloud. The aim is for users to have rapid access to the cloud. However, because the owner of the records does now no longer have complete control of his records, there are serious safety concerns with respect to storing records withinside the cloud.

A database that runs on the cloud is a cloud database manager. There are a couple of ways to utilize a cloud database manager. In the primary model, for users to run databases at the cloud, a Virtual Machine Image must be purchased. The database is then run at the digital machines. The second version is the Database as a Service model; the service provider will maintain the databases. The users will make use of the database services and pay for the service. An example is the Amazon Relational Database Service, which is an SQL database service and has a MySQL interface. A third version is the cloud provider, which hosts a database on behalf of the user. Users can either utilize the database service maintained via way of means of the cloud or they can run their databases at the cloud. A cloud database must optimize its query, storage, and transaction processing to take full advantage of the services provided via way of means of the cloud.

8. Semantic Web

While the modern internet technology facilitates the integration of information from a syntactic point of view, there's still a lot to be completed to handle the different semantics of various systems and applications (Thuraisingham, 2016.). That is, modern internet technology rely on loads at the "human-in-the-loop" for records control and integration. Tim Berners-Lee, the father of the World Wide Web, realized the inadequacies of modern internet technology and in the end strived to make the internet extra wise. His aim changed into to have an internet that could basically alleviate people from the burden of having to integrate disparate information sources, as well as to carry out extensive searches. He then concluded that one needs machine-understandable internet pages and the usage of ontologies for records integration. This resulted withinside the notion of the semantic web. The internet services that take advantage of semantic internet technology are semantic internet services.

A semantic web may be thought of as a web this is highly intelligent and sophisticated so that one needs little or no human intervention to carry out tasks such as scheduling appointments, coordinating activities, searching for complex documents, as well as integrating disparate databases and information systems. While much progress has been made towards developing such an intelligent web, there's still a lot to be done. For instance, technology including ontology matching, intelligent agents, and markup languages are contributing a lot toward developing the semantic web. Nevertheless, one still needs the human to make decisions and take actions. Since the 2000s, there have been many developments at the semantic web. The World Wide Web consortium (W3C; www.w3c.org) is specifying standards for the semantic web. These standards include specifications for XML (eXtensible Markup Language), RDF (Resource Description Framework), and interoperability.

Essentially, the semantic web consists of layers where each layer takes advantage of the technology of the previous layer. The lowest layer is the protocol layer, and that is commonly not included withinside the discussion of the semantic technology. The next layer is the XML layer. XML is a document representation language. While XML is sufficient to specify syntax, semantics such as "the creator of document D is John" is difficult to specify in XML. Therefore, the W3C developed RDF, which makes use of XML syntax. The semantic web community then went further and came up with a specification of ontologies in languages including OWL (Web Ontology Language). Note that OWL addresses the inadequacies of RDF. To reason about various policies, the semantic web community has come up with web rules language including SWRL (Semantic Web Rule Language).

9. Security

Over the last decades, cloud computing has gained tremendous popularity due to ever growing requirements (Kanwal et al., 2021.). Organizations which might be heading toward cloud-primarily totally based data storage options have numerous benefits. These include streamlined IT infrastructure and management, remote access with a secure internet link from all around the globe, and the cost-effectiveness that cloud computing can offer. The related cloud safety and privateness issues need to be further clarified.

Although a lot of challenges are confronted via way of means of emerging cloud computing technology such as interoperability, scalability, Service Level Agreement (SLA), lack of standards, continuously evolving, compliance concerns etc., safety is fundamental barrier into the adoption of cloud computing technology. Manage and maintain secure cloud computing environment is more difficult task than conventional information technology (IT) environment. As the cloud computing environment is an outsourcing of IT, in conjunction with the inherited safety issues of IT environment, cloud computing also come across with a few additional safety challenges which might be focused via way of means of researcher community withinside the last decades.

Cloud consumers need to make sure their technology save cost and never sacrifice valuable data because there are numerous ways of data being compromised. The amount of risk will increase because of the way in which a cloud particularly increases, due to which it may demand to remove and modify record, if the encoding keys lost it's also much painful. Some of them are unique due to the nature of cloud and complex too to recover because of cloud architecture. CSA's (Cyber Security Authority) suggested solutions include strong access control API implementation, data integrity and encryption and its safety at the same time as data transfer, implementing generation of strong key, analyzing the data safety at design and also at run time. While considering safety of cloud computing the data comes at topmost priority. Data robbery and corrupted storage are major risks in data safety.

10. Smart Electronics

The future Internet will comprise now no longer only millions of computing machines and software program services but also billions of personal and professional devices, diminutive sensors and actuators, robots, and so on, and trillions of sentients, clever, and digitized objects (Raj et al., 2017.). It is an overwhelmingly accepted fact that the fast-emerging and evolving Internet of Things (IoT) concept is definitely a strategic and highly impactful one to be decisively realized and passionately sustained with the clever adoption of the state of-the-art information communication technology (ICT)

infrastructures, a bevy of cutting-edge technology, composite and cognitive processes, versatile and integrated platforms, scores of enabling tools, pioneering patterns, and futuristic architectures. Industry specialists and academicians are continuously looking out for appropriate use and business and technical cases in order to proclaim the transformational power of the IoT concept confidently and cogently to the larger audience of worldwide executives, end users, entrepreneurs, evangelists, and engineers.

A developing array of open and industry standards are being formulated, framed, and polished via way of means of domain experts, industry consortiums, and standard bodies to make the IoT paradigm extra visible, viable, and valuable. National governments throughout the globe are setting up special groups in order to pop out with pragmatic strategies, policies, practices, and procedures to take forward the ground-breaking ideas of IoT, and to realise the strategic significance of the envisioned IoT era in conceiving, concretizing, and providing a set of next-generation citizen-centric services to ensure and enhance people's comfort, choice, care, and convenience. Research students, scholars, and scientists are working collaboratively towards identifying the implementation challenges and overcoming them via extraordinary means and ways, especially via trendy technological solutions.

Our living, relaxing, and working environments are envisioned to be filled up with a variety of electronics including environment monitoring sensors, actuators, monitors, controllers, processors, tags, labels, stickers, dots, motes, stickers, projectors, displays, cameras, computer systems, communicators, appliances, robots, gateways, and high-definition IPTVs. Apart from those, all of the physical and concrete items, articles, furniture, and packages will become empowered with computation and communication-enabled components via way of means of attaching specially made electronics onto them. Whenever we walk into such kinds of empowered and augmented environments lightened up with a legion of digitized objects, the devices we carry and even our e-clothes will enter into a calm yet logical collaboration mode and form wi-fi ad hoc networks with the inhabitants in that environment. For instance, if a person wants to print a document in his or her smartphone or tablet, and if she or he enters right into a room wherein a printer is situated, the smartphone will begin a conversation with the printer automatically and send the document to be printed.

Thus, in that era, our everyday spots might be made informative, interactive, intuitive, and invigorative via way of means of embedding and imbedding intelligence into their constituents (audio or video systems, cameras, information and internet appliances, consumer and household electronics, and different digital devices except digitally augmented walls, floors, windows, doors, ceilings, and some other physical objects and artifacts). The disappearing computer systems, communicators, sensors, and robots might be instructing, instigating, alerting, and facilitating decision making in a clever way, apart from accomplishing all kinds of everyday needs proactively for human beings. Humanized robots might be extensively used in order to

fulfil our everyday physical chores. That is, computer systems in different sizes, looks, capabilities, interfaces, and prizes will be fitted, glued, implanted, and inserted everywhere to be coordinative, calculative, and coherent, yet invisible for discerning human minds. In summary, the IoT technology in sync up with cloud infrastructures are to result in people-centric smarter environments. Context awareness is the key motivator for business and IT (Information Technology) systems to be distinct in their operations, offerings, and outputs. The days of ambient intelligence (AmI) are not far away as the speed and sagacity with which scores of implementation technology are being unearthed and nourished via way of means of product vendors and system integrators.

11. Conclusion

Cloud computing is the ability to access on-demand resources of computer systems, especially data storage resources and computing power, without direct active management by users, most often via the public Internet. The term is generally used to describe data centers available to many users via the Internet. Cloud computing is a technology that uses the Internet to store and manage data on remote servers and then access data over the Internet. This type of system allows users to work remotely. Cloud users do not have the physical infrastructure; they rent the use from a third party. Cloud Computing and the basic features of cloud services are on-demand self-service, wide network access, pooling of resources, fast resilience. Cloud computing is very successful because of its ease of use. They are a cost-effective solution for businesses.

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Nino Alić, MA[1] *Preliminary communication*

ANALYSIS OF HEALTHCARE PROFESSIONALS' SATISFACTION WITH THE INTRODUCTION OF A MONITORING SYSTEM FOR ATTENDANCE AT THE WORKPLACE

Abstract

The introduction of a monitoring system for attendance at the workplace has been shown to improve the quality of care provided by healthcare professionals. This study aims to analyse the satisfaction of healthcare professionals with the introduction of a monitoring system. Main goal is to analyse the degree of satisfaction, perceived usefulness, and perceived ease of use of a monitoring system for attendance at the workplace by healthcare professionals. A survey was conducted among healthcare professionals. The questionnaire consisted of three sections. Section 1 contained questions regarding demographics, Section 2 had questions related to the introduction of a monitoring systems and Section 3 included questions about the satisfaction of healthcare professionals with the introduction of a system for monitoring attendance at the workplace. The results showed that the majority of respondents were satisfied with the introduction of this system. This means that the introduction of a system of monitoring attendance at the workplace has been successful.

Key words: *Electronic Surveillance Systems, Nursing Staff, Healthcare Professionals, Attitudes, Satisfaction.*

Acknowledgements*: Special thanks go to all INZ staff for their positive support, as well as other medical staff from other healthcare institutions.*

1. Introduction

The introduction of a monitoring system for attendance at the workplace has been shown to improve the quality of care provided by healthcare professionals (Dellve, 2011; Doyle, 2008).

Workplace attendance monitoring system has been shown to improve the quality of care provided by health professionals (Louise, 2017). This study

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aims to analyse the satisfaction of healthcare professionals with the introduction of a monitoring system.

Managing and monitoring attendance of employees is important aspect for smooth functioning of any organization. Attendance management is the act of managing attendance or presence in a work setting to minimize loss due to employee downtime (Arun, 2017). Attendance is used for various purposes including record keeping, overtime payments, and promotions. The management of attendance of the employees is a complex but necessary task since the presence of officials in offices directly impacts productivity and efficiency. Traditionally, attendance has been managed through registers where officials mark their attendance upon arrival in office. It involves the use of sheets of paper or books in taking attendance (Liyanage & Liyanage, 2018).

Planning is the starting function of managing both small and medium-sized and large companies. It is based on the goals that need to be achieved, the determination of prerequisites for the realization of those goals, and the choice of methods and techniques for their success.

Planning is a conscious process of predicting the near future. Planning is a very important function of management. Planning can be strategic and operational, and, from the point of view of the time horizon, long-term, medium-term, and short-term. Well-organized business planning, based on reliable and efficient methods and techniques, is the key to successful management of business systems and processes (Hasanbegović, 2020).

There is a critical point in the development of every company when it goes from a small-medium-sized company to a large one, when it is necessary for the management to start thinking about the business culture (Radić, 2017). It should also be part of strategic planning.

Business culture is not reserved only for individuals, it applies to organizations, but also to society as a whole. Organizations with a high level of business culture are successful organizations.

If you want to succeed in the business world, you cannot allow yourself to be unreliable, to not fulfil agreements and deadlines (Radić, 2017), to promise what you cannot fulfil. Organizations focused on short-term goals and solely on profit skip serious steps in business behaviour.

Happy Workplaces foster productivity and quality at work (Kapoor, 2022). Any good leader wants their employees to be happy and satisfied, but it is difficult to gauge how satisfied employees are without regular and consistent feedback.

Employees Attitude at work is a prominent factor that defines the overall morale and culture of the company. An employee is an important asset today and his well-being is an equal measure of the company's well-being. Therefore, conducting an employee satisfaction survey and measuring it is important for building a better workplace (Kapoor, 2022).

Everyone talks about building a relationship with your customers. You should think about how to do it with your employees first (Kapoor, 2022).

Job satisfaction or employee satisfaction is a measure of contentment relative to the emotional or mental state of mind about their job. Whether or not they like the job or specific aspects of jobs, such as the nature of work or supervision (Kapoor, 2022).

Job satisfaction depends on several determinants such as satisfaction with pay, promotion opportunities, fringe benefits, job security, relationship with co-workers and supervisors, working environment, etc. Job satisfaction can further be differentiated as cognitive or affective (Kapoor, 2022).

There is difference between cognitive and affective employee satisfaction. **Cognitive satisfaction** refers to rational satisfaction over specific facets of the job, monthly payment terms, job responsibilities, opportunities to grow and learning, perks and benefits, etc. It is the combination of more rational and objective factors that determines one's involvement and satisfaction at work (Kapoor, 2022). **Affective satisfaction** is the aggregation of pleasurable emotions and feelings associated with the job and how it is perceived to be placed in the individual's life. It defines how an employee feels about working in a certain environment as to how comfortable he is with the prevailing work culture (Kapoor, 2022).

Also often used interchangeably, employee satisfaction and employee engagement are relatively different concepts. Employee Engagement is something that happens when workers are committed to helping their company achieve all of their goals whereas Employee Satisfaction defines the mental and emotional state of the employee at work and how well he is enjoying his work. An engaged employee is satisfied with his job, but the reverse may not always hold (Kapoor, 2022).

What are the advantages of measuring employee satisfaction? Happy employees make organizations happy places to work. Tracking Employee Satisfaction at regular intervals helps you to evaluate the overall health of the organization. Employee retention is a key area of concern for any organization. It becomes difficult to retain good employees if they feel undervalued or dissatisfied at work. A regular check to ensure a positive work environment and address the challenges can help you retain good talent for a long haul.

According to the two-factor theory (also known as Herzberg's motivation-hygiene theory and dual-factor theory), there are certain factors at the workplace that leads to employee satisfaction while various others that cause dissatisfaction, all of which are independent of each other and hence must be dealt with differently (Herzberg, 1993). This proposes that satisfaction and dissatisfaction are not on a continuum with one increasing as the other diminishes but are independent.

2. Law aspect in Bosnia and Herzegovina

In Bosnia and Herzegovina, with the introduction of new legislation, employers are prescribed the following items:

Labor Law of the Federation No. 26/16, 2016 - The subject of the law is working time and the concept of working time according to section IV/35, which states that it is the time during which the employee, according to the employment contract, is obliged to perform tasks for the employer, to whom if the worker is ready to respond to the call, it is not considered the employer's working time for performing the work, if the need arises and the worker is available for work and the amount of compensation for the time of readiness is regulated by the collective agreement, the work regulations and the work contract. Labor Law of the Federation (No. 26/16, 2016) which talks about record-keeping obligations according to Article 43 of the aforementioned law, where it is stated that the employer is obliged to keep daily records of workers and other persons engaged at work, which must contain data on the beginning and end of working hours, shifts and other data on the attendance of workers at work. The employer's obligation is to present the records to the labor inspector at his request.

Labor Law of the Federation No. 92/36, 2016 - There is a defined rulebook on the content and method of keeping records on workers and other persons engaged in work. This rulebook prescribes the content and method of keeping records on workers and other persons engaged in the work of the employer. The records of workers referred to in Article 1 of this rulebook must contain data on workers, other persons engaged in work and working hours.

The law does not prescribe the form of keeping records, that is, it is possible to keep records manually (for example, by recording data about working hours on paper or through Excel tables) or electronically. However, the way records will be kept, in practice, mostly depends on the number of employees. Namely, it does not matter whether an organization has 5 employees or 30 or more. It is certainly simpler to keep records of working hours manually or through an Excel table, if there is a small number of employees. However, as the organization grows, such a way of keeping records becomes more and more complex (Špica Systems d.o.o., 2021).

In addition, numerous errors caused by the human factor are possible when keeping records manually. For example, there is always the possibility of entering the time of arrival or departure of an employee incorrectly, of not entering the agreed vacation for an individual employee on time, etc. Such situations can cause unnecessary and harmful problems at work and can lead to errors that can cause the business to suffer (Špica Systems d.o.o., 2021). In order to avoid this, it is always better and simpler to introduce a system for recording working hours.

The record of working hours is an obligation prescribed by the Law on Labor and the Method of Keeping Records on Workers. However, it is not just

a legal obligation. The record of working hours is, we can say, a matter of business hygiene of every organization that employs workers. It is very useful to see how much employees are working, if they are working overtime and if there is a problem involving the need to redistribute work hours (SK SISTEM d.o.o., 2017). Sometimes it may seem that the requirement for orderly and regular keeping of records of working hours is too bureaucratically oriented, but quality records of working hours can provide a better insight into the work of employees and based on various reports, it is possible to analyse where there is room for improvement in work processes.

The development of the IT industry has also greatly influenced the way of keeping records of working hours and access control. Many companies are switching to more advanced timekeeping solutions, thus ensuring simpler and faster keeping of such records.

It is also possible to see how much a certain employee is burdened and whether it is necessary to make additional redistribution of responsibilities within the organizational structure of the company (Špica Systems d.o.o., 2020).

People as a species are fixed in their own ways, that's why it is necessary to carefully examine such a significant change and determine which items can be improved and optimized so that the results are as positive as possible.

Therefore, it is necessary to continuously research what can be done to improve quality.

3. Literature review

It is possible to create an organisational culture where absence is accepted as inevitable and something that cannot be controlled. The literature shows that the commitment of senior managers to a clear policy of attendance management is vital in avoiding such attitudes becoming entrenched. Making the objectives of any attendance policy clear is also essential. A policy which is to be credible and successful needs to communicate clearly to all staff and applied uniformly throughout an organisation (Bevan, 1998). The research demonstrates that a culture of good attendance can be created by discussion and feedback on attendance as a feature of regular staff briefings.

Policy methods defined. The purpose of any attendance policy needs to be clearly conveyed to employees so that the importance the organisation places on attendance is appreciated. This will contribute to the creation of an attendance culture (Bevan, 1998).

Emphasis on senior management commitment. Senior managers must be seen to be committed to achieving good attendance and giving support to measures that will encourage staff to attend. This will emphasise the con-

cern that the organisation has for the welfare of their employees and their attendance at work (Bevan, 1998).

According to Bevan (1998) key aspects which should be addressed by attendance policies include:

Line management responsibility for implementing policy. Line managers are best placed to monitor and deal with the absence of staff reporting to them, as they know them personally and see them on a regular basis.

Manager to use discretion as to when an attendance review is necessary. Rather than relying mechanistically on trigger points which result in disciplinary procedures starting automatically, it is preferable to use the judgement of the manager as to whether such action is appropriate, as they should be aware of the individual employee's circumstances.

Managers to stay in touch during employee's absence. To ensure that the sick employee appreciates the concern of his employer and the interest in them returning to work, it is essential that contact by post, telephone or personal visit should be maintained by the line manager.

Overall, the role of line managers is crucial to developing good practice in managing attendance, since they have the closest contact with the individuals concerned. Action taken by other parties (such as Personnel) is likely to be less timely, more formal and out of touch with the detail of the circumstances.

A culture of feedback instils faith and respect between the employees. It is difficult to address every complaint of the employees, but it is essential to make them feel that you are hearing their issues and are committed to foster positive changes and resolve the gaps (Kapoor, 2022).

Having mobile access to time tracking systems is one of the factors that increases adoption, because it does not restrict the user in any way. Today's workforce is demanding in terms of flexibility. Mobile access gives them the ability to comply with their company's time tracking requirements at their convenience, making it a win-win situation for all. Mobile access improves employee engagement and boosts acceptance of the time tracking process. Companies worldwide have invested heavily to ensure effective, seamless business communications and flow of information. Time tracking systems that cannot be accessed while on the go, or out in the field, makes it difficult for both employees and managers to report in, access vital data and make staffing plans. The fact that 10.5% of our respondents reported this to be an issue only underlines the increasing importance of being able to have location-agnostic access to timesheet data (Replicon, 2016).

Ononiwu (2012) talks about the RFID technology which she proposed to be implemented to record student's attendance and how helpful it would be for the students as it helps them save a lot of time in filling the attendance sheet a traditional practice been followed in most of the universities. Also,

it would be very cost effective to implement the RFID technology which is very fast and simple. Because of the use of RFID technology in attendance monitoring, there was real-time information available on the card. This model can be adapted and implemented in the organization for attendance monitoring system and further payroll management system based on attendance.

The organization is often concerned about employee attendance. Employee's performance is affected by his/her attendance in the organization. Unnati (2014) reviews various computerized techniques of attendance. Based on this review a newly proposed technique can be used by various organizations. RFID will take auto attendance for all the employees entered in the organization which will be directly connected to the payroll management system so that there is no loss of pay to the employee and they are motivated to work more (Unnati, 2014)

At the implementation side, it does not need any expensive technology. Today RFID based card are very affordable and voice-based/web-based voice and image capturing technology are easily available in an affordable way. Installation and maintenance are also not expensive of these technologies. At the same time, this will provide a more efficient and structured way for data collection and processing, which can reveal many hidden patterns about employees in an organization (Shukla, 2019).

However, an issue with these electronic cards or password-based system allows for imposture since cards or passwords can be shared or someone can ask another person to insert his/her card or password. This problem can be addressed by using biometric recognition system which includes fingerprint or iris recognition.

In our work, we addressed the problem utilizing smartphones internet connectivity for monitoring the presence or attendance of an individual. Smartphone based monitoring system reduces the surplus cost of additional scanning device because now a days almost each employee possesses a smartphone of his own (Shermin, 2015). An area is fixed for every employee when an employee enters or exits that area, that time stamp is saved and the time duration of any particular employee residing within its area is calculated by the system.

Enterprises should adopt a series of compensation system reforms, including a position evaluation technique that categorizes different positions using a stairway structure. Vertical and horizontal gaps should be pulled to allow incomes to be distributed to contributors. Compensation should be distributed according to contributions made to the enterprises, while bonuses, subsidies and welfare should be included in the pay system. The uniqueness of enterprises and departments should be fully considered to result in the maximum effect of human cost investment (Lai, 2011).

Hoppock (1935) was the first scholar to propose the concept of employee satisfaction, which he defined as the subjective reaction or satisfaction of

employees with physical and psychological aspects of their work environment. Beer (1993) defined employee or job satisfaction as employees' attitude toward enterprises, work, colleagues and the work environment.

Locke proposed the Value theory and suggested that employee satisfaction does not refer to individual needs, but is related to individuals' wants, desires or values. If employees are well-paid, have a good work environment and promotion opportunities that meet their work values, employees will be satisfied (Locke, 1973).

Schneider and Vaught indicated that employee satisfaction refers to the positive emotion employees feel after evaluating their work situation (Schneider, 1993).

Cherrington postulates that employees experiencing high satisfaction levels contribute to organisational commitment, job involvement, improved physical and mental health, and improved quality of life both on and off the job. Job dissatisfaction on the other hand, culminates in higher absenteeism, turnover, labour problems, labour grievances, attempts to organise labour unions and a negative organisational climate. (Cherrington, 1994).

Employee satisfaction is considered in the service profit chain, which includes internal service quality and external service quality. They emphasized that enterprises should pay attention to external customers' service quality, value internal employees' service quality, treat employees as internal customers, and thus increase employee satisfaction (Heskett, 1994).

Chang (2005) provided a general definition of job satisfaction that is very similar to earlier definitions: it is the feeling or attitude of employees toward their work environment. Chang measured workers' overall satisfaction with their work by the "Minnesota Satisfaction Questionnaire" (MSQ).

Jerald (1995) suggested that that employee satisfaction refers to the general attitude of employees toward work, and that it reflects a person's work cognition, emotions and evaluations. In general, the job satisfaction of white-collar workers is higher than that of blue-collar workers; older workers have high job satisfaction than younger ones, and more experienced workers have higher job satisfaction than inexperienced ones. Interestingly, female employees' experience higher job satisfaction than male employees.

The definition of job satisfaction most often cited by scholars is the one proposed by Locke (1976): employee satisfaction is the pleasant or positive emotion an employee feels upon evaluating his or her work (Brown 1993).

Schultz (1966) went further and suggested that the factors of job satisfaction include personal factors (that is, age, education, gender, personality traits) and work factors (that is, organization and management, pay, work safety, communication).

I it is suggested by Locke (1973) that factors that determine employees' job satisfaction can be divided into two basic categories: work events and behaviour. He indicated that job satisfaction is the interaction between these two elements. Work events include the work itself, compensation and the working environment; behaviour includes the actors and others who move in and out of the organization.

According to Shih (1991), factors included in job satisfaction include work attributes (works), pay, supervisors, partners, promotion and overall satisfaction.

Wang (1999) suggested that factors influencing employee satisfaction include employees' traits, including seniority, age, educational level, level, economic capacity and organizational commitment.

According to Lin (2002), the factors of employee satisfaction include pay welfare and the working environment.

Tsai (2004) suggested that the factors of employee satisfaction refer to internal service quality.

Finally, Chang (2005) indicated that the factors of employee satisfaction include internal marketing, gender, educational background, seniority and compensation.

It was also noted that fake leave among commercial banks in the Kingdom of Bahrain was as a result of the absence of electronic fingerprint applications. The installation of e-fingerprints is an effective attendance management system because it shows those employees who have reported to work and those who have not automatically. Therefore, this helps in curbing absenteeism among lazy employees in the commercial bank organizations within the Kingdom of Bahrain (Abdulla, 2019).

4. Research methodology

There are majorly popular methods to measure Employee Satisfaction. The methods are quantifiable means of evaluating and tracking Employee satisfaction, yet both have their pros and cons.

Given the nature of the research question, the most appropriate method for this study is a quantitative study. An online questionnaire was developed by adopting previous instruments by other researchers.

Questions asked had the task of investigating both employee satisfaction with the general sense and satisfaction with the culture and policy of work in the company, as well as to investigate the opinion and satisfaction with the introduction of a monitoring system for attendance at the workplace, perceived usefulness and perceived ease of use of a monitoring system for attendance at the workplace by healthcare professionals

A survey was conducted among healthcare professionals. The questionnaire consisted of three sections. Section 1 contained questions regarding demographics, Section 2 had questions related to the introduction of a monitoring system and Section 3 included questions about the satisfaction of healthcare professionals with the introduction of a system for monitoring attendance at the workplace.

Further, responses are kept anonymous to gather the most honest and real feedback. The employee. Question should also be combined with additional surveys to understand what factors contribute to scores.

5. Descriptive analysis & interpretation

The use of a monitoring system helped improve employee attendance at work. This allows them to take care of any personal matters that may have caused their absence before they leave the office. In addition, this type of system can help employers track employee performance and productivity.

This study aimed at assessing the impact of introducing an electronic surveillance system to monitor staff's work hours based on their attendance patterns and satisfaction levels. Data were collected from the nurses who participated in the study using questionnaires.

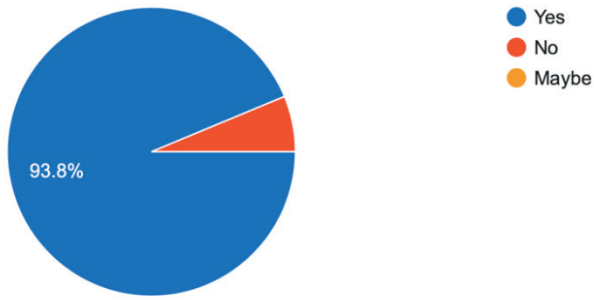

Figure 1. Are you familiar with the benefits of implementing a digital attendance monitoring system at the workplace?

To the question in Figure 1, a large number of respondents, 93%, answered the question with a positive answer.

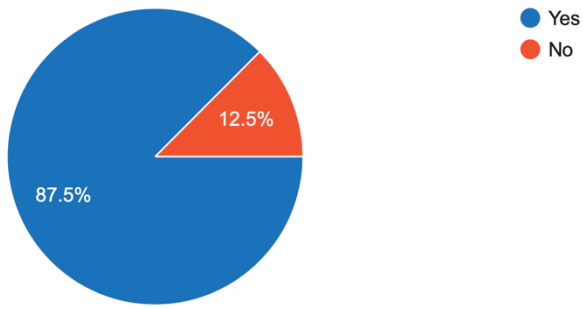

Figure 2. In your opinion has the integration - the introduction of the working time monitoring system been successfully implemented?

To the question “opinion on the integration - the introduction of the working time monitoring system has been successfully” (Figure 2) a large number of respondents, 87%, answered the question with a positive answer.

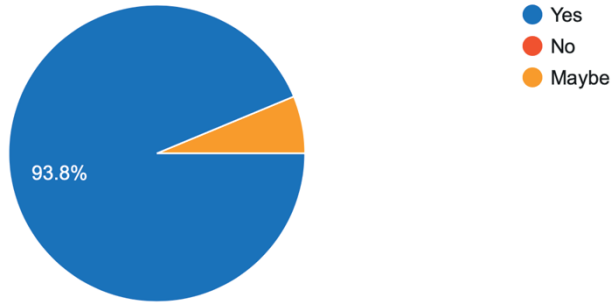

Figure 3. Can you flexibly manage your requirements in the time tracking system?

A large number of respondents (93%) answered the question with a positive answer, while 0% was negative and approximately 7% answered with maybe which indicates uninformed employees that there is a small number.

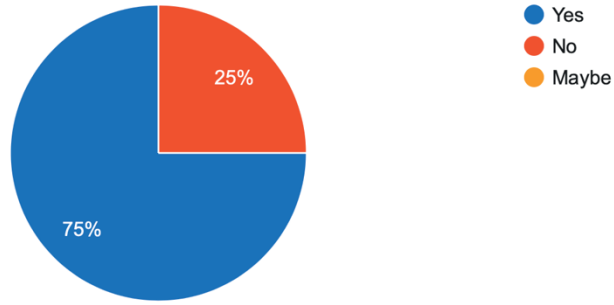

Figure 4. Do you have a mobile application for monitoring and recording working hours?

In question in Figure 4, a large number of respondents of (75%) answered the question with a positive answer, which can indicate that to determine the number of employees, there was no need to install the mobile application.

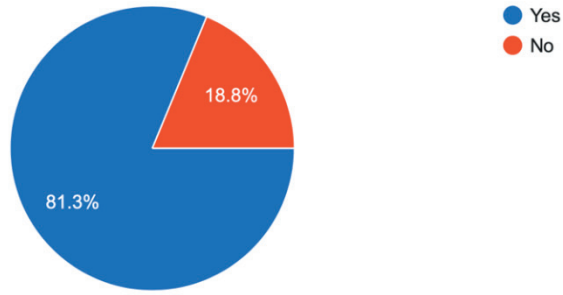

Figure 5. Are the employees satisfied with the introduction of the working time monitoring system?

Majority of respondents (81%) answered the question with a positive answer, which indicates that the majority of employees are satisfied with the introduction of the working time monitoring system.

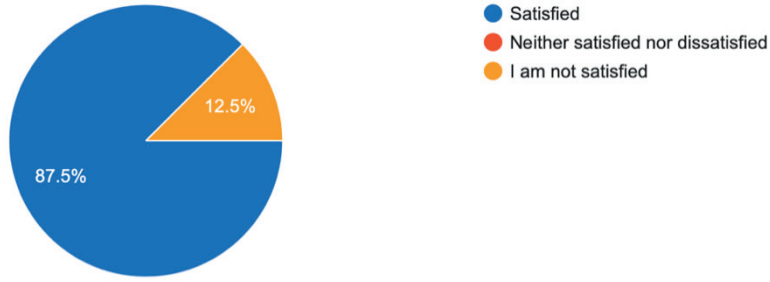

Figure 6. Are you satisfied with the work process of the IT staff on corrections related to the digital attendance monitoring system at the workplace.

In Figure 6 we see that employees answered 87% the question with a positive answer regarding the work process of the IT staff on corrections related to the digital attendance monitoring.

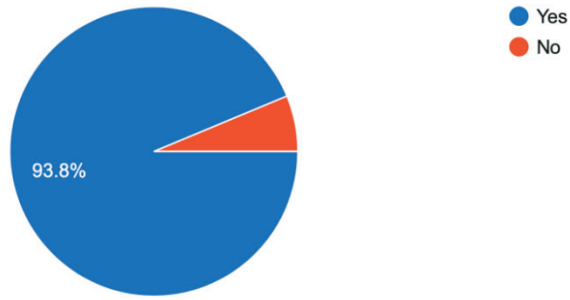

Figure 7. Do you enjoy the work culture of your company?

The majority (93%) gave positive answer to the question which indicates that the majority of employees are satisfied (Figure 7).

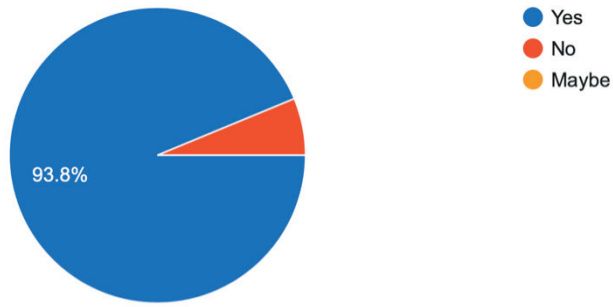

Figure 8. Do you feel positive and motivated at your workplace?

The majority (93%) also gave positive answer to the question which indicates that the majority of employees are satisfied and motivated to work (Figure 8).

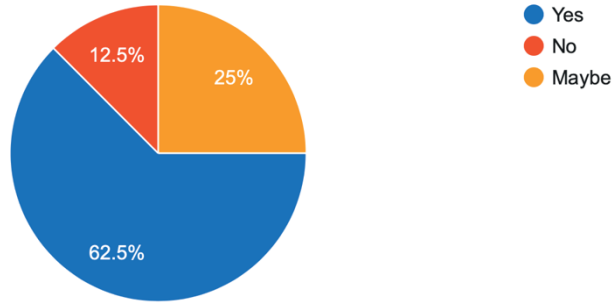

Figure 9. Do you have a standardized manual for using the digital monitoring system?

To the question in Figure 9, 67% of employees gave a positive answer, while the rest of the employees does not know or have not been instructed that there is an official user manual for the monitoring system for attendance at the workplace app.

In opinion of the 87% of employees the integration - the introduction of the working time monitoring system been successfully. The results show that 93% of health care workers can flexibly manage requirements in the time tracking system. Results of the questionary show that 75% of employees Do have a mobile application for monitoring and recording working hours. Employees are satisfied with the introduction of the working time monitoring system 81% of health workers are satisfied with the introduction of the attendance monitoring system. Conclusions indicated that the introduction of an attendance monitoring system could potentially improve employees' job satisfaction if its use is well integrated into existing organizational processes. Further studies should investigate the effect of the introduction of the system on employee turnover, job performance, and patient outcomes. Employees are satisfied with the work process of the IT staff on corrections related to the digital attendance monitoring system at the workplace in 87% of responses. Regarding company culture 98% of responses are positive and equal number of health care professionals of 98% answered that they are motivated at workplace. While a worryingly small number of 62% employees are informed that there is a standardized manual for using the digital monitoring system?

6. Conclusion, suggestions & limitation

The results showed that the majority of respondents were satisfied with the introduction of this system. This means that the introduction of a system of monitoring attendance at the workplace has been successful. Health care professionals are generally satisfied with the introduction of a monitoring system for attendance at the workplace. The results indicate that the respondents are dissatisfied with the lack of information provided about the monitoring system. The respondents are satisfied with the quality of the services provided by the monitoring system. Health care professionals are not satisfied with the quality of services provided by the monitoring systems. Research has indicated that health care professionals are concerned that the monitoring system may lead to increased workloads. It is necessary to repeat the questionnaire every year and HR management must work on improvements and understanding of employees' needs and their job descriptions in order to increase productivity. The limitation is that this is a study that was conducted on a small number of respondents, only 15% from the Institute for Health and Food Safety Zenica and a couple of voluntary respondents from other health institutions. We can also conclude that more research is needed in this field.

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Preliminary communication

CUSTOMER RELATIONSHIP MARKETING AS A PREDICTOR OF PASSENGER TRANSPORT SERVICES USER LOYALTY

Abstract

Enterprise marketing management is continuously facing the challenges of finding answers to increasingly intense competition and changes in customer behavior. Customer relationship marketing, as a marketing concept, is becoming increasingly important, especially in the service sector, because its successful application allows to build long-term relationships with customers, which creates the preconditions for gaining an advantage over the competition. The subject of the research is the customer relationship marketing and its impact on the loyalty of users of passenger transport services in the Zenica-Doboj Canton. The main aim of the research is to examine the effectiveness of marketing relationships with customers on their loyalty in case of transport services in the Zenica-Doboj Canton. The research was conducted from April 8 to April 14 2022. on the users of passenger transport services of randomly selected companies operating in the area of Zenica-Doboj Canton. Using multiple regression analysis it was found that by investing in two dimensions of marketing relationships with customers, namely building trust and better conflict management, companies engaged in passenger transport services in Zenica-Doboj Canton can build positive long-term business with their customers based on loyalty in all its manifestations: cognitive, affective, conative and behavioral dimensions. Limitation of interpretation of the obtained research results in the sample size (n = 40) and spatial limitation in the area of Zenica-Doboj Canton.

Key words: *Relationship Marketing, Customer Loyalty, Reliability Analysis, Correlation Analysis, Multiple Regression Analysis.*

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1. Introduction

Relationship marketing is an upgrade of classic marketing solutions. Its popularity was contributed by theoretical models created as a result of academic research in the field of consumer satisfaction, during the 80s and 90s of the last century. Today, relationship marketing implies the creation of interactions, which aim to build long-term relationships with clients in order to retain them, increase the number of new users and ultimately achieve greater business profitability. As a special segment of this holistic marketing approach, customer relationship marketing stands out, which forms the core of relational marketing, given that the primary interactions of every company are aimed at clients.

Yet, the implementation of this marketing concept in transport companies was much slower compared to other service companies. The primary reason for the delay in implementation is reflected in the fact that transport companies, especially in transition countries such as Bosnia and Herzegovina, were state-owned and held a monopoly position. However, with market liberalization and the process of privatization of companies in the field of transport, especially passenger, the need for the establishment and application of marketing business principles is recognized, as well as the necessity of accepting the concept of meeting the needs of users of transport services and creating their long-term loyalty.

In addition to the theoretical parts that represent the methodological and conceptual framework of research, which relate to the field of research, the results of the empirical research on the effectiveness of relationship marketing with customers on their loyalty in case of transport services in the Zenica-Doboj Canton will be presented.

2. Literature Review

In its initial stages of development and implementation, relationship marketing was primarily concerned with internal processes and resource aspects of its application in order to build long-term relationships with its clients.

According to Grönroos (1996) relationship marketing is the process of building, maintaining and improving relations with customers, with the aim of achieving common interests and exchanging products, services, values and ideas. Relationship marketing, according to Greenberg (2010), is both a philosophy and a business strategy supported by an internal organization and a technological base, designed to improve interactions between the organization and its environment. Therefore customer relationship marketing therefore focuses on the integration of resources (organizational, human, material) and activities (marketing, managerial, etc.) with the aim of building long-term and profitable relationships with customers.

Leonard Berry was the first to use the term relationship marketing in the service sector (Bitner, 1995), defining it as *attracting, maintaining and improving relationships with clients of service organizations*. He believed that the key to the survival of service companies lies in changing the perspective and trends of service marketing: targeting profitable customers, higher level of marketing relations with customers, application of tools for building trust and reducing complaints, etc. Berry (1983) proposed five strategic elements for building relationship marketing in the case of service companies: (1) developing a core service around which to build a relationship with customers, (2) tailoring the relationship to the individual customer, enlarging the core, (3) service with additional benefits, (4) price services to encourage customer loyalty, and (5) employees marketing who in turn will achieve better cooperation with customers.

In addition to the theoretical consideration of the model of marketing relationships and customer behavior, contemporary research is focused on the practical testing of the correctness of the assumptions made in individual markets. Thus, a study conducted by Ndubisi (2007) established the persistence of the influence of relationship marketing strategy on customer loyalty in the Malaysian banking sector. Multiple regression analysis identified four key constructions of marketing relationships with customers that contribute to their greater loyalty (trust, commitment, communication and conflict management).

In telecommunication services sector on the example of UAE teleoperators, Saleh MAE (2016) comes to interesting results, which show a significant positive correlation between trust, as an element of marketing relations and loyalty. Also, the study showed, contrary to expectations, that transparency in providing information to clients did not contribute to a higher degree of loyalty in this market.

The research of Stanko, Bonner and Calantone (2005) on the example of business industrial markets shows that relationship marketing can indeed find its applications in other sectors, where the creation of an emotional connection with customers ensured longer-term and more direct business relations between suppliers and customers.

Regardless of the business sector, every company that wants to implement customer relationship marketing must learn about the preferences, wishes and expectations of its customers, which must be based on the integration of computer-software support and customer databases.

3. Passenger transport services user loyalty

Customer loyalty is a modern strategy for realizing a company's competitive advantage and a current concept in marketing research. The concept of customer loyalty was first mentioned in the 20s of the last century, and until today the definition has undergone various developments. Uncles,

Dowling and Hammond (2003) consider that customer loyalty can be considered in three ways. It can be based on beliefs or affection towards a brand, it can manifest as an emotional connection with a brand, or it can be seen as simply buying a certain brand regularly.

Dick and Basu (1994) view loyalty as a combination of the effects of consumer attitudes and behavior. They argue that loyalty results from the interaction between a customer's relative attitude toward a particular brand and their repeated purchases of that brand. Given the multidimensionality of the concept, in this paper customer loyalty is viewed through three dimensions - client behavior (repurchase intention), client attitude (positive word of mouth) and client cognition (the only acceptable option for purchase).

When it comes to transportation services, the loyalty aspect of service users depends mostly on the information whether a specific carrier is the only one that provides transportation service on a certain route or there are more carriers. If it is a conditional monopoly of the carrier, then its demand, that is, the behavior of clients, is not influenced by a holistic marketing approach such as marketing relations with customers, but is the result of a privileged position. On the other hand, such situations are very rare, considering that the competition is looking for space to expand its placement, taking over other routes where certain carriers used to have a monopoly position.

Customer behavior is determined by a number of factors such as: marketing activities of companies directed towards customers, environmental influences, competitive influences, customer experience, socio-demographic framework in which customers live, etc. Achieving customer satisfaction and loyalty is a continuous process. Satisfaction and loyalty represent multidimensional categories, consisting of: 1) cognitive, 2) affective, 3) conative and 4) behavioral elements (Oliver, 1999.). While in earlier studies satisfaction was treated as a mediating variable between marketing relations and customer loyalty, in more recent research satisfaction is viewed as a separate dimension of so-called loyalty. affective, i.e. emotional dimension. Research indicates that the highest form of loyalty is actually long-term repeat purchases and passing on positive experiences to others, that is, the behavioral dimension of loyalty. In this regard, marketing managers must be aware that customers will hardly be ready to recommend some products/services if they are not personally satisfied with them, etc.

Cognitive loyalty is based on the information obtained about products and services. The assumption is that the information alone is sufficient for the customer to make a purchase decision. This represents the first stage on the way to true loyalty, since it is based on the offer-price relationship. In the case of a change in the offer-price ratio in favor of a competitor, there is a high possibility that the client will switch to a competitor. Nevertheless, this dimension is necessary in order to establish the initial bond between the company and the client, and therefore very often companies agree to lower earnings and even losses in order to include this dimension of loyalty with

their clients. In the case of companies dealing with passenger transport services, measuring the cognitive dimension of loyalty is especially important when new transport relations are just being established, that is, when new transport markets are being penetrated.

Indicators for measuring the persistence of the cognitive dimension of loyalty in the case of companies from the passenger transport segment would be: (1) preference for transport company services, (2) opinion that the transport company offers the best service at a given time, (3) preference of the transport company in relation to competitors, and (4) satisfaction with regard to the ratio of price and service.

Affective loyalty is more intense and implies emotional preferences towards services. This kind of loyalty is built gradually. According to the opinion of many authors (Oliver, 1999; Härtel and Russel-Bennet, 2010; Guillard and Roux, 2014.) the affective dimension of loyalty actually represents the level of satisfaction with the offer. Although it is more intense than the cognitive dimension of loyalty, it is still not a guarantee of users returning. One of the practical examples of building the affective dimension of loyalty is the provision of free coffee or the distribution of sweets during transportation, considering that these activities create positive emotions for users of transportation services.

Indicators for measuring the persistence of affective attachment in the case of companies engaged in passenger transport services would be: (1) satisfaction with the quality of the service provided, (2) a greater degree of interest in the transport company›s novelties, (3) the persistence of internal attachment to the transport company›s services, and (4) positive emotions and attitudes towards the transport company.

Conative loyalty is the third level of attachment and implies not only that the user likes the service, but is ready to use it again in the future. It is created as a result of several successful use of services. However, despite the persistence of willingness and realization of repeat purchases, even this phase is not an absolute guarantee of permanent customer commitment. The conative dimension of loyalty itself has its own levels, from the existence of a desire to repeat the purchase, that is, the use of the service, to the actual repeated action.

Companies engaged in passenger transport services can investigate their conative dimension of loyalty through the following indicators: (1) persistence of the desire to use the services again, (2) persistence of the repeated use of the transport company's services, (3) intensity, i.e. frequency of repeated use of the services, and (4) length of use of the transport company's services.

Behavioral loyalty or action loyalty is the highest level of customer loyalty, that is, service users. In this phase, users are familiar with the existence of the services of a particular company, the main features of its offer, achieve positive emotions by mentioning that company, use the services again, that

is, return to their supplier and attract new customers by transferring positive experiences to others. From what has been presented, it is quite clear why it is in the interest of every company, including companies in the field of passenger transportation, to achieve this level of loyalty from their clients. The final result of this dimension is not only the maintenance of long-term relationships, but also the expansion of one's market position through the acquisition of new clients.

Indicators of persistence of the behavioral dimension of loyalty in the case of a passenger transport company would be: (1) regular use of the transport company's services, (2) recommendation of the transport company's services to others, (3) transmission of positive information about the transport company and its services, and (4) the transport company and its services are the first choice in case of repeated use of the service.

4. Research of customer relationship marketing as a predictor of passenger transport services user loyalty

The main goal of the research is to examine the impact of the application of marketing relations with customers on their loyalty of users of passenger transportation services in the area of Zenica-Doboj Canton. In addition the following working hypotheses are also set:

H_1: *There is a statistically significant positive correlation between the application of customer relationship marketing and the loyalty of users of passenger transportation services who live in the area of the Zenica-Doboj Canton.*

H_2: *The dimensions of customer relationship marketing have a positive effect on the cognitive level of loyalty of users of passenger transportation services.*

Figure 1. presents the theoretical research model of connections between customer relationship marketing and loyalty of passenger transport users.

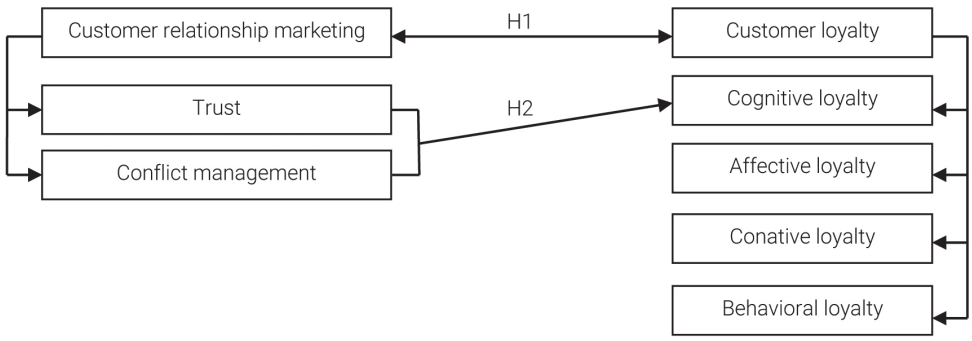

Figure 1. Illustrative presentation of research hypotheses

The statistical group consists of all companies registered for carrying out passenger transport activities in the area of the Zenica-Doboj Canton. Data on entities that provide passenger transportation services in this canton are shown in the Book of registered timetables on cantonal bus lines for the period 2019-2022. year at the Ministry of Urban Planning, Transport and Communications and Environmental Protection of the Zenica-Doboj Canton, Transport Sector. According to the same, there are 15 companies registered for passenger transportation in this area. In alphabetical order, we arranged the companies that are registered for carrying out passenger transport activities in the area of Zenica-Doboj Canton and based on the random principle, using the RNG function, we selected five companies in a controlled random sample, namely: Bosnaexpress d.d. Doboj Jug, Prevoz putnika d.o.o. Zavidovići, Jelah-bus d.o.o. Tešanj, Megatravel d.o.o. Kakanj i Sjaj d.o.o. Maglaj.

The research was conducted on users of passenger transport services of randomly selected companies from the area of the Zenica-Doboj Canton. Survey questionnaires were distributed by personal contact in the period from April 8 to April 14 2022. The total number of surveys distributed to users of passenger transport services was 60, and 40 correctly completed surveys were returned (desired choice fraction: (40/60)*100 = 0.67*100 = 66.67%), which meets the research needs.

The survey questionnaire consists of three parts. The first part of the survey questionnaire for users of passenger transport services is related to socio-demographic characteristics: gender, age, completed level of education and current work status and municipality of residence of respondents (from the area of Zenica-Doboj canton). The second part of the questionnaire is related to the perceived implementation of marketing relations carried out by the carrier in question (independent variable), and it consists of a total of 10 statements, whereby five statements measure the dimension of trust and five statements measure conflict management as a dimension of marketing relations with customers. The measurement scales related to trust and conflict management are primarily derived from the study conducted by Ndubisi on the example of the banking sector, with the adaptation of the transport sector. The third part of the questionnaire related to the loyalty of users of passenger transport services (dependent variable), and it consists of a total of 16 statements, consisting of: cognitive dimension of loyalty, affective dimension of loyalty (satisfaction), conative dimension of loyalty and behavioral dimension of loyalty. Each of the mentioned dimensions is measured with four statements. The measurement scales related to loyalty are the original work of the authors. In the second and third parts of the questionnaire, a Likert scale with five degrees of agreement was used: 1 - completely disagree, 2 - mostly disagree, 3 - neutral answer, 4 - partially agree and 5 - completely agree. Data processing and analysis was done in the statistical package IBM SPSS 26.0.

After the descriptive analysis, the reliability of the measurement scales used for hypothesis testing was examined. For these purposes, Cronbach's alpha model was used, which is based on determining the internal consistency among the characteristics that make up the construction of the mentioned

generic instrument for measuring the observed variable. It is desirable that Cronbach's coefficient alpha is greater than 0.7. However, the values of this coefficient are very sensitive to the number of items on the scale. Short scales (scales that have less than 10 items) often have rather small values of the mentioned coefficient. A higher value of the alpha coefficient indicates higher reliability, that is, it shows that the attributes of the same factor really measure the same phenomenon.

Cronbach's coefficient alpha for the variable customer relationship marketing for all 10 statements is 0.958, which shows good reliability and internal consistency for this sample. This is supported by the value of the Standardized Cronbach's coefficient alpha which is 0.959, which additionally confirms the reliability of the scale - customer relationship marketing.

Table 1. Reliability analysis of a measurement scale for customer relationship marketing

Cronbach's coefficient alpha	Standardized Cronbach's coefficient alpha	Total item number
0.958	0.959	10

The following table shows the independent variable customer relationship marketing with all the elements that this variable includes.

Table 2 shows the average scores of all variables of customer relationship marketing. The first five statements relate to trust-building relationship activities, while other five statements relate to conflict management activities. Other statistical parameters are also presented: median, mode, and standard deviation. The most commonly used mean value during the research is the arithmetic mean. In everyday life, the term average or average value is used for this environment. It can be seen that the arithmetic mean on the scale of customer relationship ranges from 3.70 to 4.10 (on a scale of 1 to 5, 1 - completely disagree, 5 - completely agree), which implies to the conclusion that the percieved customer relationship marketing activities were high. This is supported by the fact that the most common grade is 4 (mode). Mode represents the value of the quantitative or qualitative characteristic with the highest frequency. The median value in 10 questions is also 4. The table also lists the values of the standard deviation that measures the scatter of the sample data. The table shows that the values of standard deviations are in the range between 0.862 and 1.083.

Table 2. Descriptive statistics of customer relationship marketing scale

Variables	Arithmetic mean	Median	Mode	Standard deviation
1. This transport company, with its name and quality, provides a sense of security and safety to its clients.	4.05	4.00	5	1.061
2. The transport company fulfilled all the promises they made.	4.08	4.00	5	0.971
3. The services of this transport company have never been denied to me.	3.98	4.00	4	0.862
4. The employees of this transport company approach clients with special attention.	3.78	4.00	4	0.974
5. The services of this transport company are completely safe to use.	4.10	4.00	4	0.982
6. In the past, the transport company did everything to avoid potential conflicts with clients.	3.95	4.00	4	1.011
7. The transport company resolves any conflicts and misunderstandings with clients very quickly and efficiently.	3.83	4.00	4	0.903
8. I can very easily lodge a complaint about the service provided by this transport company.	3.80	4.00	4	0.911
9. In case of a mistake, the transport company will admit its fault and provide me with adequate compensation for the resulting damage.	3.83	4.00	4	1.083
10. The transport company accepts complaints and uses information from clients to improve relations with customers.	3.70	4.00	4	1.067

When it comes to the reliability of the scale of the dependent variable in the research related to the loyalty of users of passenger transport services, it should be pointed out that this scale is also reliable considering that the value of the Cronbach's coefficient is 0.977. This is supported by the value of the Standard-

ized Cronbach alpha coefficient which is 0.978, which additionally confirms the reliability of the mentioned scale.

Table 3. Reliability analysis of a measurement scale for loyalty of users of passenger transport services

Cronbach's coefficient alpha	Standardized Cronbach's coefficient alpha	Total item number
0.977	0.978	16

The following table shows the variable loyalty of users of passenger transport services with all the elements that this variable includes.

Table 4. Descriptive statistics of loyalty scale of users of passenger transport service

Variables	Arithmetic mean	Median	Mode	Standard deviation
1. I always prefer the used services of this transport company.	4.28	4.00	5	0.877
2. I believe that this transport company offers the best service at the moment.	4.13	4.00	5	0.939
3. I always prefer the services of this transport company even though I know there are other companies as well.	4.13	4.00	5	1.042
4. I am satisfied with the service and price ratio of this transport company.	4.08	4.00	5	0.971
5. I am generally satisfied with the services of this transport company.	4.20	4.50	5	0.966
6. I always follow the promotions and novelties offered by this transport company.	3.73	4.00	4	0.987
7. I consider myself bound to this transport company and its services.	3.75	4.00	4	1.006
8. I associate using the services of this transport company with positive emotions.	3.93	4.00	4	0.997
9. I return again and again to the services of this transport company.	4.08	4.00	4	0.829

10. I want to use the services of this transport company more often.	3.98	4.00	4	1.000
11. I have been using the transport services of this transport company for the longest time.	3.78	4.00	4	0.974
12. I intend to use the services of this transport company in the future.	3.85	4.00	5	1.075
13. I recommend the services of this transport company to my friends	3.75	4.00	4	0.899
14. I always pass on a positive experience with this transport company to others.	3.63	4.00	4	1.055
15. The services of this transport company are always my first choice when the need arises, regardless of the price.	3.40	4.00	4	0.871
16. I am a regular user of the services of this transport company.	3.65	4.00	4	0.893

Table 4 shows the average scores of all variables for loyalty of users of passenger transport services. Cognitive dimension of loyalty is represented by questions no. 1 to no. 4, affective dimension of loyalty is represented by questions no. 5 to no. 8, conative dimension of loyalty includes questions no. 9 to no. 12, and the behavioral dimension of loyalty includes questions no. 13 to no. 16. It can be seen that the arithmetic mean on the scale of customer relationship ranges from 3.40 to 4.28 (on a scale of 1 to 5, 1 - completely disagree, 5 - completely agree), which implies the conclusion that users of passenger transport services have achieved a sense of attachment and building loyalty towards the transport service provider. This is supported by the fact that the most common grade is 4 (mode). The median value in 16 questions is also 4. The table also lists the values of the standard deviation that measures the scatter of the sample data. The table shows that the values of standard deviations are in the range between 0.829 and 1.075. Less dispersion of the data always means more representativeness of the mean.

After analyzing the reliability of the measurement scale and a detailed descriptive analysis of all variables included in this research, both independent and dependent, we began an empirical study of the application of customer relationship marketing as a determinant of the loyalty of users of passenger transport services in the area of Zenica-Doboj Canton.

It has already been pointed out that the independent variable consists of two dimensions: trust and conflict management, while the dependent variable consists of four dimensions: cognitive, affective, conative and behavioral dimensions of loyalty. In order to test the working hypothesis H_1, we need to analyze the connection between the mentioned dimensions, which was done using the

Pearson correlation coefficient. According to Fazlović (2013) the results can be as follows: 0 – absence of correlation; up to 0.20 – insignificant correlation; 0.20 – 0.40 – low correlation; 0.40 – 0.70 – moderate correlation; 0.70 – 0.90 – high correlation; 0.90 – 1 – very high correlation and 1 – complete correlation. However, when we compare individual pairs of phenomena, the calculated correlation coefficient should not be rigidly observed, because we do not have complete agreement in the theory of statistics regarding the exact interpretation of the coefficient.

Table 5. The connection between the dimensions of customer relationship marketing and the dimensions of loyalty of users of passenger transport services from the area of Zenica-Doboj Canton

		Trust	**Conflict management**
Cognitive loyalty	Pearson Correlation	0.941**	0.934**
	Sig. (2-tailed)	0.000	0.000
	N	40	40
Affective loyalty	Pearson Correlation	0.909**	0.915**
	Sig. (2-tailed)	0.000	0.000
	N	40	40
Conative loyalty	Pearson Correlation	0.945**	0.933**
	Sig. (2-tailed)	0.000	0.000
	N	40	40
Behavioral loyalty	Pearson Correlation	0.908**	0.910**
	Sig. (2-tailed)	0.000	0.000
	N	40	40

Based on the data in the previous table, we can state the following:

- The research determined that the level of trust, as a dimension of customer relationship marketing, applied by passenger transport companies, correlates very highly at a significance level of 1% with the cognitive dimension of loyalty ($r = 0.941$; $p < 0.01$), with the affective dimension

of loyalty (r = 0.909; p < 0.01), with the conative dimension of loyalty (r = 0.945; p < 0.01) and with the behavioral dimension of loyalty (r = 0.908; p < 0.01).

- A very high correlation at the significance level of 1% is present between the level of application of conflict management as a dimension of customer relationship marketing and the cognitive dimension of loyalty (r = 0.934; p < 0.01), the affective dimension of loyalty (r = 0.915; p < 0.01), conative dimensions of loyalty (r = 0.933; p < 0.01), as well as from the behavioral dimension of loyalty (r = 0.910; p < 0.01).

So, generally speaking, we can see that the analyzed variables are significantly linearly positively related to each other, that is, through research, we have established statistically significant correlations at the significance level of 1%. By doing so, we confirmed the first working hypothesis through the research, namely that: *There is a statistically significant positive correlation between the application of customer relationship marketing and the loyalty of users of passenger transportation services who live in the area of the Zenica-Doboj Canton.*

The analysis of the impact of the dimensions of customer relationship marketing on the cognitive level of loyalty of users of passenger transportation services, in order to test the working hypothesis H_2, was carried out by means of multiple regression analysis. Through simultaneous multiple regression analysis, the predictive power of each independent variable is evaluated, that is, it is measured how much it would improve the model consisting of a series of independent variables. Multiple regression actually shows how much of the variance of the dependent variable is explained by the variance of the independent variables.

The following table shows the parameters of the simultaneous multiple regression analysis model, where it can be seen that the coefficient of multiple linear correlation is 0.950, which leads to the conclusion that there is an extremely strong positive linear relationship between the observed variables.

Table 6. Coefficient of determination of simultaneous multiple regression analysis for the dependent variable cognitive level of loyalty for users of passenger transport services

Model	R	R^2	Adjusted R^2	Standard Error of Estimate
1	0.950[a]	0.903	0.898	1.11314

Independent variable: dimensions of customer relationship marketing

Based on the parameters in the model, we can conclude that the coefficient of determination is R^2=0.903, which means that the selected model of simultaneous multiple regression analysis explained 90.3% of all deviations. In fact, this coefficient shows how much of the variance of the dependent variable (in our case, the cognitive level of loyalty of users of passenger transportation services) is explained by the model that includes the variable: dimensions of customer relationship marketing. Since the coefficient of determination is 0.903, and in accordance with Chadock's scale, we can state that there is a strong connection regarding the direction and intensity of the correlation between the observed variables.

By using ANOVA it can be concluded that the presented model of simultaneous multiple regression analysis is statistically significant, since the value of the empirical level of significance is less than 0.05 (p≈0.000); F(2,37) = 172.611. This means the model is suitable for further data processing.

Table 7. ANOVA[a] – analysis of variance of the simultaneous multiple regression analysis model

Model	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	427.754	2	213.877	172.611	0.000[b]
Within Groups	45.846	37	1.239		
Total	473.600	39			

a. Dependent variable: cognitive level of loyalty of users of passenger transport services

b. Independent variable: dimensions of customer relationship marketing

It remains to determine how much each variable in the model contributed to the prediction of the dependent variable based on standardized beta coefficients. Standardized beta coefficients mean that the values of the variables are converted to the same scale so that they can be compared, while unstandardized coefficients are used to set up a multiple regression equation. In our case, we want to compare the contributions of all independent variables, so we used beta coefficients.

Table 8. Results of simultaneous multiple regression analysis - evaluation of independent variables

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	SE	Beta		
(Constant)	1.172	0.851		1.377	0.177
Trust	0.452	0.130	0.557	3.479	0.001
Conflict management	0.335	0.132	0.406	2.539	0.015

a. Dependent variable: cognitive level of loyalty of users of passenger transport services

Based on the previous table, we can determine whether the dimensions of customer relationship marketing (trust and conflict management) have a positive impact on the cognitive level of loyalty of users of passenger transportation services. Also, in the table we can see how much each variable in the multiple regression model contributed to the prediction of the dependent variable. Therefore, we will use beta coefficients to compare the contributions of all independent variables, that is, to establish their influence on the dependent variable. Based on the presented beta coefficients, we can state that the highest beta coefficient is 0.557, which is actually the value for the variable trust. This means that this variable individually contributes the most to explaining the dependent variable cognitive level of loyalty of users of passenger transport services, while the second dimension (conflict management) also has a positive influence on the movement of the dependent variable. The same conclusion can be made on the basis of significance. Namely, if the value of sig. is less than 0.05, we can state that the independent variable has a significant influence, that is, if the empirical level of significance is greater than 0.05, that the variable has no significant influence. By this alone we can conclude that trust and conflict management have a statistically significant impact on the dependent variable.

Accepting the presented results of the multiple regression analysis, we can confirm the second working hypothesis that: *The dimensions of customer relationship marketing have a positive effect on the cognitive level of loyalty of users of passenger transportation services.*

5. Conclusion and discussion

Based on the secondary and primary empirical research, we can state that customer relationship marketing significantly predictes the loyalty of passenger transport services users in the Zenica-Doboj Canton.

The research shows that by investing in two dimensions of marketing relations with customers, (building trust and better conflict management) companies that work in passenger transportation services in the area of Zenica-Doboj Canton can build a positive long-term business with their customers based on loyalty in all its aspects. manifestations: cognitive, affective, conative and behavioral dimensions. The first working hypothesis showed the persistence of a positive correlation between the dimensions of the independent variable and all dimensions of loyalty, while the second working hypothesis showed cause-and-effect relationships between both customer relationship marketing dimensions and the cognitive dimension of loyalty. The reason for choosing the cognitive dimension of loyalty in conducting a multiple regression analysis is the fact that this dimension of loyalty represents the initial phase of attachment, and that the positive result of the analysis indicates the persistence of preconditions for cause-and-effect relationships for other levels of loyalty as well, and vice versa.

Reaching each of loyalty dimensions contributes to companies significant competitive advantages, especially in situations where there are a large number of competitors in a certain market. Given that passenger transport services are largely generic with little opportunities for enrichment, i.e. diversification compared to competing services, integrating marketing relationships is an excellent way to improve business and acquire new clients.

In order for companies providing passenger transportation services to be able to introduce trust-building and conflict management processes, it is necessary to integrate high-quality internal processes, invest in computer systems that will enable them to establish a high-quality database about their customers, and invest in their employees who will, as ambassadors of their companies, convey the values of marketing relations in their daily dealings with clients.

The limitation of the interpretation of the obtained research results is reflected in the sample size (n=40) and the locality limitation in the area of the Zenica-Doboj Canton. In order to generalize to the attitudes of the wider population, it is recommended to expand the research at the level of the entire Bosnia and Herzegovina. We also recommend conducting the same multiple regression analysis in the case of other dimensions of loyalty (affective, conative and behavioral).

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