IMPLEMENTATION OF BLOCKCHAIN TECHNOLOGY IN THE SMART CITY

Zoran Ćirić[1]
Otilija Sedlak[2]
Stojan Ivanišević[3]

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Abstract: *This document presents an attempt to determine guidelines for the implementation of the blockchain projects within smart city (SC) information systems (IS) to improve their security and sustainability through harnessing benefits of blockchain technology. Although available scientific sources are scarce a review of contemporary scientific literature and other available sources attempts to determine weaknesses of current IS within SC and to compare their vs benefits of the blockchain technology in order to show that blockchain technology can offer potential solution to weaknesses and improve SC IS and therefore the sustainability of the SC itself. However, this research only shows the need for such implementations and discuss what further research is required to provide a framework for the implementation of blockchain technology in smart cities.*

Keywords: *Blockchain, Smart city, Project management, Information systems, Sustainability.*

1. INTRODUCTION

This paper elaborates downsides of IS within SC found within the scientific literature and the promise delivered by the blockchain technology to solve them. In the brief review of most common problems and limitations of ICT within SC and a brief review of strongpoints of blockchain technology, a synthesis is attempted. This synthesis shows that there is a possibility that blockchain technologies can improve IS security, privacy and network availability — furthermore the scientific. Accepting blockchain technologies and exploring ways to apply these technologies to addressing challenges in smart cities is a research direction and represents a new area that has not been sufficiently explored through the prism of scientific research because blockchain technologies were recently adopted with creation of Ethereum Enterprise Alliance in 2017 [1], [2]. The result of the research in this paper is to show the possibility for improvement of IS within SC with the application of blockchain technology and to search for a scientific founded framework for the implementation of blockchain technologies.

There are strong indications that the application of blockchain technologies improves existing systems based on automatic data processing while ensuring increased security, transparency and easier participation of a large number of actors, regardless of whether they are natural or legal persons (see literature review in chapter 2.). Although the term Information Systems in Smart Cities marks a very broad term, this research refers to software solutions in smart cities that are related to e-government and fields of application of blockchain technology: payments, infrastructure for payment and exchange, smart contracts, identification, confidential data, data storage, voting and fundraising.

[1] Faculty of Economics Subotica, Segedinski put 9-11, Subotica, Serbia
[2] Faculty of Economics Subotica, Segedinski put 9-11, Subotica, Serbia
[3] JKP Informatika Novi Sad, Bul. cara Lazara 3, Novi Sad, Serbia

In scientific literature, blocking technology has not been sufficiently explored since its beginning is related to 2008 [3], while wider acceptance by large corporations only in 2017 [2], therefore there are not enough scientific studies of the application of this technology in practice. This technology is still in its early adoption phase, and the lack of use cases and standards make scientific research documents very scarce.

2. BLOCKCHAIN TECHNOLOGY IN THE SMART CITY

A brief literature review is examining the problems encountered by IS in smart cities and examples of the application of blockchain technology to contribute to the sustainability of a smart city as well as any limiting circumstances related to the application.

One of the known definitions of the smart city (ITU) is: „A smart and sustainable city is an innovative city that has extensive use of information technology using them to develop the quality of life level, city administration, by taking into the account the needs of current and future generations in the same way as it takes into account economic, social and environmental aspects [4].

Dameri and Rosenthal, (2014) in the collection titled „Smart City - How to create a public and economic value in an urban area with high technology" give the idea that citizens expect to live in urban dwellings that are designed to provide a high quality of life which can only be achieved through investments in sustainable development. The complexity of the concept of a smart city is nonsense from the fact that the concept itself is connected simultaneously with the physical flow and the intellectual and social capital of the city. In this regard, planning the city is not just a design of urban environments to incorporate social, political and economic studies. The concept of smart cities by them is essentially supported by the development of ICT technologies [5].

ICT solutions are considered as a key factor in building smart cities because of their ability to support a large number of services for citizens. Because of this, it must be pointed out that in the smart cities a large number of versatile devices are coexisting, they are equipped with heterogeneous technologies, but they will nevertheless be joined in interaction using a large number of services [6].

The group of authors believes that the information systems of the city are crucial for the relation of intelligence (intelligence) and innovation. They believe that ICT is a key component for the development of knowledge-based organisations and intelligent cities. As ICT develops, the number of users and cases of use increase [7].

Due to the above, the following challenges will arise: service availability, location dependency problem, security problem and user identification, mobility problem - it is necessary to enable users to move between networks, the problem of scaling large numbers of users without reducing the quality of service, the problem of error tolerance. Due to these challenges, it is necessary to create information systems that can be more resistant to systemic errors and system failures [8].

The literature prevails that existing Internet architectures cannot respond to the before mentioned challenges [9], [10], [11].

The group of authors in its work as the biggest challenges also signifies privacy, analysis and data search, data integration, GIS-based visualisation, service quality and intelligent systems that use these data [12].

The privacy problem is created by the large amounts of personal information about the smart city's residents who are the subject of the analysis and can, therefore, be misused for making personal profiles. For example, a large amount of data on the social activities of individuals is collected every day. Although a lot of effort has been invested in solving this challenge, saving large amounts of personal data is a problem. Although the number of successful hacker attacks is very low, a constant battle for data retention is ongoing and a growing number of cybersecurity problems that smart cities have to deal with [13].

In addition to the problem of privacy, one of the problems that are certainly interesting for the topic of this research is the problem of quality and availability of the service. A group of authors thinks that to establish a smart city a large number of technologies must be integrated and hence the quality of service provided by different technologies represents a major challenge for the success of a smart city [14].

Progress in ICT solutions has been facilitated not only by the development of the private sector but also by public administration institutions and how they perform operational activities [15]. Progress in ICT has allowed local governments to transform the way they offer services to citizens [16], [17], [18].

Blockchain technology, which became known primarily thanks to bitcoin (Bitcoin), is a type of distributed system technology further referred to as Distributed Ledger Technology (DLT), which is defined as a „distributed, shared, encrypted database that serves as irreversible and non-recoverable (non-corrupt) information repository „[19]. When blockchain technology is used to create a platform, the product is a digital platform that stores and verifies the entire transaction history between its users anywhere on the network. From a technical point of view, blockchain is a „database consisting of chronologically arranged series of transactions known as blocks" about which each proposed transaction must be checked with the certainty and integrity of that particular block" [20].

Once the information is entered, it can never be deleted. [21]. Block technology is described in the literature as a database and as a network equipped with a built-in security system and internal integrity [22].

One of the applications of blockchain technology is the development of smart administration as part of the 3.0 phase of the blockchain technology development through the idea of providing services traditionally provided by public administrations in a more efficient, decentralised and cheaper way [23].

3. CONCLUSION AND FURTHER RESEARCH

The review of the contemporary scientific literature shows that the main problems of IS within SC such as privacy, security, availability and heterogeneous architectures correspond with strong points of blockchain technology because blockchain based systems provide strong security together with total anonymity; their distributed nature also increase availability and finally their nature is interoperable.

Although the blockchain technology is relatively new, fundamental studies of the technology itself exist in each problem domain including security and literature on distributed systems (for example, multi-level authorization [24], energy efficient resource management in distributed

systems [25] [26], etc.). A careful look and acceptance of proven solutions would speed up the overcoming of the current challenges and limitations of blockchain technology [27].

In scientific literature, papers are dealing with the use of blockchain technology to increase the sustainability of smart cities, as shown in the literature review. The available scientific literature has not so far dealt with the challenges, limitations and effects of the implementation of blocked IS in smart cities. The available materials on this subject are not scientific. Secondary sources on this subject can be found in studies conducted by major consulting companies such as Deloitte [28] or in the forms of whitepaper presented upon blockchain project pitch events.

However, the authors did not find any working framework for the implementation of information systems projects (IS) based on these technologies in the scientific literature. According to the authors, it is necessary to mark the areas of application of this technology in smart cities and to continue to explore ways of applying to define the success factors and results indicators for the implementation of the IS projects based on block technology.

To achieve a higher degree of sustainability in smart cities, it is necessary to define subsystems whose business would be improved by the use of block technology. Analysing the problems and the previous effects of the application of blockchain technology will identify the smart cities sub-systems that realize the greatest benefit from the implementation of this type of projects with the high performance of the projects themselves. The data obtained using this scientific method would be further used to establish critical success factors and indicators of the results of project implementation of this type. Based on the identification of the field of successful application of information systems in smart cities and critical success factors as well as the result indicators, a working framework for the implementation of information systems projects based on technologies in smart cities can be created.

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