ISSN 2449-9781
NR 22
(2022)
BIBLIOTEKA REGIONALISTY
REGIONAL JOURNAL

Oğuz Özbek

Pamukkale University, Turkey
e-mail: oguzozbek@pau.edu.tr
ORCID: 0000-0002-6742-4006

Dilara Efe

Dilara Efe Architectural Office, Turkey
e-mail: dlaraefe@gmail.com
ORCID: 0000-0002-9079-366X

Blockchain Technology and the Use of Municipal Cryptocurrencies in Metropolitan Planning*

Technologia blockchain a wykorzystanie miejskich kryptowalut w planowaniu metropolitalnym

DOI: 10.15611/br.2022.1.07
JEL Classification: O18, P25, Q55, R14

Quote as: Özbek, O. and Efe, D. (2022). Blockchain technology and the use of municipal cryptocurrencies in metropolitan planning. *Biblioteka Regionalisty. Regional Journal*, (22).

Abstract: This paper examines the potential use of blockchain technology in metropolitan planning by focusing on municipal cryptocurrencies as a new type of crypto financing. Decentralisation through blockchain technology offers several advantages for the provision of metropolitan services: transparency, security, participation, productivity and immutability. The transformation of traditional municipal

* This paper is partially based on an unpublished MS thesis by Dilara Efe (2021) from the Department of Urban and Regional Planning at Pamukkale University. The thesis is entitled "The Use of Blockchain Technology in Metropolitan Cities: The Case of Denizli Metropolitan City and Commuter Belt".

services into smart city functions raises the importance of blockchain technology for metropolitan planning. Blockchain technology can be used in metropolitan planning for several analytical purposes: transportation planning, logistics planning, demarcation of metropolitan borders and metropolitan hinterland, mapping urban morphologies, accessibility analysis of metropolitan services and monitoring of metropolitan safety services. Here, labour market data, commuting data, statistical regional data and jurisdiction data are the main components of metropolitan analysis. Municipal cryptocurrencies incentivise and enrich the processes of data management for metropolitan planning. In the paper, one potential application of municipal cryptocurrencies is briefly exemplified by a peer-to-peer (P2P) transmission and incentivisation of commuting data for metropolitan areas.

Keywords: blockchain technology, commuting, functional regions, metropolitan planning, municipal cryptocurrencies.

Streszczenie: Artykuł analizuje potencjalne zastosowanie technologii blockchain w planowaniu metropolitalnym poprzez skupienie się na kryptowalutach miejskich jako nowym typie kryptofinansowania. Decentralizacja poprzez technologię blockchain oferuje kilka korzyści dla świadczenia usług metropolitalnych: przejrzystość, bezpieczeństwo, uczestnictwo, produktywność i niemożliwość zmiany danych. Przekształcenie tradycyjnych usług miejskich w funkcje miast inteligentnych podnosi znaczenie technologii blockchain dla planowania metropolitalnego. Technologia ta może być wykorzystana w planowaniu metropolitalnym do kilku celów analitycznych, takich jak: planowanie transportu, planowanie logistyki, wyznaczanie granic metropolii i jej otoczenia, mapowanie morfologii miejskiej, analiza dostępności usług metropolitalnych oraz monitorowanie bezpieczeństwa usług metropolitalnych. Dane dotyczące rynku pracy, dojazdów do pracy, statystycznych danych regionalnych i jurysdykcyjnych stanowią główne składniki analizy metropolitalnej. Kryptowaluty miejskie są bodźcem i wzbogacają procesy zarządzania danymi w planowaniu metropolitalnym. W artykule jedno potencjalne zastosowanie kryptowalut miejskich jest krótko przedstawione jako transmisja P2P (*peer-to-peer*) i bodźcowanie danych dojazdów do pracy dla obszarów metropolitalnych.

Słowa kluczowe: technologia blockchain, dojazdy do pracy, regiony funkcjonalne, planowanie metropolitalne, kryptowaluty miejskie.

1. Introduction

Blockchain technology is characterised by efficiency, permanency, decentralised consensus, verifiability and immutability. Blockchain has recently become a popular concept not only in financial technology (FinTech) but also in smart cities. Blockchain, or distributed ledger technology (DLT), has a wide variety of potential uses in smart city projects including the issues of governance, design and planning. Here, decentralisation and 'non-tampering' provide transparency and verification in data management of smart cities. The potential advantages of DLT can be clearly seen in issues of spatial planning in metropolitan areas.

This paper aims to provide an analysis of blockchain powered-metropolitan planning by focusing on municipal cryptocurrencies. More specifically, the paper examines both the role of crypto financing in recent smart city projects and how it can be applied to metropolitan planning. Municipal cryptocurrencies incentivise and enrich the processes of data management for metropolitan planning. In this

paper, one potential application of municipal cryptocurrencies is exemplified in brief by a peer-to-peer (P2P) transmission and incentivisation of commuting data for metropolitan areas. Here, personal mobility and location data can be incentivised as a digital asset through blockchain technology. The disclosure of personal mobility data on a voluntary basis can be used as both an analytical information and digital asset. A municipal cryptocurrency (experimental Metropolitan Token) is the main incentive mechanism in this process. The process of incentivisation through cryptocurrencies requires a clear classification of personal mobility data by commuter trip patterns and commuter specific socio-economic characteristics.

The methodology employed in this study includes both a literature review on blockchain technology, municipal cryptocurrencies and metropolitan regions and the brief findings of an unpublished MS thesis on the use of blockchain technology in metropolitan cities. The first part of research is based on online and offline resources. In the second part, an experimental Metropolitan Token suggested in the aforementioned MS thesis is exemplified using a P2P network-based data structure for commuter profiles in metropolitan planning. This part of the paper partly involves original research.

2. Blockchain technology and municipal cryptocurrencies

A blockchain is a "distributed database" based on a peer-to-peer (P2P) network (Hayes, 2022). It is an open and distributed ledger that stores data in lists called blocks which are tied together as a chronological chain of records. Efficiency, permanency, decentralised consensus, verifiability and immutability are the main characteristics of blockchain. Here, the most important innovations of blockchain technology include providing verifiability by ensuring "the fidelity and security of a record of data" and creating decentralised consensus "without the need for a trusted third party" (Hayes, 2022).

Blockchain technology became a key innovation via a number of influential contributions to the fields of decentralised network and cryptocurrency starting from the early 1980s: public key cryptography (Merkle, 1980), timestamp (Haber & Stornetta, 1991), Merkle Trees (Bayer et al., 1993), smart contracts (Szabo, 1997) and Bitcoin (Nakamoto, 2008). Today the concept of cryptocurrency is more popular than blockchain. The ongoing 'crypto revolution' is driven by the increasing adoption of cryptocurrencies as both means of payment and value storage (digital asset). The current market cap (market capitalisation) of the first and most popular cryptocurrency, Bitcoin, reached approximately 800 billion US dollars in circulating supply (Coinmarketcap, 2022). In parallel to the rapid adoption and diffusion of Bitcoin, alternative coins (alt coins) have undergone an extraordinary development in the last five years. Nowadays, the proliferation of altcoins has led to the emergence of alternative and powerful financial instruments for recent smart city projects.

Despite the growing importance of blockchain technology as a new way of financing smart city projects, the literature on urban and regional planning, in particular metropolitan planning, has paid too little attention to this area of study. Hence, this paper aims to address this topic by focusing on municipal cryptocurrencies as a new type of crypto financing.

Table 1. Municipal cryptocurrencies and smart city projects

Cities and Regions	Goals	Municipal Cryptocurrencies
Beijing (The People's Republic of China)	To enhance urban innovation and governance	Stablecoins
Belfast (Northern Ireland)	To help bolster the local economy	BelfastCoin (non-blockchain municipal currency)
Berkeley (California)	To fund affordable housing To rebuild transit system To support social services	Initial Community Offering (ICO) for tokens backed by municipal bonds
Busan (South Korea)	To boost the local economy To create a token economy	Municipal Stablecoin
Catalonia (Spain)	To create an alternative central banking system To adopt a blockchain voting system	Conceptual Regional Cryptocurrency
Dubai (The United Arab Emirates)	To put all official documents on blockchain	EmCash (municipal stablecoin)
Liberstad (a project aiming at creating a private city) (Norway)	To create a smart city platform	City Coin (CITY) (native cryptocurrency)
Malacca (Malaysia)	To build a "tourist blockchain--destination of the future"	DMIcoin (municipal cryptocurrency)
Philadelphia (the United States)	To integrate blockchain and smart contract space into municipal government	City-specific Crypto Tokens

Source: authors' work based on several short online articles (Gallagher, 2021; Huillet, 2020; O'Connell, 2019).

Municipal cryptocurrencies are "cryptocurrencies launched by cities" for funding certain projects and new investments (O'Connell, 2019). Table 1 presents the role of municipal cryptocurrencies in recent smart city projects. A close inspection of the table shows that municipal cryptocurrencies have become efficient FinTech tools for promoting tourism development, strengthening civil democracy and creating a technological platform for smart land use development in several cities around the world. Municipal cryptocurrencies are characterised by specific coin (operating in an independent blockchain) and token (using a decentralised network of another blockchain) projects (Ledger, 2019). The advantages of token projects are obvious in two aspects – one is benefiting from strong peer-to-peer networks of big market

cap pioneer coins like Bitcoin and Ethereum, while the other is related to the issues of scalability, security, penetration rate and market cap of these digital assets. These technological advantages are of the utmost importance in smart city projects implemented in highly populated metropolitan areas. In particular, the problem of scalability "arising with the increasing number of nodes and transactions in blockchain" (Khan et al., 2021) affects the success of both smart city and smart municipality projects in the provision of municipal and metropolitan services.

3. The use of municipal cryptocurrencies in metropolitan planning

Decentralisation and P2P network became popular concepts in information and communication technology (ICT) in the last decade. In addition to the issues of ICT, the advantages of decentralised networks are appearing also in spatial planning. Decentralisation through blockchain technology offers several advantages for the provision of metropolitan services: transparency, security, participation, productivity and immutability. Today, the transformation of traditional municipal services into smart city functions raises the importance of blockchain technology for metropolitan planning. The technological advantages of DLT are applicable to the spatial planning of metropolitan areas. Most of today's metropoles are undergoing a dynamic morphological and demographic change, which is more apparent in the metropolitan fringe. A spatial analysis of these areas through a blockchain-powered incentive mechanism (municipal cryptocurrency) can make metropolitan planning more responsive and effective (Özbek & Efe, 2019, p. 22). Through blockchain--powered tools (smart contracts, coins, tokens and altcoins), land use planning and the provision of public services in metropolitan areas are becoming smart, incentivised and analytical.

Incentivisation for metropolitan smart city projects via blockchain technology becomes an important goal "to improve various aspects of city finance, administration and residents' monetary well-being" (Linighan, 2021). Here, municipal cryptocurrencies are emerging as important financial tools for incentivising and subsidising the processes of data management for metropolitan planning.

Through recent smart city projects, the role of blockchain technology in spatial planning has become more apparent. Here, the key issue is which characteristics of blockchain technology may deliver benefits for technology-based spatial planning projects, more specifically in metropolitan planning. The answer of this is three--fold: decentralised management and governance, smart and real time analysis and planning and incentivised services.

Potentially blockchain technology can facilitate an efficient and incentivised (tokenisation) analytical framework for metropolitan planning. Here, there are several fields of application: transportation planning, logistics planning, demarcation of functional borders, hinterlands and morphologies (central business district, land

uses, transition zone, urban and rural fringes and the commuter belt etc.), accessibility issues of public services, monitoring of safety services and optimum public service areas in metropolitan areas. All these operational fields require the implementation of specific smart city projects powered by DLT.

One potential application of blockchain technology to metropolitan planning is exemplified by a P2P transmission and incentivisation of commuting data for metropolitan areas. In this way, the disclosure of personal mobility data on a voluntary basis can be used as both an analytical information and as a digital asset. Through permissive and blockchain-based location-sharing apps, personal mobility data can be transformed into smart transportation information based on user-defined profiles. Here, such applications, especially decentralised ones (dApps) can incentivise both the creators engaging in the operation and maintenance of a network infrastructure, and the anonymous users sharing their GPS (Global Positioning System) location (Özbek & Efe, 2019, p. 22). DApps can be defined as being embedded in "a decentralised network that combines a smart contract and a frontend user interface" (Ethereum.org, 2022).

Prior to discussing a blockchain-based application of commuting data management in metropolitan areas, it is helpful to review the basic terminology of metropolitan planning and morphology. Metropolitan regions can be described by three perspectives: agglomerational, functional and territorial scalar (Gallad & Harrison, 2020, p. 14). Labour market data, commuting data and statistical regional data, as well as jurisdiction data are key for classifying and identifying metropolitan areas (Demographia, 2021). The spatial planning of these areas addresses a vast number of planning and policy issues including metropolitan services, land use areas, urban sprawl, communities, economy and production, socio-cultural context, urban-rural interaction, metropolitan morphologies, transportation, statistical classification, natural environment, etc.

The metropolitan commuter zone is a peripheral semi-urban area located in the metropolitan fringe. A daily-commuter belt can be considered as a special type of functional regions. The key characteristics of a functional region are: functional relationship, hierarchy and complementarity between the sub-regional units (Özbek, 2012, p. 144). Functional Urban Areas (FUAs) are an important part of "local level typologies" used for generating subnational statistics in the European Union. A functional urban area is defined as an area comprising "the city and its surrounding commuting zone" in the Regional Yearbook of Eurostat (Eurostat, 2020, pp. 8-14). The extent of metropolitan regions varies by both agglomerations of NUTS (Nomenclature of Territorial Units for Statistics) three level regions and functional urban areas in the European Union (Eurostat, 2020, p. 15). A commuter zone can be determined by daily regular trips and labour market data. These two factors create a "daily urban system" in urban fringes (Pacione, 2005, pp. 106-107 and 915). Commuter zones are one of the most dynamic areas in metropolitan cities. This dynamic development is characterised by expanding residential areas, changing

transportation facilities and emerging manufacturing and service activities in the urban fringe. The key parameters for the extent and composition of a commuter zone are as follows: transportation technology, mass transit facilities, topography, commercial, industrial and public land uses in urban fringes, metropolitan development areas (suburbs, exurbs, satellite towns etc.) and niche labour markets (Özbek & Efe, 2019, p. 22).

The key benefit of blockchain-powered data management in metropolitan planning rests on the advantages of peer-to-peer network. Here, two important factors play a decisive role in the production and use of spatial data in metropolitan planning. The first one is the transformation of spatial data produced by city-dwellers into smart information and knowledge valuable for the development of spatial planning strategies, the other is related to how this personal information in the form of data blocks becomes a financial asset via the P2P network. The former emphasises the key characteristics or benefits of blockchain technology (efficiency, permanency, decentralised consensus, verifiability and immutability) in both the implementation of any smart city project and in the provision of digital metropolitan services. Here, the crucial concept is the incentive mechanism enabled by blockchain technology.

Location-based services targeting specific commuter profiles can be subject to possible application of blockchain technology to metropolitan planning – as exemplified by a P2P network-based acquisition and processing of personal mobility data for defining and displaying distinct metropolitan morphologies. One of the claims of this study is that a P2P network-based location services can be used for metropolitan planning on a volunteer basis. Through permissive and blockchain-based location--sharing apps, personal mobility data can be transformed into smart transportation information based on user-defined profiles. Here, municipal cryptocurrencies such as the experimental Metropolitan Token can incentivise both the creators engaging in the operation and maintenance of the network infrastructure and the anonymous users sharing their GPS location (Özbek, 2019a). This information can be used by the main actors of metropolitan planning (urban planners, traffic engineers, bureaucrats and technocrats responsible for urban and regional policies and researchers) in spatial planning terms. Metropolitan transport departments, both public and private institutions, can benefit by analysing and synthesising these smart mobility data. The tasks of acquisition and processing smart mobility data on a P2P basis indicate the need for FinTech innovation in metropolitan planning. A municipal cryptocurrency (the Metropolitan Token) constitutes the main incentive mechanism in this process. In the process of incentivisation through cryptocurrencies, trip patterns and socio--economic characteristics are important parameters. These parameters involve data type, data availability period, continuity of data flow, data accuracy by commuter trip patterns, availability of socio-economic data provided by anonymous users (commuters) and user profile details (Özbek, 2019a). Table 2 illustrates a detailed overview of the issues on metropolitan commuter profiles. As seen in the table, the six types of data are identified for addressing the incentivisation of commuter

trips. This P2P network-based data structure is incentivised by the Municipal Token proposed in this study. The Municipal Token performs two functions: as an incentive based on the disclosure of different types of commuting data and "a form of digital asset" (Frankenfield, 2022). Hence, blockchain "guarantees the fidelity and security of a record of data" (Hayes, 2022). In other words, municipal tokens carry both the value created by cryptocurrency miners and data blocks including a vast variety of spatio-temporal data for metropolitan planning. A "token economy" and "smart city platform" (O'Connell, 2019) are created by this incentivisation mechanism at metropolitan level.

Table 2. P2P network-based data structure for commuter profiles in metropolitan planning

Commuter Profile Data	Content of Spatial Data	Incentivisation
Availability of Socio-economic Data	Age Car Ownership Gender Mass Transit Use Profession	Municipal Token incentivisation by extent of socio-economic data
Continuity of Data Flow	Continuous Peak Hour Pattern Periodic Rare	Municipal Token incentivisation by data continuity
Data Accuracy by Commuter Trip Patterns	Random Trips Regular Trips	Municipal Token incentivisation by data accuracy (commuting routes)
Data Availability Period	Daily Periodic Random Weekly	Municipal Token incentivisation by duration
Data Type	All Trip Data Interval Data Multi-Destination Data Pedestrian Trip Data Single Destination Data Vehicle Trip Data	Municipal Token incentivisation by data type (spatio-temporal characteristics of commuting)
User Profile Details	Full Profile Details Limited Profile Details Without Profile Details	Municipal Token incentivisation by profile details

Source: authors' own work.

There are some potential problems and drawbacks for developing this sort of P2P network-based data structure in metropolitan planning. The first concerns privacy issues: How will this system ensure the privacy of users providing trip data? Another problem is whether public authorities will use these data for spatial planning or for suppressing and controlling society (Skyfan, 2019). There are some possible solutions here: anonymity, limited user profiles, transparency of data flow, incentive

mechanism (by data type and user profile detail) and most importantly, choosing the appropriate type of blockchain (public, private, hybrid etc.). A hybrid or semi--public blockchain can guarantee the anonymity and privacy of users. In this type of decentralised network, commuters (pedestrians, bicyclers, motorcyclists, other personal mobility device users and car drivers) might be considered as smart nodes based on commuter profiles. In urban transportation planning, the origin-destination (single or multi-destination) data are an important part of trip-based models (trip generation, trip distribution, mode choice, route choice, trip assignment and trip estimation). All these categorised data sets can be acquired through traditional survey techniques or remote sensing surveys. In both cases, metropolitan mobility data are raw data without additional information on commuting (space-time characteristics of trips and socio-economic profiles of commuters). At this point, a blockchain--based incentive mechanism can make these types of mobility data categorised and smart (Özbek, 2019b).

Today, urban fringes are experiencing the most rapid land-use and demographic changes. Metropolitan surveys provide just a glimpse into the extent of urban sprawl and are scattered in certain periods. An adequate understanding and analysis of these changes is of the utmost importance for urban policy makers and practitioners. A blockchain-powered incentive mechanism (cryptocurrency) defined above can help to draw a more realistic picture of the urban fringe and metropolitan hinterland (Özbek, 2019c). Several institutions and professions can benefit from the P2P network-based data management in metropolitan planning. Civil and private planners (community, urban, regional and transportation), spatial planning institutions, non-governmental organizations, municipalities and urban planning students and scholars are possible actors in blockchain-powered metropolitan planning.

In conclusion, a proper integration of blockchain technology into existing analysis and synthesis techniques in metropolitan planning can provide advantages and benefits for both the institutions and organizations responsible for spatial planning and metropolitan residents. Municipal cryptocurrencies can play a significant role in this integration process.

4. Conclusion

Nowadays, the urban fringes, urban regions and metropolitan commuter belts are experiencing rapid spatial and demographic changes. An accurate and factual analysis of morphological changes in these functional areas can be made possible through a blockchain-based incentive mechanism (cryptocurrency). Hence, labour market data, commuting data, statistical regional data and jurisdiction data are the main components of metropolitan analysis.

Municipal cryptocurrencies have become efficient FinTech tools for promoting tourism development, strengthening civil democracy and creating a technological

platform for smart land use development in several cities around the world. Municipal cryptocurrencies as a new type of public financing in metropolitan areas can incentivise and enrich the processes of data management for metropolitan planning. An accurate and real time demarcation of functional sub-regions and mapping distinct urban morphologies in metropolitan areas can be made possible by municipal cryptocurrencies.

An integrated use of remote sensing and blockchain technology can provide several benefits for border-mapping process in metropolitan areas. The proper use of these technological tools can contribute to the demarcation of actual metropolitan borders in spatial planning terms. A blockchain-powered incentive mechanism can help to draw a more realistic picture of the urban fringe and metropolitan hinterland.

In conclusion, incorporating blockchain technology into various aspects of metropolitan planning (such as land use and transportation planning, governance etc.) can bring benefits for both the institutions responsible for spatial planning and residents themselves. The use of cryptocurrencies specific to municipalities may become a key aspect of this integration. In this way, traditional spatial planning issues may become the main components of smart city projects in metropolitan areas. Metropolitan data management and crypto financing (as an incentive mechanism) through the use of distributed ledger technology can be seen as key drivers of this transformation process.

References

Bayer, D., Haber, S., & Stornetta, W. S. (1993). Improving the efficiency and reliability of digital time-stamping. In R. Capocelli, A. De Santis and U. Vaccaro (Eds.), *Sequences II: methods in communication, security and computer science* (pp. 329-334). Springer-Verlag.

Coinmarketcap. (2022). *Bitcoin*. https://coinmarketcap.com/currencies/bitcoin

Demographia. (2021). *Definition of urban terms*. http://www.demographia.com/db-define.pdf

Efe, D. (2021). *Büyükşehirlerde Blokzincir Teknolojisinin Kullanımı: Denizli Büyükşehir ve Gidiş--Geliş Kuşağı Örneği*. Unpublished M.S. Thesis, Denizli: The Graduate School of Natural and Applied Sciences, The Department of Urban and Regional Planning, Pamukkale University.

Ethereum.org. (2022). *Introduction to Dapps*. https://ethereum.org/en/developers/docs/dapps

Eurostat. (2020). *Eurostat regional yearbook 2020 edition*. Publications Office of the European Union.

Frankenfield, J. (2022). Cryptocurrency. *Investopedia*, January 11, 2022.
https://www.investopedia.com/terms/c/cryptocurrency.asp

Gallad, D., & Harrison, J. (2020). Conceptualizing metropolitan regions: how institutions, policies, spatial imaginaries and planning are influencing metropolitan development. In K. Zimmermann, D. Galland, J. Harrison (Eds.), *Metropolitan regions, planning and governance*. Springer Nature Switzerland AG.

Gallagher, J. (2021). The city of Philadelphia rolls out its own blockchain initiative. *Cointelegraph*. Retrieved November 10, 2021 from https://cointelegraph.com/news/the-city-of-philadelphia-rolls-out-its-own-blockchain-initiative?utm_source=Telegram&utm_medium=social

Haber, S., & Stornetta, W. S. (1991). How to time-stamp a digital document. *Journal of Cryptology*, *3*(2), 99-111.

Hayes, A. (2022). Blockchain explained. *Investopedia*. Retrieved January 20, 2022 from https://www.investopedia.com/terms/b/blockchain.asp

Huillet, M. (2020). Huawei and Beijing jointly develop a municipal blockchain directory. *Cointelegraph*. Retrieved August 24, 2020 from https://cointelegraph.com/news/huawei-and-beijing-jointly-develop-municipal-blockchain-directory?utm_source=Telegram&utm_medium=social

Khan, D., Jung, L. T., & Hashmani, M. A. (2021). Systematic literature review of challenges in blockchain scalability. *Applied Sciences*, *11*(20), 1-27. https://doi.org/10.3390/app11209372

Ledger. (2019). The difference between coins and tokens. *Ledger*. Retrieved October 23, 2019 from https://www.ledger.com/academy/crypto/what-is-the-difference-between-coins-and-tokens

Linighan, B. (2021). Law decoded: crypto cities, investor protection nation, nov. 8-15. *Cointelegraph*. Retrieved November 15, 2021 from https://cointelegraph.com/news/law-decoded-crypto-cities-investor-protection-nation-nov-8-15

Merkle, R. (1980). Protocols for public key cryptosystems. *IEEE Symposium on Security and Privacy*, 122-134.

Nakamoto, S. (2008). Bitcoin: a peer-to-peer electronic cash system. *Consulted*, (28) 2012.

O'Connell, J. (2019). Municipal crypto spreading around the world, from California to Dubai. *Cointelegraph*. Retrieved July 16, 2019 from https://cointelegraph.com/news/municipal-crypto-spreading-around-the-world-from-california-to-dubai

Özbek, O. (2012). Normative regions and the provincial development planning in Turkey. *TODAİE's Review of Public Administration*, *6*(3), 137-164.

Özbek, O. (2019a). Demarcation of metropolitan commuter zone through blockchain technology by summertimeblues (nickname). *Cent (Blockchain-Based Network for Wisdom and Creativity)*. https://beta.cent.co/+epeh7x.

Özbek, O. (2019b). Demarcation of metropolitan commuter zone through blockchain technology by summertimeblues (nickname). *Cent (Blockchain-Based Network for Wisdom and Creativity)*, https://beta.cent.co/+epeh7x.

Özbek, O. (2019c). *Demarcation of metropolitan commuter zone through blockchain technology by summertimeblues (nickname)*. *Cent (Blockchain-Based Network for Wisdom and Creativity)*. https://beta.cent.co/+epeh7x.

Özbek, O., & Efe, D. (2019). *The use of blockchain technology in the demarcation of metropolitan commuter zone: A case of Denizli metropolitan area.* (8th International Scientific-Practical Conference on Actual Question of Management of Sustainable Development in Today's Society: Problems and Prospects, October 24-25, pp. 21-26). Kremenchuk: Kremenchuk Mykhailo Ostrohradskyi National University.

Pacione, M. (2005). *Urban geography: A global perspective*. Routledge Taylor & Francis Group.

Skyfan (Nickname). (2019). A response to the entry titled demarcation of metropolitan commuter zone through blockchain technology by summertimeblues (nickname). *Cent (Blockchain-Based Network for Wisdom and Creativity)*. https://beta.cent.co/+epeh7x, Responded: 04.04.2019.

Szabo, N. (1997). Formalizing and securing relationships on public networks. *First Monday*, *2*(9).