

Betting on Metaverse for a more modern and efficient public administration

Mădălina-Cornelia ZAMFIR, Ionuț-Emanuel GIURA, Andreea Cătălina CRĂCIUN

Institutul Național de Cercetare-Dezvoltare în Informatică – ICI București, Romania

madalina.zamfir@ici.ro, ionut.giura@ici.ro, andreea.craciun@ici.ro

Abstract: The public administration constitutes the mechanism through which government policies and public programs are implemented for citizens. Coherent communication and the quality of services provided are extremely important and must take place in a safe and collaborative environment, both for citizens and the organizations with leadership role involved. The rapid development of emerging technologies has determined a huge innovation potential in the virtual environment, with results especially in the economic, educational and health fields. This paper aims to highlight the potential of Blockchain technology and the Metaverse space in the field of public administration in the coming years, starting from the motivation that of all categories of citizens must benefit from high quality administrative services in a fully immersive world. The technological and application aspects of Blockchain technology addressed in this research can support the digitization of public services and the development of clear governance models. Potential public services in the Metaverse have been suggested along with the role of Blockchain technologies as an alternative to traditional government services.

Keywords: Metaverse, Blockchain, Web 3.0, Public Administration, Services.

Mizând pe Metavers pentru o administrație publică mai modernă și mai eficientă

Rezumat: Administrația publică reprezintă mecanismul prin care sunt implementate politicile guvernamentale și programele publice pentru cetățeni. Comunicarea coerentă și calitatea serviciilor oferite sunt extrem de importante și trebuie să se desfășoare într-un mediu sigur și colaborativ, atât pentru cetățeni cât și între organizațiile de conducere implicate. Dezvoltarea rapidă a tehnologiilor emergente a determinat un potențial de inovare uriaș în mediul virtual, cu rezultate în special în domeniul economic, al educației și al sănătății. Această lucrare își propune să evidențieze potențialul tehnologiei Blockchain și al spațiului Metavers în sectorul administrației publice în următorii ani, plecând de la motivația că toate categoriile de cetățeni trebuie să beneficieze de servicii administrative de înaltă calitate într-o lume complet imersivă. Aspectele tehnologice și aplicative ale tehnologiei Blockchain abordate în această cercetare și analiza implicării comunității de cercetători și dezvoltatori la nivel național și internațional, pot sprijini digitalizarea serviciilor publice și dezvoltarea unor modele de guvernare mai transparente. Au fost sugerate potențiale servicii publice în Metavers împreună cu rolul tehnologiilor Blockchain, ca o alternativă la serviciile guvernamentale tradiționale.

Cuvinte cheie: Metavers, Blockchain, Web 3.0, administrație publică, servicii.

1. Introduction

Web 3.0, Blockchain and Metaverse technologies are three interconnected concepts that enable the achievement of digital and immersive experiences for users. The emerging technologies used in virtual environments, such as Virtual Reality (VR), Augmented Reality (AR), Extended Reality (XR) and Mixed Reality (MR), must ensure not only the demanding requirements of tech enthusiasts but also a safe environment in which they benefit from ethical principles and confidentiality, similar to those in their day-to-day activities.

Web 3.0 technology represents the third generation of the Internet, a decentralized web based on decentralized protocols, user sovereignty over their own data and digital identities, as well as improved security and privacy (Buldas et al., 2022). The seamless integration between different services and platforms is achieved with the help of interoperability, an important feature of Web 3.0.

Blockchain technology represents a registry of decentralized data that records transactions and events permanently on several computers and can be considered a basic infrastructure for the development and operation of the Metaverse (Lnenicka et al., 2024).

Due to its key features, such as security, transparency, and immutability (Holotescu, 2018), the number of applications that use decentralized technologies is continuously increasing (Gadekallu et al., 2022). Blockchain is deemed to form the backbone of Web 3.0 technology, enabling decentralized applications, smart contracts and user control over their own data.

Metaverse is regarded as a common collective virtual space, encompassing technologies and digital experiences (Marinescu & Iordache, 2023), where communication takes place in real time with no latency (Kshetri et al., 2024). The Metaverse is a virtual world where users, through their avatars, live interactive experiences without being physically present in that place and combines virtual reality (VR) or augmented reality (AR) technology, allowing people to socialize, create, buy goods and services within these digital realms. As the Metaverse develops, Blockchain technology can play an important role in shaping its evolution through new opportunities for immersive virtual experiences.

The applications and innovative solutions of recent years are oriented towards the citizen and mainly cover vital fields such as health, education, business and the industrial area. Recently, there has been an increased interest in the area of public administration. The benefits of digital services addressed to the population have captured the attention of those less interested in participating in the virtual environment or reluctant to the opportunities brought by emerging technologies, as well.

This paper is structured as follows: Section 2 outlines the initiatives regarding the modernization of the public sector services at national and international level. Section 3 presents technological and applicative aspects of Blockchain technology in Metaverse. In Section 4, potential virtual public services in Metaverse for Romania are proposed. The conclusions of this article present potential avenues for further research.

2. National and international initiatives regarding the modernization of the public sector services

The rapid development of emerging technologies facilitates the development of modern solutions addressed to citizens. In some countries, they already benefit from the advantages brought by technology and get involved in the process of customizing applications, according to needs. In other countries, the necessary infrastructure is being built to support the critical requirements to overcome the challenges of a technical, social and regulatory nature: scalability, interoperability, simplified interfaces for non-technical users, privacy and security, and robust tools and frameworks.

The situation at the national and international level of initiatives regarding the modernization of public administration services is presented below.

A utility of Metaverse in the Romanian public sector is the organization of events and meetings in the virtual environment, such as conferences or workshops at the public institution level. It is important for citizens to have their virtual space where they can easily communicate with the employees of a municipality or government agency, find out answers to their questions in real time or pay their taxes in a friendly, interactive and immersive 3D environment in front of a computer or a personal mobile device.

According to the Aspen Institute report (Aspen Institute Romania, 2024), among the key points established in the approach to the Metaverse strategy in Romania, there are relevant case studies in the case of public services and regulations regarding the safe implementation of Metaverse technologies. Interactive experiences can contribute to good social interaction in areas such as health, education and entertainment.

The National Catalog of Public Services (2024) presents 2900 public services that are administered by 300 institutions. More than 50% of these services are fully or partially digitized. The interest in using the Metaverse at a global level, and the use of VR platforms and equipment in fields such as health, industry or entertainment, have determined the need to analyze the challenges and opportunities that emerging technologies attract in the adoption of Metaverse.

Another study by Vlăduțescu & Stănescu, (2023) analyzes the potential negative impact that

Metaverse can have on the environment due to constantly changing technology, increased energy consumption and carbon dioxide emissions.

The work of Holotescu et al. (2021) provides an analysis of the Blockchain ecosystem in Romania, consisting of companies with experience, start-ups and government projects, legislation and innovative initiatives in education.

According to Kshetri et al. (2024), Finland has launched an initiative to create a Metaverse city and develop utilities and safety strategies, while cities in the United States are looking to improve the public transport experience for people with disabilities.

Israel has a Metaverse embassy in South Korea dedicated to events in which the two countries will participate (Kshetri et al., 2024). The purpose of the virtual embassies is to offer additional services that cover consultancy in the real estate field and support of local businesses.

Norway has taken steps to open virtual offices in the Decentraland platform regarding the fiscal authority and national public registers (Kshetri et al., 2024).

Egypt uses Metaverse to train local development workers and improve services for citizens (Kshetri et al., 2024).

China intends to implement Metaverse in public services by 2025, while several cities already have their own 3D model to simulate a real center where citizens will be able to follow the implementations that will be undertaken (Kshetri et al., 2024).

According to Lnenicka (2024), certain requirements and compliances are necessary for the implementation of Metaverse technologies in the public administration. Functional requirements refer to hardware and software requirements (such as data infrastructure, content, networks and communication, physical devices, sensors and controllers) and technologies (such as concepts, modeling and recognition and interpretation environments). Non-functional requirements refer to features such as accessibility, consistency, confidentiality, cyber security, policies and governance, and quality of service.

According to de Alemida (2023) and Kshetri et al. (2024), Seoul is the first city in the world to launch a test phase for administrative services in Metaverse, through a virtual office and user avatars. Here you can find information and documents related to property taxes, filing income taxes, or books in electronic format. Proposals for improving the city's governance can also be sent. This project aimed to motivate the young population to get involved in government activities and the individuals less familiarized to adapt to the digital transformation aspects.

Another study by Yfantis & Ntalianis (2022) shows the familiarity of citizens from other countries (such as Turkey, France, Belgium and Poland) with Digital Twin, AR, VR and Metaverse technologies, but also the involvement in improving municipal services.

The United States wishes to access public services through Metaverse in an easy and accessible way for its citizens.

According to Yfantis & Ntalianis (2022), the Barbados Island has opened an embassy on the 3D Decentraland virtual platform, and its small area can compete in the Metaverse with the size of any state with a much larger area.

The Republic of Indonesia has announced its desire to participate in Metaverse, which they deem as a source of additional income for its citizens.

Tan et al. (2022) established a framework for understanding the dynamics of Blockchain governance in the public sector, offering nine types of governance decisions, which can contribute to the rise of Blockchain-based public services for the administrative side.

During Covid 19, the Metaverse platform was able to provide the delivery of some public services regarding the need for assistance or filing complaints (Kshetri et al., 2024).

3. Technological and application aspects of Blockchain technology in Metaverse

3.1. Technological aspects of Blockchain technology

Because Metaverse deals with massive volumes of data, especially sensitive data, ensuring security and confidentiality is the first consideration when choosing to integrate a technology into Metaverse. With the help of consensus mechanisms (such as asymmetric key encryption), Blockchain technology offers users total control and security over their data (Gadekallu et al., 2022). The quality of data is extremely important, whether it is about making critical decisions based on it or distribute it without interruptions, and Blockchain can enable an improved quality of data in Metaverse, ensuring the validation of data at the level of the organization or user. Another feature of Blockchain technology, interoperability, allows the use of digital assets between different platforms and systems in Metaverse. According to Kohad et al., (2020), interoperability between different Blockchain networks contributes to an improvement in decentralization in Web 3.0, allowing them to communicate and interact seamlessly.

The Blockchain technology comes with great features that can help society to increase the innovation process in every lacking sector. The innovation process means big accountability and enhanced transparency, even more efficiency in data management and operations, great collaboration and engaged citizens in a secure digital environment. The Blockchain technology allows a decentralized control over entities and enables true ownership of users' digital assets. With the help of standardized protocols provided by Blockchain, these digital assets and different information can be moved between different virtual spaces.

The immutability feature specific to Blockchain ensures safe interactions and transactions among users and preserves data integrity.

Taking into account the complexity of the technologies discussed and the study of (Kohad et al., 2020), it is determined that the technological aspects must cover five essential areas: decentralization, acquisition, storage and distribution of data, interoperability, the area dedicated to issues related to data security and automation area.

According to Gadekallu et al. (2022), the acquisition, storage and distribution of data in the Metaverse represent a challenge, because of the multiple sources of provenance (such as data from AR or VR devices or data generated through decentralized applications) or the complexity given by the variety of stakeholders and applications that use these data. Blockchain technology allows the acquisition of original and validated data, and the stored data is resistant to fraud and duplication. Blockchain technology can also help with data sharing, making transactions more transparent and accurate in the Metaverse.

By assigning control to users and communities, decentralized systems can foster increased collaboration and innovation, thus contributing to the development and management of platforms (Avrillionis & Hardjono, 2021), applications and digital assets. The Web 3.0 technology stack given by (Ray, 2023) includes encrypted storage capability, Zero-Trust interaction protocols, pub/sub communication tools for transient data, along with data distribution protocols like IPFS (Interplanetary File System) and computation protocols.

Ray (2023) presents cross-chain solutions, such as Polkadot, Cosmos and Avalanche that allow the transfer of data and assets between networks and enable the development of decentralized applications called DApps. These applications can be built on different Blockchain platforms such as Ethereum, Binance Smart Chain and Solana (Pengquil, 2023) and can provide users with more secure and transparent digital services. Users have the ability to store and distribute data in a distributed network of nodes, ensuring data resiliency. Gan et al., (2023) described in his paper the decentralized data storage platforms Filecoin, Storj and IPFS. These solutions offer better data privacy because users can manage access to their own data (Gan et al., 2023).

With decentralized web hosting platforms that support the development and implementation of decentralized applications, such as Dfinity's Internet Computer and Skynet, user communities have more control over their digital assets and online interactions (Pengquil, 2023). Content distribution is streamlined thanks to decentralized networks, for example the utilization of computing resources of a distributed network of nodes. Two such networks are Theta Network and Livepeer.

Privacy and security are critical aspects of Web 3.0, as they enable users to maintain control over their data, assets and identities while being protected from various threats such as cyber-attacks, fraud and theft. Web 3.0 uses various privacy-enhancing technologies, such as Zero-Knowledge proofs, homomorphic encryption, and multiparty computation, to store, share, and process confidential data. Web 3.0 uses robust security measures such as consensus algorithms, cryptographic hashing, and smart contract audits to ensure the integrity and trust of decentralized platforms, applications, and digital assets (Gan et al., 2023).

Figure 1 summarizes the role of Blockchain technology in Metaverse.

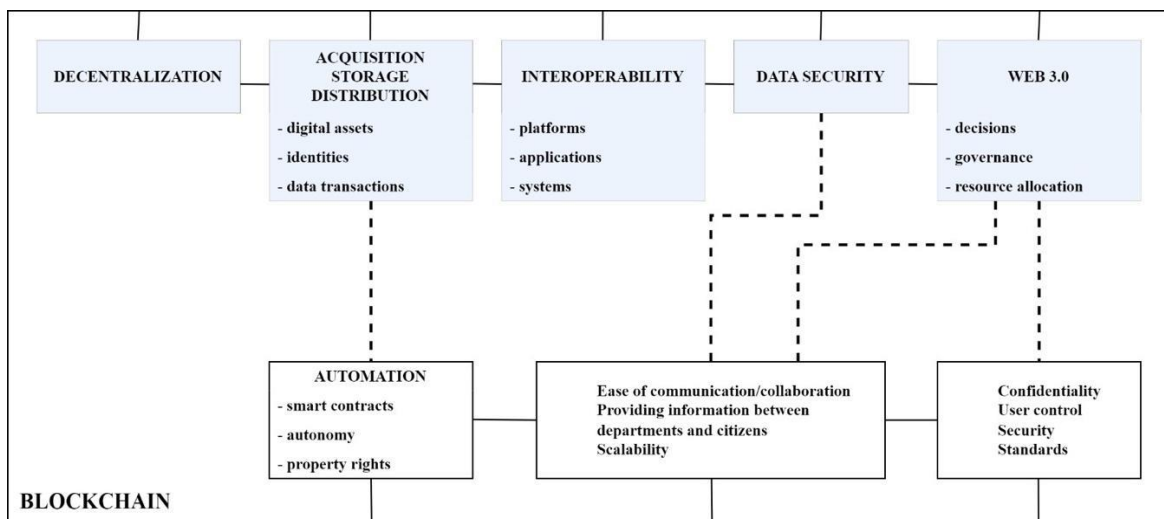


Figure 1. Blockchain - key technology in Metaverse

3.2. Application aspects of Blockchain technology

Blockchain technology has the potential to transform various aspects of the public sector by improving important features such as efficiency, transparency and security in government operations and services. With the adoption by governments of various Blockchain solutions, it is aimed to achieve significant benefits regarding the provision of services and the increase of public confidence in their use.

Both Blockchain technology and Metaverse will offer new manners to run public services by engaging citizens. Some key applications of Blockchain technology for the public sector mentioned below outline the way the intersection between Blockchain and Metaverse can transform in better the public administration services.

Blockchain voting systems. Blockchain can be used to create voting systems characterized by safety and transparency, capable of monitoring votes in real time and ensuring the integrity of election results, mitigating the risk of fraud and offering help to those who encountered various problems in the voting process. The Metaverse will provide platforms for all virtual public debates and votes.

According to Specter et al. (2020), Voatz company launched the first Internet voting application, which was used in federal, state and municipal elections in various states in the United States in 2016. The application mainly helps absentee voters, such as be the case of soldiers in mission.

Managing identity data. Blockchain facilitates the use of identity management systems, providing the ability for users to control and access their digital identities. This reduces the risk of identity theft and provides simplified access to government services, ensuring verifiability and confidentiality. The usefulness of these systems is beneficial for the administration of taxes or pensions or in activities related to academia. The Metaverse will provide digital identity for all the platforms with dedicated activities, such as social interactivity, cultural events and education or government services.

According to Lundkvist et al. (2017) the self-sovereign identity system Uport is easy to use and built on the Ethereum Blockchain platform. Self-sovereign identities (Holotescu, 2018) are controlled and fully owned by the creator and can take many forms (such as people, devices, entities and institutions). They can digitally sign and verify a request or transaction.

Land Registry. Blockchain can improve land registration and property rights management by providing a transparent and immutable land ownership record. This brings advantages such as reducing land ownership disputes, increasing the transparency of land transactions and making property management more efficient. In the virtual worlds of the Metaverse, the virtual land and property are critical assets that drive the economy.

According to Tilbury et al. (2019), the decentralized real estate application Propy facilitates Blockchain-based real estate transactions, the first real estate parcel being sold in 2017.

Supply Chain Management. Blockchain improves transparency and traceability in public sector supply chains. Blockchain can be used to track the flow of goods and services, ensuring regulatory compliance, preventing fraud and improving procurement processes. The Metaverse can offer virtual supply chains, reshaping the way the related goods and services and the whole experience are managed and traded.

According to Nguyen & Do (2018), the IBM Food Trust app represents a collaborative network of growers, distributors, manufacturers and others that improves visibility and responsibility for food supply.

Healthcare Data Management. Blockchain provides secure and interoperable systems for managing medical data. It aims to ensure the integrity of data, their confidentiality and accessibility, to facilitate the exchange of information between healthcare providers. In the Metaverse virtual spaces, users will have granted access to hospitals and any other treatment centers and their sensitive data from the personal health records will be updated and safety managed with the help of Blockchain technology. Integrating Blockchain with Metaverse in this sector will bring user-centric and secure immersive experiences for the citizens' health data on various virtual platforms.

According to Azaria et al. (2016), the decentralized electronic medical records management system MedRec based on Blockchain, 2016, allows patients easy access to their medical information through authentication, ensuring the confidentiality of sensitive information exchange.

Credentialing and Licensing. Blockchain can simplify credentialing and licensing processes in the public sector. Governments can issue and verify licenses, certifications and permits securely to reduce administrative overhead and ensure the authenticity of credentials. The Metaverse can host virtual offices for citizens to interact with the specific public services.

According to Capece et al. (2020), Turcu et al. (2019) with the help of Blockcerts application, the specific education certificates can be issued using Blockchain technology.

The advantage is that the diplomas of students are safe, tamper proof and the issuance time is reduced. This open-source project launched in 2016 can be used in any school to issue and verify educational credentials.

Disaster Management and Humanitarian Aid. Blockchain technology can improve the efficiency and transparency of disaster management and humanitarian aid efforts. Governments and aid organizations can use Blockchain to track aid distribution, verify identities, and ensure that assistance reaches those in need just in time. Having Blockchain technology integrated, the Metaverse will provide access to virtual health and support groups services for citizens in need.

According to Hadjisophocleous et al. (2021), Blockchain can be used as a way to transfer information, not just financial value, into humanitarian aid programs, such as data on refugee camps and land registers. Building Blocks is considered the largest humanitarian use of Blockchain technology and is based on the Ethereum platform that provides security in terms of involvement of third parties.


Tourism. Tița (2022) has analyzed for Romania the ability of Blockchain to ensure the improvement of the travel experience from the point of view of the booking services, payment and verification of identity for the citizen through the three characteristics of technology: transparency, security and efficiency. The integration of the Metaverse with Blockchain technology will offer big opportunities from providing immersive personalized travel experiences to safety transactions. Also, according to Yfantis & Ntalianis (2022) the solutions developed in Metaverse both for tourism activities and for administrative sector can contribute to achieve a new business model in public administration.



4. Potential public services in Metaverse




The integration of public services in a virtual reality space such as Metaverse, where citizens can interact with other users, is an emerging field with significant potential. The experience of providing and accessing public services through immersive and interactive experiences can be considerable improved. In this regard, applications dedicated to accessing and using public services developed for Metaverse could radically transform the way citizens interact with government agencies whenever they need and regardless of their location.


Traditional public services in Romania cover sectors designed to provide essential services to citizens. In this paper, the key services were established in the health, education, transport, public safety, social services, utilities and infrastructure, public administration, cultural services and environmental services. Table 1 contains a brief description of these key services for which similar virtual services have been proposed along with exemplified roles of Blockchain technologies for each service.

Table 1. Key services offered in Metaverse

Traditional government services	Governmental Services in Metaverse	Users as Avatars in virtual spaces	Role of Blockchain technologies
<p>Health</p> <p><i>Public Health System</i> - network of hospitals, clinics and doctors; - funded by the state and mandatory health insurance.</p> <p><i>National Health Insurance House CNAS</i> - the health insurance system and access to medical services;</p> <p><i>Emergency Medical Services</i> - ambulance services and emergency response; - Mobile Emergency Service for Resuscitation and Extrication <i>SMURD</i>.</p>	<p>Virtual Healthcare</p> <p><i>Virtual Consultations</i> - virtual clinics; - treatment plans in a 3D environment.</p> <p><i>Health Education and Training</i> - use of virtual reality simulations.</p>		<ul style="list-style-type: none"> - managing medical records in a safe, transparent, interoperable and patient-centric environment; - safety and reduced costs in the provision of remote health consultations and the realization of contracts for payments or insurance claims.

<p>Education</p> <ul style="list-style-type: none"> - primary, secondary, and higher education institutions. <p>Ministry of Education manages the education system, curriculum, and policies</p> <p>Public Universities and Research Institutes</p> <ul style="list-style-type: none"> - undergraduate and postgraduate programs. 	<p>Virtual Education</p> <p>Virtual Classrooms</p> <ul style="list-style-type: none"> - immersive learning experiences for students. <p>Virtual campus tours</p> <ul style="list-style-type: none"> - to make decisions about the best school to choose. 		<ul style="list-style-type: none"> - securing the permanent educational records; - allowing students to own, control and share their digital diplomas and certificates; - facilitating the sharing of resources and collaborations.
<p>Transportation</p> <p>Public Transport</p> <ul style="list-style-type: none"> - buses, trams, trolleybuses and metro services. <p>Railway Services operated by Romanian Railways CFR</p> <ul style="list-style-type: none"> - domestic and international rail services. <p>Airlines</p> <ul style="list-style-type: none"> - the national airline TAROM; - international airports. <p>Maritime and river transport</p> <ul style="list-style-type: none"> - Constanța, Mangalia, Mădăria Ports; - Key ports on the Danube River: Galați, Brăila, Tulcea. 	<p>Virtual Transportation</p> <p>Virtual Traffic Management</p> <ul style="list-style-type: none"> - to simulate traffic scenarios and urban congestion management. <p>Traveler Assistance</p> <ul style="list-style-type: none"> - virtual kiosks at transportation hubs to provide real-time information and assistance to travelers. 		<ul style="list-style-type: none"> - providing more secure, transparent, efficient and trustworthy virtual transportation systems with real-time status updates and automated processes such as ticketing and toll payments.
<p>Public Safety</p> <p>The Romanian Police maintains public order, prevents and investigates crime</p> <p>Firefighting and Rescue Services managed by the General Inspectorate for Emergency Situations IGSU</p> <p>Judicial System</p> <ul style="list-style-type: none"> - courts; - prosecution services; - other legal institutions for administration of justice. 	<p>Virtual Public Safety</p> <p>Virtual Training for Police and Emergency Responders</p> <ul style="list-style-type: none"> - simulations of various scenarios for safety measures. <p>Community-oriented policing</p> <ul style="list-style-type: none"> - virtual spaces for citizens to interact and report issues with police officers. 		<ul style="list-style-type: none"> - ensuring data security and integrity of the public records; - providing transparency and accountability of the transactions; - reducing fraud in public transportation.
<p>Social Services</p> <p>Social Welfare Programs provide support for low-income families, elderly and individuals with disabilities</p> <p>Child Protection Services ensure the welfare and rights of children</p> <p>Pension System managed by the National House of Public Pensions</p>	<p>Virtual Social Services</p> <p>Virtual Counseling and Support Groups in private virtual environment</p> <p>Benefit Applications for citizens</p>		<ul style="list-style-type: none"> - improving secure virtual service delivery; - building build public trust in social service organizations; - ensuring efficient resources allocation.

<p>Utilities and Infrastructure</p> <p><i>Water and Sewage Services</i> provided by regional companies, ensuring access to clean water and proper sanitation</p> <p><i>Electricity and Gas Supply</i> managed by state and private companies, ensuring the provision of energy to households and businesses</p>	<p>Virtual Utilities and Infrastructure</p> <p><i>Virtual Inspections of infrastructure</i></p> <p><i>Virtual Customer Service Centers</i></p>		<ul style="list-style-type: none"> - enhancing data security and integrity of the records; - providing transparency and accountability of the transactions and data entries; - ensuring secure operations (such as billing and resource allocation); - improving real-time data sharing; - offering fraud prevention and transparent and efficient resource allocation.
<p>Public Administration</p> <p><i>Local and Central Government Services</i></p> <ul style="list-style-type: none"> - municipal services; - civil registry offices; - various administrative functions. <p><i>E-Government Services</i></p> <ul style="list-style-type: none"> - Online platforms for accessing various public services (tax payments, document requests). 	<p>Virtual Public Administration</p> <p><i>Virtual Government Offices</i> for citizens to access public services (renew documents, access records)</p> <p><i>Public Participation</i></p> <ul style="list-style-type: none"> - virtual town halls and public consultations to improve citizen engagement in governance. 		<ul style="list-style-type: none"> - enhancing data security and integrity of the records; - ensuring transparency and accountability of the decisions, transactions and data entries; - building public trust in government operations; - ensuring streamlined administrative processes; - improving coordination among government bodies; - ensuring reduced risk of identity fraud.
<p>Cultural Services</p> <p><i>Public Libraries and Museums</i></p> <p><i>Cultural Events and Programs</i></p>	<p>Virtual Cultural Services</p> <p><i>Virtual Museums and Libraries</i></p> <p><i>Virtual Cultural Events</i></p> <ul style="list-style-type: none"> - concerts; - exhibits; - theater performances. 		<ul style="list-style-type: none"> - ensuring verifiability and immutability for the digital provenance and ownership of digital cultural assets; - offering decentralized platforms for distributing cultural content; - ensuring accurate royalty distribution

<p>Environmental Services</p> <p><i>Waste Management</i></p> <p><i>Environmental Protection Agencies</i></p>	<p>Virtual Environmental Services</p> <p><i>Virtual Environmental Monitoring</i></p> <p>- simulations and tours to engage the public in conservations.</p> <p><i>Waste Management Education</i></p> <p>- interactive virtual experiences to educate the public on management practices.</p>		<ul style="list-style-type: none"> - enhancing data security and integrity of the environmental monitoring; - reducing the potential for fraud and misuse of the transactions and data entries; - ensuring streamlined administrative processes; - improving coordination and response times in real-time data sharing between users and stakeholders.
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While Metaverse offers significant potential for creating innovative approaches to how governments interact with citizens and deliver services, Blockchain ensures the security of these interactions, transparency and accountability.

For each of the services presented in Table 1, Metaverse can contribute in various ways, such as: easy and friendly access to various government services with the help of virtual government offices, the involvement of citizens in real time, regardless of their location, in civic activities in digital public spaces, such as virtual elections or urban planning. The public clerks will have the opportunity to use collaborative workspaces for training and real-life scenarios simulations. Virtual public services in Metaverse, such as healthcare or educational resources can be offered with easy access from the citizens in physical world.

The Blockchain technology in public administration will ensure the security, transparency and accountability and efficiency for all the interactions in Metaverse with the help of immutable records of government transactions and smart contracts that automate public processes. Blockchain offers decentralized identity management to establish secure, decentralized identities for citizens, secure personal records or financial information

5. Conclusions and future research directions

The evolution of technology requires the need to understand and deepen the changes that work brings to the virtual environment. In the particular case of public services addressed to citizens, one must understand the various implications that accessing certain services in Metaverse can generate.

Due to its decentralized nature, Blockchain is considered a key technology in Metaverse, with huge potential to revolutionize various industries, including the public sector, by ensuring the safety of government operations, increase accessibility and follow-up to reduce the risk of fraud.

The paper details the technological and applicable aspects of Blockchain technology together with a series of activities specific to the public services sector, which can be improved on a Metaverse platform, with the aim of providing a future direction of more detailed research in the field of the public sector. This research will continue with the development and testing of established scenarios in the public administration, with the purpose of educating users on virtual work and using specific equipment to perform certain simplified operations.

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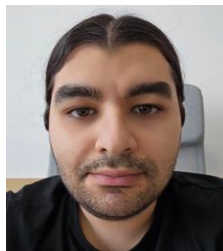
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Mădălina-Cornelia ZAMFIR graduated from the Faculty of Automation and Computers at the Politehnica Bucharest National University of Science and Technology. She is a scientific researcher within the *Digital Transformation and Governance* Department at the National Institute for Research and Development in Informatics – ICI Bucharest. Topics of interest in the research activity cover Cloud infrastructures, IoT support for Big Data, Big Data Analytics, Geospatial Analytics.

Mădălina-Cornelia ZAMFIR a absolvit Facultatea de Automatică și Calculatoare din cadrul Universității Naționale de Știință și Tehnologie Politehnica din București. Este cercetător științific la Departamentul „Transformare și guvernare digitală” din cadrul Institutului Național de Cercetare-Dezvoltare în Informatică – ICI București. Subiectele sale de interes în activitatea de cercetare acoperă infrastructurile de tip Cloud, suportul IoT pentru soluțiile de tip Big Data, Big Data Analytics, Geospatial Analytics.



Ionuț-Emanuel GIURA graduated from the Faculty of Engineering at Lucian Blaga University of Sibiu. He is an assistant researcher within the Digital Transformation and Governance Department at the National Institute for Research and Development in Informatics – ICI Bucharest. Topics of interest in the research activity cover web development, web application optimization, user experience (UX), and the integration of emerging technologies in software development.

Ionuț-Emanuel GIURA a absolvit Facultatea de Inginerie din cadrul Universității “Lucian Blaga” din Sibiu. Este asistent de cercetare la Departamentul „Transformare și guvernare digitală” din cadrul Institutului Național de Cercetare-Dezvoltare în Informatică – ICI București. Subiectele de interes în activitatea de cercetare includ dezvoltarea web, optimizarea aplicațiilor web, experiența utilizatorului (UX) și integrarea tehnologiilor emergente în dezvoltarea de software.



Andreea Cătălina CRĂCIUN with a diversified academic background, which includes a bachelor's degree in economics with a specialization in marketing obtained from the Academy of Economic Studies in Bucharest (ASE) and a master's in cultural studies at the University of Bucharest, works as a research assistant at the National Institute for Research and Development in

Informatics – ICI Bucharest. Her research interests focus on the intersection of technology and society, exploring how technological developments, artificial intelligence, metaverse and digitalization influence human behaviour and social structures.

Andreea Cătălina CRĂCIUN are o pregătire academică diversificată, ce include o diplomă de licență în economie cu specializare în marketing de la Academia de Studii Economice din București și un master în studii culturale de la Universitatea din București. În prezent, este asistent de cercetare în cadrul Institutului Național de Cercetare-Dezvoltare în Informatică – ICI București. În activitatea de cercetare, subiectele de interes se concentrează pe intersecția dintre tehnologie și societate, explorând modul în care evoluțiile tehnologice, inteligența artificială, metaversul și digitalizarea influențează comportamentul uman și structurile sociale.



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