

BLOCKCHAIN CHARACTERISTICS AND IMPLICATIONS: ASSESSING THE IMPACT ON SUSTAINABILITY IN TURKISH SECTORS

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UDC 336.74
JEL Classification: Q01

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Technological advances are accelerating the activation of the saving, preserving and using information in various economic models. Blockchain technology is one of the latest technologies used by many international institutions and organizations. Compared to other banking or technological technologies, it transmits and accumulates information transparently, instantly, and reliably at a low cost. As Turkey plays a significant economic role in the Middle East and Europe regions, this article highlights a sample of Turkish companies that use blockchain technology of the version 4.0. It is an attempt to measure the variables of the coefficient of trust, immutability, transparency, and cost reduction in combination with blockchain applications by scientists, administrative authors, and blockchain technologists. A quantitative descriptive approach has been adopted to examine the interrelation between blockchain applications and increase in transparency, confidence, stability, and cost reduction, based on the SPSS statistical software to produce accurate results. 19 Turkish companies were selected from 62 Turkish companies that have adopted blockchain, according to the official agency «BTCR» that tracks these organizations in Turkey. The selected companies, operating in banking, telecommunications, industry, and non-governmental associations, make large contributions to Turkey's GDP. The study found that all four variables in the sectors improved significantly after the introduction of blockchain technology, but the systems for monitoring and tracking their influence were complex ones.

Keywords: blockchain, trust, immutability, cost reduction, sustainability, Turkey.

DOI: <https://doi.org/10.32983/2222-0712-2023-3-265-270>

Tabl.: 3. **Bibl.:** 21.

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УДК 336.74
JEL Classification: Q01

Краснокутська Н. С., Адигузель К. Характеристики блокчейну та наслідки його використання: оцінка впливу на сталий розвиток в економічних секторах Туреччини

Технологічний прогрес прискорює активізацію зберігання, збереження та використання інформації в різних економічних моделях. Технологія блокчейн є однією з найновіших технологій, яку використовують багато міжнародних установ і організацій. Порівняно з іншими банківськими або технологічними технологіями він передає та зберігає інформацію прозоро, миттєво та достовірно за невелику вартість. Оскільки Туреччина відіграє значну економічну роль у регіонах Близького Сходу та Європи, у цій статті висвітлюється вибірка турецьких компаній, які використовують технологію блокчейн у версії 4.0. Це спроба виміряти змінні коефіцієнта довіри, незмінності, прозорості та зниження витрат у поєднанні з блокчейн-додатками вченими, адміністративними авторами та блокчейн-технологіями. Кількісний описовий підхід був прийнятий для вивчення зв'язку між блокчейн-додатками та підвищенням прозорості, впевненості, стабільності та зниження витрат на основі статистичної програми SPSS для отримання точних результатів. 19 турецьких компаній було відібрано з 62 турецьких компаній, які перейняли блокчейн, згідно з офіційним агентством, яке відстежує ці організації в Туреччині, «BTCR». Вибрані компанії, залучені в банківських, телекомунікаційних, промислових і неурядових асоціаціях, роблять великий внесок у ВВП Туреччини. Дослідження показало, що всі чотири змінні в секторах суттєво покращилися після впровадження технології блокчейн, але системи моніторингу та відстеження їх впливу були складними.

Ключові слова: блокчейн, довіра, незмінність, зниження витрат, стійкість, Туреччина.

Табл.: 3. **Бібл.:** 21.

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Introduction. Since the advent of blockchain technology in the past two decades, research and articles have abounded on their matrimonial impact on sustainability in various industries and sectors [13] using blockchain technology, which is based on a ledger for transactions and supply chains, it is possible to track the source of information in supply chains, especially financial laboratories, or to identify sources of contaminated food, for example, to ensure food safety [22]. Transparency and traceability are advantages of this technology used by many scientists and observers to prevent fraud and corruption. In smart cross-technical contracts, changes and modifications can only be made with the consent of all participants, allowing businesses and governments to reduce corruption and rationalise resource use [4].

In addition, this technology has a decentralised feature that reduces the need for intermediaries and reduces waste or cost associated with intermediaries. Blockchain can revolutionise supply chain management by providing a comprehensive view (Nguyen Q., 2016). Through this approach, waste can be reduced, costs can be reduced, and sustainable practices can be ensured [2].

Scientific studies addressing Blockchain characteristics and its implications for the Turkish economic sectors: Blockchain technology has already been identified as having the critical characteristics of trust, immutability, transparency, and cost reduction, according to scholars who have conducted significant studies in the field [3]. Blockchain studies are often described as a trust mechanism based on decentralisation and the involvement of all primary and secondary stakeholders in the validity and recording of information [21]. It is impossible to change or delete the information once it has been entered into the system, which enhances its stability and accuracy. Additionally, the technology includes a self-encryption mechanism that ensures that only those stakeholders are authorised to access and verify information [17]. Additionally, Blockchain technology has been shown to reduce miscellaneous costs [9; 12] and enhance the immutability of protecting an organisation's information systems against hacking attacks [11]. Bibliometric study has been made to address the impact of Blockchain features and interconnection with the sustainability by [6], where it revealed from their study that Blockchain technology has the potential to contribute to economic, social, and environmental sustainability. Blockchain technology provides a tamper-proof record of the entire supply chain process during global trade.

Economic growth and stability can be achieved by reducing operational delays, reducing conflicts between stakeholders, and ensuring fair business practices. With blockchain technology, individuals can securely manage and share their data, making them self-reliant. Those without proper identifi-

cation can access healthcare, education, and financial services more efficiently.

Additionally, Blockchain enhances transparency in charitable activities by providing donors with real-time visibility into the use of their donations. Using blockchain technology, employers can ensure that wage agreements, working conditions, and employment contracts are transparent. Explicit labour practices can be prevented, and social justice can be promoted [7].

In a study of global economies, Turkey was ranked 38th out of 170 countries from 1961 to 2021. In 2021, the value was 88.84 percent. According to the International Monetary Fund, banks' assets and percentage of GDP in Turkey reached their maximum in 2021, with 92.93 % fund [18].

Telecommunications have experienced rapid growth in recent years and are expected to continue to do so until 2025 [19]. The main drivers of the sector's growth are increasing urbanisation and the widespread use of mobile phones supporting 3G, 4G, and 5G services. The Internet of Things (IoT) is increasingly used in industries that connect to wired and wireless Internet, and this is expected to lead to significant growth in the telecom sector [19]. The Turkish government has provided significant development aid in the last five years. Turkey ranks among the top ten countries in terms of international development co-operation as part of its proactive foreign policy, official development assistance increased by 0.79 percent in 2022, resulting in an increase in Turkey's gross national income of USD7.2 billion [10] As a result of its favourable geopolitical location, young, energetic workforce, and government incentives for foreign and domestic investors, Turkish industry continues to expand regularly. By enhancing the Turkish industry's competitiveness and efficiency, the country is accelerating the transition to an industry structure with a more significant share of global exports, primarily producing high-tech products with high added value, and attracting qualified labour. In addition to being sensitive to the environment, it is also sensitive to society 31.1% of total production is accounted for by the manufacturing sector [19] Manufacturing products include food, textiles and apparel, motor vehicles, manufactured metal products, plastic products, chemicals and chemical products, and electrical equipment. Almost all of the country's production, employment, and exports come from the textile and apparel industry. As of 2023, Turkey is the fourth-largest apparel exporter and the seventh-largest exporter of textile products worldwide [19].

The article examines the possibility of incorporating Blockchain into business process models in four significant Turkish economic sectors: banking, telecom, non-governmental organisations, and the industrial sector, all contributing considerably to the country's gross domestic production.

Methodology. This quantitative study examines the perception of organisational support after the adoption of blockchain technology and tests the following hypotheses:

Hypothesis 1: There is a positive relationship between integrating Blockchain applications and increasing trust among internal and external stakeholders.

Hypothesis 2: There is a positive relationship between integrating Blockchain applications and promoting immutability.

Hypothesis 3: There is a positive relationship between integrating Blockchain applications and enhancing transparency among financial and non-financial issues.

Hypothesis 4: there is a positive relationship between integrating Blockchain technology and reducing costs.

Based on the interdependent variables "Trust, Immutability, Transparency, Cost Reduction", and its impact on economic, social, and ecological sustainability, the study's hypotheses could assist the observer in measuring phenomena independently. In order to achieve these objectives, a cross-sectional study design was used [15], which allowed comparisons between different demographic groups at a particular time. This cross-sectional study examines how 19 selected Turkish companies will use Blockchain 4.0 after 2021.

A survey of 12 questions was distributed to 120 employees and managers in 19 selected companies in Turkey (the companies are in the banking, telecommunication, NGOs and industrial sectors). Analyses of cost-benefits, case studies, and comparisons between traditional systems and blockchain-powered solutions will be used to conduct the survey. By conducting thorough research, researchers can gain insight into the economic implications of blockchain adoption. These insights can benefit many domains, including decision-makers and stakeholders interested in implementing blockchain technology to improve efficiency.

The survey consists of four sections:

- the first sections contain questions to test the relationship between integrating blockchain technology and trust;
- the second section includes questions to test the relationship between integrating blockchain technology and transparency value;
- the third section includes questions to test the relationship between integrating blockchain technology and immutability;
- the fourth section includes a question to test the relationship between integrating blockchain technology and cost reduction.

For the survey, we used a Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree) [14]. Two main reasons explain the choice of the scale. First, the study was based on the theory of the three-dimensional model of organisational commitment founded by [8] Second, the scale has been applied in different contexts (countries, sectors, language and time) and evaluated for validity and reliability [5].

Abductive research methodology is frequently associated with the survey tactic. In business and management research, questions such as what, who, where, how much, and how many are most commonly addressed using this popular and widely used technique. Due to this, it frequently appears in exploratory and descriptive research. Survey methods based

on questionnaires are popular because they allow for the collection of standardised data from a large population, enabling easy comparisons. Furthermore, the survey approach is considered authoritative by the general public and easy to understand and explain. Smith (1994) argues that questionnaires are an adequate method of gathering quantitative research data. Hence, it is compatible with the research paradigm, methodology and purpose. Rohm confirms that questionnaires are usually employed in studies aiming to measure and analyse relationships between variables in social reality (Rohm, 2013).

The questionnaire was developed in English and Turkish on Google Forms, with the obtained results securely stored in an account for the author. The Statistical Package for the Social Sciences (SPSS) Program analysed the data.

This study employed a survey strategy to collect data from a sample of 120 employees and executives operating in 19 targeted companies within the banking, industrial, NGO, and telecommunication sectors in Turkey. It helped assess the relationship between integrating blockchain technology and various variables, ultimately contributing to evaluating Blockchain's impact on economic, social, and ecological sustainability in Turkish companies.

In order to analyse data, the author used SPSS to perform two kinds of statistical analysis. The one-dimensional descriptive approach allows us to describe the respondents' profiles and the degree to which each variable was measured. Explanatory (inferential) methods involve identifying causal relationships between two or more variables to test hypotheses. Tests have been selected based on the nature of the dependent and independent variables.

Findings and results. The Cronbach Alpha Value was used to test the reliability and consistency of the questions in the questionnaire. Questions are considered reliable and consistent if the Cronbach Alpha value exceeds 0.7. Accordingly, the reliability results for the questionnaire were equal to $0.931 > 0.7$; thus, all the results were perfectly reliable and consistent.

Comparative analysis regarding the four main factors. The section compares the Trust factor, transparency factor, immutability factor and cost reduction factors. First, a normality test (Shapiro-Wilk) is applied to see if the normality assumption is met. As seen in the following table, the Sig. of all variables is higher than 0.05; therefore, the normality assumption is met. Second, and as a consequence, a parametric test is applied – Chi-Square – for comparison.

The sections below study if there is any relationship between organisational commitment and withdrawal behaviours through the Spearman Test [16]. The value of Sig. is higher than 0.05 for trust value, meaning trust is highly related to Blockchain integration. The value of Sig. is higher than 0.05 for transparency and blockchain integration. The coefficient is positive; thereby, the relationship between them is positive. The value of Sig. is higher than 0.05 for immutability and integration of Blockchain technology. The coefficient is positive; thereby, the relationship between them is positive. The value of Sig. is higher than 0.05 for cost reduction and integration of Blockchain technology. The coefficient is positive; thereby, the relationship between them is positive.

The descriptive and comparative analysis results showed that not all the demographic and professional factors are re-

Table 1

The statistician tests methods used to measure the data variables resulting from the questionnaires

Statistics	Test	Variables	Objective
Descriptive Statistics	Univariate Statistics	Economic sector for the organisation (Banking, Telecom, Industrial; NGOs) Position Level: "first line employee; Middle manager or supervisor; top manager." Experience level: 1-3 years; between 3 and 5 years; above five years	Present the Respondents' Profile in order to analyse whether it affects the results or not
Inferential Statistics	Chi-Square or Non-Parametric independent test;	Relationship between integrating Blockchain and increasing achieving the economic factors	To verify or deny Hypothesis Number 1
	Chi-Square or Non-Parametric independent test; Spearman Independence Test	Relationship between integrating Blockchain and increasing achieving the social factors	To verify or deny Hypothesis Number 2
	Chi-Square or Non-Parametric independent test; Spearman Independence Test	Relationship between integrating Blockchain and increasing achieving the Ecological factors	To verify or deny Hypothesis Number 3

Table 2

Shapiro-Wilk (Test of Normality) the factors affecting integrating Blockchain technology

	Category	Shapiro-Wilk		
		Statistic	Df	Sig.
Trust Factor	3.00	.902	9	.266
	4.00	.867	8	.142
	5.00			
Immutability factor	3.00	.885	9	.175
	4.00	.942	8	.630
	5.00			
Transparency factors	3.00	.897	9	.237
	4.00	.907	8	.332
	5.00			
Cost reduction factor	3.00	.901	9	.259
	4.00			
	5.00			
	3.00			
Overall Org Com	4.00	.986	8	.987
	5.00			

Source: Obtained by the author via SPSS

lated to each type of organisational commitment and overall organisational commitment. Thereby, H₁ and H₂ and H₃ and H₄ are accepted.

Conclusion. Based on the results and statistical analysis described in the article, it can be concluded that blockchain technology is beneficial for enhancing transparency, confidence, and stability and reducing costs in banking, industry, telecommunications, and NGOs. In addition to reducing fraudulent risk and piracy, technology ensures the integrity of

financial statements by providing a system resistant to information tampering and remittances. In gaining customer confidence, transparency of procedures and regulatory compliance is crucial. In addition to protecting financial records, the unchangeable advantage decreases the risk of stakeholders being in conflict. Furthermore, the technology allows for a greater level of confidence, transparency, and stability while reducing expenditures on the telecommunications sector to ensure that these services are available to a broader segment of Turkish so-

Measuring the correlation between adopting Blockchain and the intermediate variables Trust, Immutability, Transparency and Cost reduction

Correlations		Affective Com	Normative Com	Continuance Com	Overall Org Com
Trust	Correlation Coefficient	.539*	.378	.033	.434
	Sig. (2-tailed)	.078	.100	.890	.056
	N	60	60	60	60
Immutability	Correlation Coefficient	.645*	.336	.225	.415
	Sig. (2-tailed)	.068	.147	.341	.069
	N	60	60	60	60
Transparency	Correlation Coefficient	-.744	-.061	-.437	-.586
	Sig. (2-tailed)	.084	.798	.054	.533
	N
Cost reduction	Correlation Coefficient	0.632	0.326	0.221	0.410
	Sig. (2tailed)	.056	.124	.326	.091
	N	60	60	60	60

Source: author's development

ciety. This technology facilitates international trade within supply chains in the industrial sector. The technology has enabled NGO actors to document and share projects so that they can measure their contribution to sustainable development.

Additionally, it has made it easier to raise funds for social, environmental, and relief development. While technology advances, it still faces technical and regulatory challenges, most notably differences in regulations and approaches between countries and regions. Cryptocurrency regulations in Turkey, for example, have been ambiguous and changed, creating uncertainty for investors and companies. Aside from the ambiguity in the law regarding cryptocurrencies and smart contracts, these technologies also consume a large amount of energy, which is concerning from an environmental perspective. Consequently, these challenges require more in-depth studies of environmental operability, legal scalability, and application accessibility to reach a broader range of sectors and professionals.

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Стаття надійшла до редакції 06.08.2023 р.