AN ANALYSIS OF THE FEASIBILITY OF BLOCKCHAIN TECHNOLOGY IN THE NATIONAL DEFENSE INDUSTRY[1]

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ABSTRACT

The aim of this study is to analyze and evaluate the feasibility of blockchain technology in the management of technology investments in the national defense industry. Blockchain technology (BT) has the potential to provide an important tool and infrastructure in providing technical cooperation and partnerships between national defense technology companies and institutions. It is predicted that BT shall become widespread in the field of defense industry and its cost shall decrease over time. Data sending and assessment of trust in the collaborative ambiance are seen as important problem areas in the use of blockchain technology by defense industry companies. In order to use blockchain technologies effectively in Turkey's move of national defense industry, legal foundations, and platforms should be established and a state strategy should be formed in this regard.

Keywords: *Blockchain technology, defense industry, management information system*
JEL Codes: *M00, M15, M110*

Scope: *Management information systems*
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[1] Compliance with the ethical rules of the relevant study has been declared.

MİLLİ SAVUNMA SANAYİİNDE BLOKZİNCİR TEKNOLOJİSİNİN UYGULANABİLİRLİĞİNE İLİŞKİN BİR ANALİZ

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ÖZ | Bu çalışmanın amacı milli savunma sanayiinde teknoloji yatırımlarının yönetiminde blokzincir teknolojisi uygulamasının gerçekleştirilebilirliğini analiz etmek ve değerlendirmektir. Milli savunma teknoloji şirketleri ve kurumları arasında teknoloji işbirliğini ve ortaklıklarını sağlamada blokzincir teknolojisi önemli bir araç ve alt yapı sunabilme potansiyeline sahiptir. Blokzincir teknolojisinin savunma sanayii alanında yaygınlaşacağı ve maliyetinin zamanla düşeceği öngörülmektedir. Blokzincir teknolojisinin savunma sanayii şirketleri tarafından kullanımında işbirliği ortamında veri paylaşımı ve güven değerlendirmesi önemli sorun alanları olarak görülmektedir. Türkiye'nin milli savunma sanayii hamlesinde blokzincir teknolojisinin etkili şekilde kullanılması için yasal temellerin ve platformların oluşturulması ve bu konuda bir devlet stratejisinin bulunması gerekmektedir.

Anahtar Kelimeler: *Blokzincir teknolojisi, savunma sanayi, yönetim bilişim sistemleri*

JEL Kodları*: C44, D70, M110*

Alan: *Yönetim bilişim sistemleri*
Türü: *Derleme*

1. INTRODUCTION

After the Second World War, significant and rapid development has been experienced in the field of technology and new products and ways of production have emerged over time. The effects of technology, which has been the main actor of all these processes, especially in the defense industry (DI) have been greater compared to those in other fields and continue to be so.

The DI consists of the aggregation of industrial assets that provide essential elements to national security and military power. The DI is the sum of a country's producers of defense-related value, employment, technology, or composed of all the companies that provide defense or defense-related equipment to the defense ministries (Dunne, 1995). The DI is a group of companies owned by private and public institutions which develop, manufacture, maintain, and repair all kinds of strategic and tactical attack and defense systems and military equipment needed by the armed forces (Akgül, 1987). The DI, which includes all sectors that manufacture various materials for attack and defense such as airplanes, helicopters, submarines, ships, missiles, radars, tanks, cannons, rifles, and bombs, is the whole of industrial enterprises which manufacture military products that countries use to ensure their national security and to increase their foreign policy activities (Köseoğlu, 2010). It is not possible to have an army equipped with modern weapon systems and advanced military equipment without a strong DI. Developed and developing countries, which are aware of this situation, attach special importance to the national DI and intensively effort to develop this type of industry (Yeloğlu, Çakır & Yıldırım, 2022; Yeşilyurt & Yeşilyurt 2019).

It is predicted that blockchain applications can be a faciliteted tool at the point of providing control. The reason for choosing specifically the national DI in this study is the expectation that companies operating in the DI can more clearly reflect the effects of blockchain applicability due to the importance and high rate of technological investment, and the fact that DI is a repulsive and locomotive sector compared to other branches of industry.

How, to what extent, and in what context blockchain technology (BT) can be used in the national DI is an important question and issue. In particular, it is important to demonstrate the relevance and impact of BT in the context of solving the problems that may be encountered as part of defense projects and collaborations, and of putting forward a strategy.

The purpose of this study is to analyze and evaluate the feasibility of BT application in the management of technology investments in the DI. In line with this general aim, answers to the following research questions have been sought:

1.Considering the rapidly changing DI activities and needs in the management of national DI technologies, how and in what areas should BT be applied?

2.What are the problems and opportunities encountered/may be encountered in the application of BT in the national DI?

3. How can blockchain application be implemented in the management of national DI technologies and technological investments in the future, and what are the possible obstacles to its implementation?

This study aims to contribute to the related research by providing information about the feasibility of BT in the field of national DI and about how it can be utilized. For this purpose, national and international literature on BT in the field of DI was reviewed; and those related to the national DI among these studies were compiled and presented. Problem areas and opportunities were attempted to theoretical determined by revealing the relationship between BT and the field of DI.

2. THEORETICAL FRAMEWORK

In particular, international arms production and the market have undergone significant changes since the end of the Cold War. Transformation requires an increasing level of cooperation between DI organizations, which includes joint production/development, partnerships, mergers and, acquisitions and joint ventures in response to increasing arms production and R&D costs. Cooperation is likely to ease pressures on defense companies and national budgets, leading to the adoption of an export-oriented DI policy, market liberalization, privatization, and integrative DI policies. In this context, the Turkish national DI follows an integrative approach and continues to encourage foreign defense partnerships by establishing joint ventures and subsidiaries (Kurç & Biztzinger, 2018). However, in the study conducted by Yaşar (2010), it was revealed that being under the defense umbrella of NATO restricts Turkey's ability to enter into alternative security and DI cooperation; the same policy does not fit every country, and different internal dynamics shape the DI policies of developing countries.

With the embargo implemented after the Cyprus Peace Operation in 1974, the importance of national DI was understood and attention has been paid to the DI sector since the 1980s. It was observed that the performance of this sector increased significantly, especially in the mid-2000s. While Turkey develops its DI in order to reduce foreign dependency on defense, its export potential is also increasing. Turkey seems to be a candidate country to have an

important place in the future with its investments and developments in the DI (Sezgin & Sezgin, 2018). While there was foreign dependency in the pre-1980 period in Turkey for the provision of defense services, which are fully public goods, it has been gradually moving away from foreign dependency since 1980 (Baran, 2018).

Considering the importance that Turkey attaches to the national DI and the resources it allocates for the industry, it is out of the question to ignore the BT. It is important to consider technological investments in the field of DI from many aspects such as cost-benefit efficiency, private-state contribution, patent, international relations, information sharing, innovation, cooperation between private and state companies and organizations, as well as meeting efficiency and needs. The process of technological investments in the DI is carried out through multiple contractors; this situation leads to difficulties in controlling information flow, security, resource waste, and similar issues. In order to enable control in all processes, it is possible that BT effectively meets the needs of stakeholders and is used in management processes.

In the empirical study conducted by Alkan (2020), in which the factors affecting the adoption of BT are discussed in terms of security, it has been revealed that there is a positive relationship between perceived ease of use in blockchain and perceived usefulness, and behavioral intention; and a positive relationship between innovation and perceived usefulness. In addition, it has been determined that there is a positive relationship between confidentiality and benefit, and a positive relationship between trust, and knowledge level and behavioral intention. Within the context of the results of this study, it can be stated that there is a positive vision and perception regarding the use of BT in the field of national DI.

Technological investment projects carried out under the DI are costly, and although they have great financial returns when successfully completed, they also impose a heavy burden on the economy if they are unsuccessful. Large DI organizations cannot do the work themselves at every level; therefore, they benefit from the sub-industry in many areas. From this point of view, it is observed that there are many small-scale companies in the field of DI and they specialize in certain areas. In DI, process management is carried out with many sub-contractors rather than a single contractor; this situation makes it difficult to control information flow, security, resource waste, and similar issues.

2.1. Blockchain Technology

Blockchain is an innovative distributed ledger technology allowing network nodes that do not fully trust each other to exchange financial values and interact without the need for mutual trust (Hofmann, Magnus & Bosia, 2018; Wüst & Gervais, 2018). Blockchain is a data structure that is copied, shared, and synchronized between many sites, countries and/or institutes through consensus algorithms (Taş & Kiani, 2018). Blockchain represents complex business networks with nodes for each of the different operations that want to collaborate and exchange information (Lucena, Binotto, Momo & Kim, 2022; Nakamoto, 2008).

BT attracts great attention in the fields of industry, defense, health, energy, education, and advanced technology as it includes an innovation that allows parties with mutual trust problems to exchange information and data reliably without the need for a third party. This is a fully desirable application and platform for collaborative detection with a good chance of solving problems related to data sharing and trust management. Blockchain is typically classified into two main categories (Meng et al., 2018; Mukhopadhyay et al., 2016; Viriyasitavat & Danupol, 2018):

- *Permissionless Blockchain:* In an open blockchain network, anyone can join the network. This system is considered to be a completely independent and central authority-free blockchain system. In a permissionless or public blockchain, any entity is free to participate, especially in the consensus process, as a reader or writer. Examples of permissionless blockchain include most cryptocurrencies such as Bitcoin and Zerocash, as well as more general blockchain such as Ethereum.
- *Permissioned Blockchain:* In the private blockchain system, only authorized users can join the network. Engagement in consensus within the network can be defined publicly or in a permissioned way. For such blockchains, a central administration controls the set of entities that can act as readers or writers. Consensus decisions are made unilaterally, either by this central body or by a pre-selected group (called "consortium blockchains"). In these structures based on security and privacy, members take place in chains connected in parallel with each other. The number of participants is low as security is at the forefront. The most widely known closed blockchains are Hyperledger Fabric, and Corda channels.

The use of blockchain is increasing day by day due to its superior features including distributed and decentralized storage services. It is observed that blockchain has extremely important features such as flexibility, resistance to malicious use, immutability, openness, transparency, and robustness; and that

although it was first developed to support crypto money technology, it has become popular for different fields such as e-commerce, global payments, health, registration, voting, logistics, and defense in recent years (Akhter, 2021).

The integration of BT reduces operating costs, and effective communication oversupply channels and a trust-based system that shall reduce delays have emerged with the BT embedded in the data transmission system (Ünal & Ulusoy, 2020), and it was emphasized that while the blockchain ecosystem optimizes production tools over secure networks, it also has positive effects on company performance.

Advantages and disadvantages of BT are (Bakan & Şekkeli, 2019; Hajizadeh et al., 2015; Irak & Topçu; Ünal & Ulusoy, 2020):

Security and Privacy: While blockchain reduces transaction costs, it makes it possible to reduce or eliminate integrity violations such as fraud and corruption. Many existing blockchain-related applications require smart transactions and contracts to be associated with known identities, and such a situation raises privacy and security concerns for the data stored in the shared database. Additionally, BT is a desirable target for cybercriminals.

Delay and Complexity: BT-based transactions may take several minutes to complete until all parties have updated their relevant data. This delay shall create a lot of uncertainty for transaction participants and open a hole for cybercriminals.

Ensuring Simultaneity and Transparency: Another advantage is that it provides simultaneous traceability. Thanks to this technology, it becomes possible to monitor and track all the steps from the point of exit to the destination point of the products as they are recorded simultaneously.

Awareness and Adoption: One of the biggest challenges with BT is the lack of awareness and adoption. Most people have insufficient knowledge about how the system works, so there is resistance to adopting the system in practice.

Organization and Size: It is very likely that many different organizations shall develop their own blockchains and standards. In this case, increasing size of distributed data can drastically reduce performance and make blockchains less efficient than existing frameworks.

Rules and Administrations: Rules are often far behind advanced technology. There are not common standards for completing transactions on a blockchain. However, blockchain applications need to operate within legal regulations.

Not Being Dependent on the Central Structure: Not being dependent on a central authority allows transactions to run faster and costs to be lower. However, this advantage also paves the way for disadvantages because this

system, which operates without being dependent on a structure, can be configured in different ways for different purposes by a wide variety of software developers. It means that chains are not standard and if the chain members have any problems, these problems cannot be solved easily because there is no interlocutor.

Currently, it seems that BT is difficult to be applied by every sector or business because it shall require both high investment and radical changes in the traditional structure in order to be compatible with BT. This technology has already started to be implemented by finance and technology-oriented companies and collaborations such as partnerships. Studies on BT are carried out in many different countries, including Turkey which is not yet active enough on BT (Ekin & Unay, 2018; Petersen, Hackius & See, 2018; Ünsalı & Kocaoğlu, 2018).

2.2. Implementation Processes of Blockchain Technology

Blockchain is a system that verifies and stores all transactions between users using the system with the help of the network. In blockchain system, transactions are kept in blocks and these blocks are linked together to form a chain. Blocks created within the framework of certain rules are coded to the system (Anand, 2018).

In the blockchain system where there is more than one party, it is necessary to check its compliance with the generally accepted rules in order to verify any transaction that is requested to be added to the system. This process of checking and finally reaching a consensus that the transaction is valid is called "consensus". The control process in the consensus can be carried out within the system or it can be carried out by a secure external element. Once the consensus is reached, the transaction is verified and it is now added to the transaction registry. This approach is called "consensus structure" (Nakamoto, 2008; Türekçi & Karahan, 2019; Ünal & Uluyol, 2020; Yıldırım, 2018).

2.3. Defense Industry

With the development of states and changes in military strategies, DI'ies are also being reshaped in accordance with the needs of armed forces. One factor that remains constant, however, is the importance of technology for the sector of DI. In the process of establishing national policies for DI companies, allocating resources for R&D, reducing the level of arms supply from foreign sources, intensifying the relations between the organization in military needs and the manufacturing side (DI companies), increasing the level of arms exports and acting jointly (Kızmaz, 2007), BT can be used effectively in the context of cooperation and partnership.

In today's world, states do not want to share their superior military technologies with other states. Even if they have to transfer their technology to other states, they prefer to transfer their old technologies to these states. The basis

of this situation lies in the fact that the fields that countries attach most importance to are military technology and information about these technologies due to reasons such as defending themselves to ensure their survival (Ünsalı & Kocaoğlu, 2018; Yeloğlu, Çakır &Yıldırım, 2022). Therefore, there is a national confidentiality in the sector of DI, which is very difficult to overcome (Pınar, 2018).

National DI'ies mostly consist of large-scale defense companies which have the necessary resources for large defense contracts. Small and medium-sized enterprises (SMEs) are disadvantaged because they do not have sufficient resources. In order to overcome this handicap and to be a part of the business, national DI clusters, mainly composed of SMEs, are formed. DI clusters comprised of SMEs can play an important role in the industry provided that there is good national planning and support in this area. SMEs have the chance to offer special services and special or customized products when needed. As a result, large DI companies outsource certain parts of their defense projects to SMEs (Demir, Caymaz & Erenel, 2016).

The DI Development and Support Administration, which was established in 1985 for the development of the DI, was restructured in 1989 and renamed as the Undersecretariat for DI; in 2018, it was restructured as the DI Agency in order to develop a modern DI and to modernize the Turkish Armed Forces, and it still continues to function actively under this name (Yeloğlu, Çakır &Yıldırım, 2022). In this context, the Agency provides incentives with the aim of revising the national DI in accordance with its needs, and of finding domestic and foreign technology opportunities; cooperates in the execution of projects, and carries out activities that facilitate integration with rapidly changing global innovations by organizing new technology blockchain workshops (Ünal & Uluyol, 2020; Yıldırım, 2018).

According to the DI Agency, the most important reason for the development of Turkey's DI is that the state revived the DI by investing $60 billion in defense projects; in addition to this, it is aimed to make the Turkish DI one hundred percent independent by 2053 (Presidency Digital Transformation Office, 2022). In the document of 2019-2023 Strategic Planning of Defense, within the context of the objective of strengthening cooperation in the DI ecosystem and of leading the development of all relevant sectors, sub-targets have been determined to strengthen the understanding of integrity in the DI ecosystem by increasing the interaction between stakeholders and to act as a holistic development and value network platform for the multiple use of products between sectors. In this context, BT can be used as an important tool. However, BT was not mentioned in the aforesaid document. BT has the potential to present

an important tool and infrastructure in providing technological cooperation and partnerships among national DI technology companies.

2.4. Defence Industry and Blockchain Technology

DI consists of the sum of industrial assets providing the basic elements of national security and military power. Besides production, DI should also include R&D activities, service support, product update, and elimination. In other words, it should include not only the main producer, but also a structure in which all producers and organizations involved in the production process are included.

In this structure, BT offers a solution opportunity to problems related to interoperability, privacy, security, traceability and reliability, especially in the field of DI technologies (Ahmada et al., 2020). Areas of use of BT in DI are as follows:

Management of Operations on the Battlefield: In the execution of military plans and battlefield operations, troops need to coordinate and communicate safely and reliably. In the context of IoT (internet of things), military units are threatened by the possibility of eavesdropping (Bao & Chen, 2012). Therefore, the detection and isolation of compromised nodes in a battlefield network can improve the performance of a military operation. Cyberattacks against military systems can significantly affect the progress of a military operation. For example, leaking attacks against GPS-based missile systems may disable them. During a war, an effective cyber attack on the navigation system of the airspace can cause the separation of alliance forces, ships, soldiers and aircraft carriers.

Logistics and Supply Chain Management: BT can be used effectively to organize various organizations, people, information and activities in the production and delivery of defense goods, services and technologies from manufacturers to customers.

Management of Drone Swarms: BT can be used effectively in a swarm's controllable, transparent and highly reliable decision-making process.

Border Protection: BT can be used in effective and sustainable information technology-based border protection solutions. In internet of things-based border protection technologies, unattended static and mobile devices equipped with sensors and cameras are used to capture real-time data from the border (Liang et al., 2017).

DI affects the market in terms of technology development and use (Baran, 2018). BT has great potential in DI, and product development and implementation processes. It is known that NATO, the largest defense alliance of which Turkey is a member, has also started to take an interest in innovative products based on BT (Presidency Digital Transformation Office, 2022). NATO

specifically aims to use BT in the infrastructure of more traditional applications such as logistics and procurement (Kar, 2016).

Blockchains are being studied as a new and universally feasible architecture for trust management as part of NATO. In addition, analyzes are made in terms of their feasibility in the context of military operations. As stated in NATO Standardization Agreement (STANAG) 4778, which has undergone an approval process within NATO, studies have been carried out with the use of blockchain as a new approach to implementing a trusted binding mechanism for independent tags. First of all, the effective conduct of NATO mission operations often requires the involvement of external partners who are not involved in existing trust arrangements. The lack of these arrangements may be due to dynamically changing operational requirements (for example, a new non-NATO participating country), a clear distrust of NATO (for example, local militant groups) or an unwillingness to be perceived by the public as a partner of NATO. In such cases, blockchain can offer an alternative solution to a registration process required by traditional trust management solutions. However, countries and institutions need to have an adequate infrastructure in place to ensure that information is included and verified on a blockchain to provide an appropriate level of trust and security (Wrona & Jarosz, 2018).

Within the context of internet of things, the use of devices in military and civilian fields is becoming widespread; moreover, the number of devices specific to each field and the amount of data produced in parallel with this increase significantly. BT comes to the fore in eliminating the security problem of devices and data shared between devices (Kösesoy, 2019).

3. CONCLUSION

In order for the knowledge and experience in BT to create a stable ecosystem, there is a need for people and institutions interested in this technology in the field of DI, as in every field. In this sense, the strategy of forming legal infrastructure and platforms as soon as possible by adopting BT, especially in Turkey's national DI move, should be brought to the fore. It is clear that such a structural change may create some adaptation problems initially, but in the near future its advantages will outweigh its disadvantages (Akagün, 2020). In the field of national DI, BT is considered an important strategy in raising the defense infrastructure and clustering level of developing countries. It is important that the human power infrastructure of the BT is created in the context of a strategy in ensuring the integration of land, sea and air defense technologies, especially in countries with diverse defense needs and threats, such as Turkey.

Within the context of defense technologies, a BT provided with the permissions granted by the Agency of Defense Industry and a TÜBİTAK-based governance structure shall facilitate the access of the system by everyone, thus ensuring the principles of reliability and confidentiality (Uysal & Aldemir, 2018).

Many DI-related blockchain applications are recommended by both the industry and research communities (Berryhill, Bourgery & Hanson, 2018). In this regard, it is also important that the institutions forming the national DI BT have the knowledge and competence of this technology. In this case, as in all technological fields, developments and studies in this field should be supported, and academic studies and R&D studies should be encouraged.

In conclusion, it is of great importance not only to invest in BT, but also to invest in new areas that it shall open. Investments to be made in these areas shall contribute to faster development and spread of blockchain. For this reason, it is beneficial to systematically review the BT, to keep the usage areas, open points and future expectations constantly updated, and to conduct prediction studies on BT.

For a strong central blockchain infrastructure that shall bring together new industries and sub-industries created by changing technology and global threats in DI, a team of experts may be requested to initiate a study in TUBITAK Block Chain Research Laboratory for the creation of a structure in which public institutions and organizations shall be in the center, and private and autonomous institutions and organizations shall be in the network.

Suggested topics to be carried out are listed below:

1. Students should be directed to BT at universities; it should be taught as a compulsory course in the relevant departments, and subsequently, students should be given internship opportunities in public-private institutions and organizations operating in the field of blockchain. In addition to this, TUBITAK should support undergraduate/graduate programs related to the subject.

2. Civil and military projects should be designed in cooperation with TUBITAK Blockchain Research Laboratory, and invited projects for national blockchain software in accordance with the precision of national DI should be initiated. Due to Turkey's geopolitical position, the need for national defense systems is high; therefore, it is considered that supporting R&D expenditures shall have a positive impact on BT.

3. The scope of blockchain workshops carried out by the DI Agency should be expanded and the experience gained should be ensured to reach all areas which shall accelerate the development of the national DI; in addition, with the training programs to be organized, the aim of increasing the required qualified and highly motivated human resources should be supported.

4. With respect to BT; standards for assessment and verification should be determined, government incentives for implementation should be provided, and legal infrastructure should be established through legal regulations by forming cooperation with the relevant institutions of our state under the coordination of the Ministry of Industry and Technology.

5. BT is a fast-developing technology, and the country is still at the bottom of the ladder with regard to BT especially in DI; therefore, it is inevitable that we shall experience a cost-effective process with encouraging studies in the field of software. We should take advantage of all the benefits of BT, which shall contribute to our national DI, by taking necessary initiatives with universities, public institutions and relevant non-governmental organizations as soon as possible.

6. Blockchain awareness of small and medium-sized organizations, which have a great contribution to the DI in our country but remain in the background, should be increased; at the same time, the necessary infrastructure should be established to ensure the integration of BT, which shall facilitate interaction with local and national authorities and contribute to their development; and if necessary, action should be taken in cooperation with defense clusters.

7. Attempts should be made to represent Turkey and to increase its visibility in this regard by starting bilateral cooperation works with NATO and similar organizations and countries with advanced technology in international platforms.

Making claims about the future of BT in the national DI and making clear suggestions about how it should be used in this field shall be healthier as the application examples become more diverse. However, it is important that especially public institutions and other relevant institutions invest in developing their knowledge of this technology, discover new applications, and try them in pilot institutions. Within the context of this study, it is necessary to make a plan in both academic and industrial environment regarding the above-mentioned suggestions and to accelerate the process.

4. CONFLICT OF INTEREST STATEMENT

There is no conflict of interest between the authors.

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6. AUTHOR CONTRIBUTIONS

AA: The idea;

AA: Design;
SÇ: Supervision;
AA: Collection and/or processing of resources;
AA, SÇ: Empirical Analysis and/or interpretation;
AA: Literature review;
AA, SÇ: Writing of Article;
SÇ: Critical review;

7. ETHICS COMMITTEE STATEMENT AND INTELLECTUAL PROPERTY COPYRIGHTS

Ethics committee principles were followed in the study. There has been no situation requiring permission within the framework of intellectual property and copyrights.

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