Presenting A Blockchain Marketing Model Based on Challenges and Solutions to Improve Business Performance

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Abstract

This study aimed to present a blockchain-based marketing model based on challenges and solutions to improve business performance. The information required for the study to present the model was collected from experts, namely 15 marketing experts who were university professors and were active in the field of blockchain. In this study, a model for blockchain-based marketing was designed using interpretive structural modeling (ISM) based on challenges and solutions to improve business performance. The results showed that the challenges of blockchain-based marketing include unclear rules, technical complexity, scalability, trust and awareness, integration with existing systems, and high initial costs. Blockchain-based marketing solutions include the use of smart contracts, data privacy and security, tracking and personalization of advertisements, automated execution of processes, reducing legal restrictions, and the use of scalable economic models. Limitations of blockchain-based marketing include technological and infrastructure limitations, legal and regulatory restrictions, and a shortage of blockchain-based marketers. Finally, it can be said that blockchain-based marketing, by using solutions and overcoming the challenges and limitations of blockchain marketing, can lead to improved business performance by increasing the speed of transactions, increasing accuracy and efficiency, increasing productivity, and increasing sales and profitability.

Keywords: Performance improvement, blockchain-based marketing, blockchain, business performance.

Introduction

Blockchain is known as the underlying technology of digital currencies such as Bitcoin, and has been considered as one of the most fundamental transformative technologies after the Internet (Yermak, 2017). As it is estimated, blockchain has the ability to transform business models and market structures in various industries (Schmitz and Leoni, 2019). The fundamental advantage of blockchain technology as a decentralized public ledger is that once a transaction is confirmed by network nodes, it cannot be reversed or re-sequenced. The inability to modify a transaction is important for the integrity of the blockchain and means that all parties have the same and accurate records. Given that the blockchain is a distributed system, all changes to a ledger are clear and transparent to all members of a network (Garanina et al., 2021). One of the important effects of blockchain is in digital marketing. The most important change in marketing with the presence of blockchain is to provide transparency, democratic marketing, more reliable marketing immutability, and decentralization of advertising. The application of blockchain in marketing will make online transactions more favorable, thereby providing a secure environment for advertisers and publishers (Ahmed et al., 1402). Recently, blockchain technology has attracted attention, which may reduce transaction costs and business risks (Di Giovanni, 2020). Blockchains, as distributed digital ledgers, use consensus protocols to produce a version of the truth in which recorded transactions will not change due to encryption protocols, thus making them immutable. These features make blockchain technologies attractive technical solutions for facilitating transactions between parties with different interests, such as borrowers and lenders or suppliers and buyers (Tsang et al., 2021). Blockchain includes three specific features. First, Wang et al. (2020) emphasized that blockchain is a distributed technology that promotes transparency and transparency of recorded transactions. Second, Queiroz and Fuso-Wamba (2019) believed that blockchain guarantees the only true version in establishing trust in recorded information due to the existence of an immutable ledger. Third, Schutz and Venkatesh (2020) stated that blockchain enables the automatic completion of transactions. The mechanism in blockchain allows transactions to be verified by any entity at any time, thus providing a distributed, transparent, secure, immutable, and auditable ledger that can be fully and openly reviewed to retrieve all transactions that have occurred since the initial transaction (Reina et al., 2018).

Competitive advantage is a relational term to facilitate organizational comparison based on organizational competitiveness and their competitive capabilities to adopt an appropriate strategy to ensure optimal performance. There are many methods that help achieve competitive advantage to avoid competitors, such as using first-mover advantage and maintaining higher efficiency in terms of reputation and cost, increasing sales and profits in untouched areas with lower levels of competition; improving legitimacy for being a good corporate citizen; and producing superior goods with cutting-edge technology (Kant, 2021). Furthermore, Porter (1980) believes that competitive advantage can be achieved by using three general strategies, namely differentiation, focus, and cost leadership. Tisi (2007) also stated that competitive advantage can be achieved through the dimensions of sensing opportunities or threats, exploiting them, and reconfiguring them based on requirements. Barney (2001) argued that competitive advantage is the result of fast and agile implementation of appropriate strategies and resources compared to competitors. Porter (1985) also emphasized that technological innovations such as blockchain are an essential factor in changing the rules of competition and play a fundamental role in achieving competitive advantage. Hence, blockchain offers tremendous potential as a key intangible resource for organizations to implement strategies to achieve competitive advantage (Leung et al. , 2023).

Blockchain technology is one of the most important technological advances of the century. As a mechanism for storing information and transactions in a secure and decentralized manner, blockchain technology has been primarily formulated to create cryptocurrencies such as Bitcoin (Tapascott and Tapascott, 2017). Initial efforts have been made to discuss the marketing applications of blockchain (Stallone et al., 2021; Jain et al., 2021). However, this research stream is in its infancy. One of the goals of new research is to incorporate blockchain technology into scientific marketing thinking (Schreier et al., 2021). Some of the potentially impactful research questions that emerge in the market that uses blockchain technology include focusing on specific practical applications of blockchain technology in marketing, such as the operational benefits of increased security, fraud prevention, and reduced number of intermediaries (Berkowitz, 2017; Bookis, 2019; Rajab et al., 2020).

One of the main challenges in traditional marketing is the lack of transparency and security in transactions and advertising. Blockchain, with its automated and immutable features, can help solve these challenges. This technology enables secure and transparent payments using smart contracts and digital tokens, thereby increasing customer trust. However, implementing blockchain in marketing faces challenges such as technical complexity, scalability, and regulations. Traditional marketing faces challenges such as fraud in interaction data, high intermediary costs, and lack of transparency in advertising. Blockchain can help solve these challenges by providing innovative solutions. The use of smart contracts in influencer marketing ensures that payments are made only based on real results. In affiliate marketing, blockchain increases transparency and trust by eliminating intermediaries and providing accurate tracking of traffic and sales. Also, blockchain, with advanced features such as tradable tokens and reward programs, helps marketers attract and retain their customers. A blockchain-based marketing model with the aim of improving business performance should be designed based on existing challenges and solutions. This model should leverage the benefits of blockchain such as transparency, security, and eliminating intermediaries to help marketers interact with their customers efficiently and effectively (Taherdoost and Madanchian, 2023). Using this model, businesses can gain customer trust and increase their marketing efficiency. Also, this model should help marketers use blockchain technology as an innovative tool to attract new customers and provide them with added value. Implementing a blockchain-based marketing model requires solving existing challenges. One of the main solutions is to facilitate education and awareness about the benefits of blockchain. Also, collaboration with technology partners is essential to develop appropriate infrastructure and ensure compliance with existing regulations. By using these solutions, businesses can fully leverage the benefits of blockchain in marketing and improve their performance. In addition, innovation in the areas of energy and scalability can help reduce costs and increase efficiency in the use of blockchain.

Theoretical foundations and research background

In recent years, businesses have faced increasing challenges in marketing due to issues such as data transparency, lack of trust, and inefficiencies in traditional systems. These challenges have been exacerbated by the increasing complexity of digital ecosystems, where consumers want more personalized, secure, and transparent interactions with brands. Factors such as financial performance, profitability, and operational efficiency significantly affect the value of a company, but these metrics are often undermined by outdated marketing practices that fail to meet modern consumer expectations. The lack of a robust framework to ensure data integrity, reduce fraud, and increase customer engagement has created an urgent need for innovative solutions. Blockchain technology, with its decentralized and immutable ledger system, offers a potential solution to these problems by enabling transparent, secure, and efficient marketing processes (Christie et al. & Yelento, 2020).

Blockchain technology has emerged as a transformative force in the digital marketing landscape, offering unparalleled transparency, security, and efficiency. By leveraging blockchain, businesses can increase trust with their audiences, streamline operations, and gain valuable insights from verifiable data, leading to a significant impact on their marketing initiatives. However, despite its potential, blockchain adoption in marketing faces several challenges, including technical complexity, scalability concerns, and regulatory hurdles. To address these challenges and improve business performance, a blockchain-based marketing model is needed that integrates solutions to these issues. The main challenges in implementing blockchain in marketing include technical complexity and integration issues that can hinder seamless adoption into existing systems. Scalability and transaction speed concerns are also significant obstacles, as blockchain networks often struggle to match the speed and capacity required for large-scale marketing operations. In addition, regulatory and compliance challenges pose risks due to the evolving regulatory landscape surrounding blockchain technology. In addition, the high energy consumption of blockchain networks raises environmental concerns.

It increases the cost and impacts the sustainability of marketing strategies. Addressing these challenges is crucial for developing an effective blockchain-based marketing model (Rajeb et al., 2020).

To overcome the challenges in blockchain-based marketing, several solutions can be integrated into a comprehensive model. Increasing transparency and trust through blockchain can help build stronger customer relationships and improve campaign effectiveness. Smart contracts can automate processes, reduce intermediaries and costs, while ensuring safe and efficient transactions. Blockchain-based loyalty programs can incentivize customer engagement and loyalty by offering transparent and secure rewards. In addition, educational initiatives and practical demonstrations of blockchain benefits can help overcome business and technical barriers and encourage wider adoption. (Liu, 2022). A proposed blockchain-based marketing model should focus on integrating solutions to the identified challenges while leveraging the benefits of blockchain technology. The model should include transparent and secure data management, using blockchain to ensure accurate and verifiable data for efficient advertising targeting and fraud prevention. It should also use smart contract-based automation to streamline processes and reduce costs. In addition, the model should emphasize customer-centric loyalty programs that use blockchain to increase engagement and trust. By addressing technical, regulatory, and environmental challenges through innovative solutions, this model can significantly improve business performance in the digital marketing sector (Taherdoost and Madanchian, 2023).

Nim et al. (2025) Achieving Performance and Reliability in Bitcoin Marketing Price Forecasting through Blockchain Technology examined the relevance of the technology in predicting the Bitcoin market price and its business implications. Four critical success factors for Bitcoin price forecasting were identified: currency statistics, Bitcoin cycle indicators, block details, and mining information. The success factors consist of 23 indicators measured using data from secondary sources such as newspapers, US-based Bitcoin companies, social networking sites, and other web sources. The study used a comprehensive analytical approach to assess how these indicators influence Bitcoin market price forecasting and business strategies. The study demonstrates the effectiveness of the technology in predicting Bitcoin market price for businesses. By analyzing the identified CSFs and their indicators, the study sheds light on how they perform. These findings underscore the importance of blockchain as a tool for enhancing market forecasting and strategic decision-making in the cryptocurrency landscape.

In a study titled Blockchain Meets Marketing: Opportunities, Threats, and Future Research Directions, Pierce et al. (2023) stated that blockchain technology is increasingly having a profound impact on the business landscape. Blockchain – a means of storing information and transactions in a secure and decentralized manner – has many potential applications for marketing. However, marketing and performance research on blockchain use is still experimental and has not yet fully understood and embraced it. The aim of this editorial is to advance this direction and provide a path towards incorporating blockchain technology into our scientific marketing thinking. We review the terminology and basic principles of the blockchain process, provide a comprehensive overview of the potential impact of blockchain on several key marketing domains, and propose research questions that can help advance research and practice as the technology is developed. Leung et al. (2023) stated in their study titled SEM-ANN Analysis of Blockchain's Impact on Competitive Advantage that understanding the impact of blockchain on achieving competitive advantage remains unknown. Many industries, organizations, and companies are still in a "wait and see" mode. This study aimed to examine the effects of technological, organizational, and environmental factors derived from the technological, organizational, and environmental framework on creating competitive advantage. In this study, a two-stage deep learning structural equation modeling artificial neural network analysis was conducted on 211 samples of small and medium-sized enterprises. Four neural network models were involved to rank the normalized importance of each predictor variable. The research model can explain 57.99 and 47.33 percent of the variance in blockchain adoption and competitive advantage, respectively. The study successfully identified nonlinear relationships. The theoretical and managerial contributions are useful for researchers and practitioners such as industry players, investors, chief executive officers (CEOs), managers, decision makers, and other stakeholders who intend to use blockchain technology. Wu and Monfert (2023) in a study titled The Role of Artificial Intelligence in Marketing Strategies and Performance examined the role of artificial intelligence as a marketing strategy and explained its contribution to companies and the factors affecting their development. This study is an empirical model based on the research variables and the identified constructs using structural equation modeling and a comparative analysis approach. Data were collected from 278 food companies. The findings show that the implementation of AI marketing strategy affects performance. Furthermore, the study shows that marketing capabilities, customer value co-creation and market orientation are positively related to performance. Finally, the results show that marketing capabilities, customer value co-creation and market orientation influence the development of AI marketing strategies. FsQCA Research Results To overcome the challenges in blockchain-based marketing, several solutions can be integrated into a comprehensive model. Increasing transparency and trust through blockchain can help build stronger customer relationships and improve campaign effectiveness. Smart contracts can automate processes, reduce intermediaries and costs, while ensuring safe and efficient transactions. Blockchain-based loyalty programs can incentivize customer engagement and loyalty by offering transparent and secure rewards. In addition, educational initiatives and practical demonstrations of blockchain benefits can help overcome business and technical barriers and encourage wider adoption. (Liu, 2022). A proposed blockchain-based marketing model should focus on integrating solutions to the identified challenges while leveraging the benefits of blockchain technology. The model should include transparent and secure data management, using blockchain to ensure accurate and verifiable data for efficient advertising targeting and fraud prevention. It should also use smart contract-based automation to streamline processes and reduce costs. In addition, the model should emphasize customer-centric loyalty programs that use blockchain to increase engagement and trust. By addressing technical, regulatory, and environmental challenges through innovative solutions, this model can significantly improve business performance in the digital marketing sector (Taherdoost and Madanchian, 2023).

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Ahmadi et al. (1402) in a study titled Providing a Framework for Identifying Drivers Affecting the Future of Innovative Marketing in the Banking Industry with a Focus on Blockchain Technology identified and analyzed the drivers affecting the future of innovative marketing in the banking industry with a focus on blockchain technology.

The present study is applied in terms of orientation and has a mixed methodology due to the use of qualitative and quantitative methods together. The theoretical community of the research was experts in banking marketing and digital financial technologies, and the sampling method was judgmental. The sample size in this study was 15 people. For data analysis, meta-composition methods, Benim and the extended Kapras statistical test were used. The data collection tools in this study were expert survey questionnaires and Kapras priority survey. 47 drivers were extracted from the meta-synthesis and these drivers were categorized into nine drivers: cultural, legal, technological, structural and process, fintech, environmental, customer, security, and awareness and information. After theoretical and statistical screening, 12 drivers were considered for prioritization using CAPRAS. The remaining drivers were evaluated using CAPRAS and three indicators of importance, certainty, and expertise of experts. The results showed that the drivers of marketing researchers' interest in digital financial technologies and blockchain and the development of decentralized banking have the highest priority in terms of impact on the future of innovative marketing in the banking industry with a focus on blockchain technology.

Al-Yasin et al. (1402) in a study titled "Developing Supply Chain Businesses and Increasing Competitive Advantage and Performance by Investing in Blockchain Technology" showed how investing in blockchain technology and its application can improve supply chain characteristics (compatibility, alignment, and agility) which in turn increases competitive advantage, which in turn affects company performance. The analysis method was structural equation modeling with partial least squares (PLS) in a sample of 246 accountants working in companies on the Tehran Stock Exchange and accounting professors. The results of the present study show that blockchain technology can improve the supply chain (compatibility, alignment, and agility) which leads to competitive advantage, which in turn leads to better company performance. The present study shows that blockchain technology will help improve supply chain parameters. In addition to enriching the theoretical literature on the subject, these findings can help companies develop and promote blockchain-based information technology applications for competitive advantage and better performance. In a study titled Designing and Explaining the Model of Artificial Intelligence Competencies on Organizational Performance Considering B2B Marketing Capabilities, Karamipour (2014) designed a model of artificial intelligence competencies on organizational performance considering business-to-business marketing capabilities. The research method is exploratory (qualitative-quantitative). In the qualitative part, the Shannon entropy approach was used, and in the quantitative part, the descriptive-survey approach was used. The participants of the present study in the qualitative part were faculty members and elites in artificial intelligence, marketing, and management, which was conducted based on the theoretical saturation law with 14 people, and in the quantitative part, the executive managers of industrial parks in northern Iran numbered 540 people, of whom 224 were selected as a statistical sample. The data collection tool in the qualitative part was a semi-structured interview and in the quantitative part, a researcher-made questionnaire. The data analysis method in the quantitative part was confirmatory factor analysis tests using Smart PLS software. The results showed that the mechanisms of AI competencies have an impact on business-to-business marketing capabilities and organizational performance, and the AI competencies model on organizational performance is also confirmed by considering the aspect of business-to-business marketing capabilities. Khosravi Labab et al. (1401) studied the effect of digital marketing on consumer purchasing behavior (case study: customers of the Digikala online store) in their research. After designing a new conceptual model, questionnaires were distributed among 492 customers of the Digikala online store, and using statistical analyses and structural equation modeling using SPSS 26 and Smart PLS 3.0 software, the overall model fit and hypothesis testing were performed. It is worth noting that all digital marketing tools and channels, such as search engines, content, social media, online public relations, affiliate marketing, email marketing, and mobile marketing, except for retargeting, had a positive and significant impact on consumer purchasing behavior among Digikala customers. Of course, online public relations, content marketing, and social media marketing were identified as the most effective digital marketing tools and channels for the Digikala store, and digital marketing-based actions should be developed in this store with the most effective channels and tools on consumer purchasing behavior in order to manage customers optimally.

Research Questions

Based on the problem raised in this study, the questions that can be asked are:

1- What are the challenges of blockchain-based marketing to improve business performance?

2- What are the solutions to blockchain-based marketing to improve business performance?

3- How does blockchain-based marketing improve business performance?

Research Methodology

This research will be an exploratory study in terms of addressing the basics of presenting a blockchain-based marketing model based on challenges and solutions to improve business performance. It is also considered an applied study because it provides practical recommendations. Therefore, it can be said that this research is of an exploratory-applied type. The present research is exploratory in nature; it considers a sub-problem that has not been addressed in this way and at this level before. For this purpose, a mixed approach will be used. The aim is to combine qualitative and quantitative research methods to achieve an appropriate method to achieve the research objectives.

The current study will use a mixed research method. Depending on the approach, strategy, and method used in the higher layers of the research, the researcher uses different methods to collect and analyze research data. Interviews, observations, questionnaires, etc. are among the methods that may be used to collect data. Of course, in some studies, several methods may be used simultaneously to collect data. In this study, the researcher uses qualitative tools such as semi-structured interviews to collect the required and useful data. For this study, interviews, which are tools of the qualitative research method, were conducted. In this study, the research method is specifically a mixed exploratory method. In these designs, the main goal is to start the research with a qualitative stage and then continue it with a quantitative stage. In this way, qualitative data was first collected through interviews from experts. Then, an experimental model was designed for the research using interpretive structural modeling (ISM).

The statistical population of the present study included all marketing professors at universities with at least an assistant professorship who had at least 5 years of empirical work experience in the field of digital marketing and blockchain. Snowball sampling considering theoretical saturation for interviewing experts: In this way, sampling continues until no new findings are obtained in the interviews. At this stage, the researcher reached theoretical saturation after interviewing 15 people. Purposeful judgment sampling for using the interpretive structural modeling (ISM) method: Lashkar-e-Blouki et al. (2012) stated in their study (which used the ISM method) that the number of experts was between 4 and 14 people. However, in this method, the same 15 people who were used for the interview were used.

Research findings

Interpretive structural modeling (ISM)

Step one: Identifying components related to the title

In this stage, the relative content coefficient of each component was determined using the CVR index. For this purpose, a questionnaire was provided to the experts and they were asked to evaluate each of the components and dimensions based on a 3-point scale: “It is necessary; It is useful but not necessary; It is not necessary.” Since the number of experts is 15, if the CVR value of each component is higher than 0.49, the content validity of that component is confirmed. The results showed that 19 components are acceptable and the experts have complete consensus on them for designing the model. These components are categorized into 4 dimensions and can be seen in Table 1.

Table (1): Confirmed components in the form of dimensions

row	Components	CVR value	Result	Dimensions
1	Undefined rules	1	Confirm	Blockchain Marketing Challenges
2	Technical complexity	1	Confirm	
3	Scalability	0.86	Confirm	
4	Trust and awareness	1	Confirm	
5	Integration with existing systems	0.73	Confirm	
6	High initial costs	1	Confirm	
7	Use of smart contracts	1	Confirm	Blockchain Marketing Solutions
8	Preserve data privacy and security	1	Confirm	
9	Track and personalize advertising	0.86	Confirm	
10	Automate processes	1	Confirm	
11	Reduce legal restrictions	1	Confirm	
12	Use scalable economic models	0.73	Confirm	
13	Technological and infrastructure limitations	1	Confirm	Blockchain Marketing Limitations
14	Legal and regulatory restrictions	1	Confirm	
15	Lack of expert blockchain marketers	0.86	Confirm	
16	Increase transaction speed	1	Confirm	Improving Business Performance
17	Increase accuracy and efficiency	1	Confirm	
18	Increase productivity	0.86	Confirm	
19	Increase sales and profitability	1	Confirm	

The results showed that all 19 factors and all 4 dimensions are acceptable and the experts have complete consensus on them for designing the model.

Step 2: Formation of the structural self-interaction matrix

After determining the components, another questionnaire with a matrix format was designed and the experts examined these components in pairs and determined the relationships between the components using the determined scale. Bolanos et al. (2005) stated that to combine the opinions of the experts, the sum of their opinions for each element of the matrix should be used. The results obtained from the questionnaires regarding the components under study are given in Table 2.

Table (2): Results obtained from the questionnaires

19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	row
45	45	44	42	6	10	7	8	20	26	10	28	19	39	41	45	40	41	0	1
45	42	39	44	8	12	9	10	10	10	6	8	6	42	15	36	16	0	14	2
45	45	40	39	4	6	7	16	23	23	23	22	12	41	42	32	0	34	39	3

45	44	43	42	6	10	11	6	14	20	11	20	5	45	10	0	8	42	12	4
45	45	42	39	2	10	4	8	7	8	12	26	15	31	0	37	41	40	33	5
45	44	43	42	3	4	4	10	4	3	4	5	9	0	10	17	6	26	9	6
45	43	41	39	12	10	14	28	26	25	39	42	0	20	22	26	25	10	22	7
45	45	45	45	2	4	4	15	28	29	24	0	26	23	16	6	26	2	4	8
41	42	39	39	3	3	3	10	12	15	0	43	34	20	14	6	11	10	5	9
45	44	43	42	2	3	2	41	39	0	39	41	40	20	15	5	22	9	2	10
42	42	41	40	2	3	3	40	0	40	40	42	41	28	12	10	20	10	4	11
45	41	40	39	3	2	2	0	42	41	42	40	42	12	5	9	3	16	2	12
45	42	39	38	36	39	0	28	8	19	6	12	10	22	6	27	26	28	3	13
42	40	38	39	32	0	18	22	19	28	14	22	11	26	10	28	29	27	4	14
43	41	40	39	0	27	28	25	18	27	20	26	18	23	11	26	22	25	4	15
42	45	42	0	4	11	4	18	16	14	12	14	15	14	5	6	12	5	5	16
45	45	0	45	2	3	5	18	9	11	10	16	11	3	2	3	2	3	2	17
45	0	20	26	7	4	4	14	12	18	16	18	14	4	3	6	12	10	2	18
0	44	28	28	1	5	7	18	25	23	26	22	18	2	7	8	8	14	3	19

Step Three: Formation of the Initial Access Matrix

The initial access matrix is obtained by determining the relationships in the form of zero and one from the structural self-interaction matrix in two steps:

In the first step, we first consider a single numerical scale and compare the numbers in the table of the previous step with it. If the corresponding number in the table is larger than the scale, we use the number one in the new table, otherwise we use zero. Based on Bolanos' logic, Table 3, the structural self-interaction matrix is designed and shown.

Table (3): Structural Self-Interaction Matrix

19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	Components
1	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	1
1	1	1	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	2
1	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	0	1	1	3
1	1	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	4
1	1	1	1	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	5
1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
1	1	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	7
1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8

1	1	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	9
1	1	1	1	0	0	0	1	1	0	1	1	1	0	0	0	0	0	0	10
1	1	1	1	0	0	0	1	0	1	1	1	1	0	0	0	0	0	0	11
1	1	1	1	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	12
1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	13
1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19

In the second step, we add the matrix obtained in the first step (Table 3) with the identity matrix to obtain the initial access matrix. By doing this, all the numbers of the main diagonal are converted from 0 to 1. Table 4 shows the matrix of the initial access matrix.

Table (4): Matrix of the initial access matrix

19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	Components
1	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
1	1	1	1	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	2
1	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	3
1	1	1	1	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	4
1	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	5
1	1	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	6
1	1	1	1	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	7
1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	8
1	1	1	1	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	9
1	1	1	1	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	10
1	1	1	1	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	11
1	1	1	1	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	12
1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	13
1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	14
1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17

1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19

Step 4: Creating the Final Access Matrix

After the initial access matrix is obtained, the secondary relationships of the components are checked. The secondary relationship is such that if component i leads to component j and component j leads to component k, then component i will also lead to component k. If this is not the case in the initial access matrix, the modified matrix and the missing relationships must be replaced; this process is called adapting the initial access matrix. In this step, all secondary relationships between the components were examined, but no secondary relationships were discovered. Therefore, the final access matrix is the same as the initial access matrix. In this matrix, the influence power and the degree of dependence of each of the components are also shown. The influence of a component is obtained from the sum of the number of components affected by it and the component itself, and the degree of dependence of a component is obtained from the sum of the components affected by it and the component itself.

Table (5): Final Access Matrix

Power of influence	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	Components
10	1	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
7	1	1	1	1	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	2
10	1	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	3
7	1	1	1	1	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	4
10	1	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	5
5	1	1	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	6
7	1	1	1	1	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	7
5	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	8
7	1	1	1	1	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	9
10	1	1	1	1	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	10
10	1	1	1	1	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	11
10	1	1	1	1	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	12
7	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	13
6	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	14
5	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
4	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
4	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17
2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
-	19	19	17	17	3	2	1	3	3	3	5	6	5	6	3	5	3	5	3	Degree of dependency

Fifth: Determining the relationships and leveling of components

In this step, using the access matrix, after determining the input and output sets, the commonality of these sets is obtained for each of the components. The output set of a component includes the component itself and the components that it affects, which can be identified by the "1"s in the corresponding row. The input set of a component includes the component itself and the components that it is affected by, which can be identified by the "1"s in the corresponding column. After determining the input and output sets, their commonality is determined for each of the components. Components whose output and common sets are completely similar are placed at the highest level of the hierarchy of the interpretive structural model. In order to find the components of the next level of the system, the components of the highest level are eliminated in the mathematical calculations of the relevant table, and the operation related to determining the components of the next level is performed in the same way as the method for determining the components of the highest level. This operation is repeated until the components of all levels of the system are determined. Table 6 shows the first iteration of the leveling.

Table (6): Leveling (1)

Level	Joint collection	Input set	Output set	**Components**
	1 ،3 ،5	1 ،3 ،5	،3 ،4 ،5 ،6 ،16 ،17 ،18 ،19 1 ،2	1
	2 ،4	1 ،2 ،3 ،4 ،5	2 ،4 ،6 ،16 ،17 ،18 ،19	2
	1 ،3 ،5	1 ،3 ،5	،3 ،4 ،5 ،6 ،16 ،17 ،18 ،19 1 ،2	3
	2 ،4	1 ،2 ،3 ،4 ،5	2 ،4 ،6 ،16 ،17 ،18 ،19	4
	1 ،3 ،5	1 ،3 ،5	،3 ،4 ،5 ،6 ،16 ،17 ،18 ،19 1 ،2	5
	6	1 ،2 ،3 ،4 ،5 ،6	6 ،16 ،17 ،18 ،19	6
	7 ،9	7 ،9 ،10 ،11 ،12	7 ،8 ،9 ،16 ،17 ،18 ،19	7
	8	7 ،8 ،9 ،10 ،11 ،12	8 ،16 ،17 ،18 ،19	8
	7 ،9	7 ،9 ،10 ،11 ،12	7 ،8 ،9 ،16 ،17 ،18 ،19	9
	10 ،11 ،12	10 ،11 ،12	،11 ،12 ،16 ،17 ،18 ،19 7 ،8 ،9 ،10	10
	10 ،11 ،12	10 ،11 ،12	،11 ،12 ،16 ،17 ،18 ،19 7 ،8 ،9 ،10	11
	10 ،11 ،12	10 ،11 ،12	،11 ،12 ،16 ،17 ،18 ،19 7 ،8 ،9 ،10	12
	13	13	،14 ،15 ،16 ،17 ،18 ،19 13	13
	14	13 ،14	14 ،15 ،16 ،17 ،18 ،19	14
	15	13 ،14 ،15	15 ،16 ،17 ،18 ،19	15
	16 ،17	،4 ،5 ،6 ،7 ،8 ،9 ،10 ،11 ،12 ،13 ،14 ،15 ،16 ،17 1 ،2 ،3	16 ،17 ،18 ،19	16
	16 ،17	،4 ،5 ،6 ،7 ،8 ،9 ،10 ،11 ،12 ،13 ،14 ،15 ،16 ،17 1 ،2 ،3	16 ،17 ،18 ،19	17
1	18 ،19	،6 ،7 ،8 ،9 ،10 ،11 ،12 ،13 ،14 ،15 ،16 ،17 ،18 ،19 1 ،2 ،3 ،4 ،5	18 ،19	18
1	18 ،19	،6 ،7 ،8 ،9 ،10 ،11 ،12 ،13 ،14 ،15 ،16 ،17 ،18 ،19 1 ،2 ،3 ،4 ،5	18 ،19	19

As shown in Table 6, the output set and the common set of components 18 and 19 are completely identical; therefore, they are placed at the first level and are removed from the table above for further leveling. The other leveling steps are summarized in Table 7.

Table (7): Leveling (2)

Level	Joint collection	Input set	Output set	Components	Repeat
2	16 ،17	،5 ،6 ،7 ،8 ،9 ،10 ،11 ،12 ،13 ،14 ،15 ،16 ،17 1 ،2 ،3 ،4	16 ،17	16	Second
2	16 ،17	،5 ،6 ،7 ،8 ،9 ،10 ،11 ،12 ،13 ،14 ،15 ،16 ،17 1 ،2 ،3 ،4	16 ،17	17	
3	6	1 ،2 ،3 ،4 ،5 ،6	6	6	Third
3	8	7 ،8 ،9 ،10 ،11 ،12	8	8	
3	15	13 ،14 ،15	15	15	
4	2 ،4	1 ،2 ،3 ،4 ،5	2 ،4	2	Fourth
4	2 ،4	1 ،2 ،3 ،4 ،5	2 ،4	4	
4	7 ،9	7 ،9 ،10 ،11 ،12	7 ،9	7	
4	7 ،9	7 ،9 ،10 ،11 ،12	7 ،9	9	
4	14	13 ،14	14	14	
5	1 ،3 ،5	1 ،3 ،5	1 ،3 ،5	1	Fifth
5	1 ،3 ،5	1 ،3 ،5	1 ،3 ،5	3	
5	1 ،3 ،5	1 ،3 ،5	1 ،3 ،5	5	
5	،11 ،12 10	10 ،11 ،12	10 ،11 ،12	10	
5	،11 ،12 10	10 ،11 ،12	10 ،11 ،12	11	
5	،11 ،12 10	10 ،11 ،12	10 ،11 ،12	12	
5	13	13	13	13	

Step 6: Drawing the Final Model

In this step, an initial model is drawn according to the component levels and the final access matrix, and the final model is obtained by removing the portability in the initial model. Therefore, the final ISM model, which is derived from the components related to blockchain-based marketing based on the challenges and solutions to improve business performance, is drawn as Figure 1.

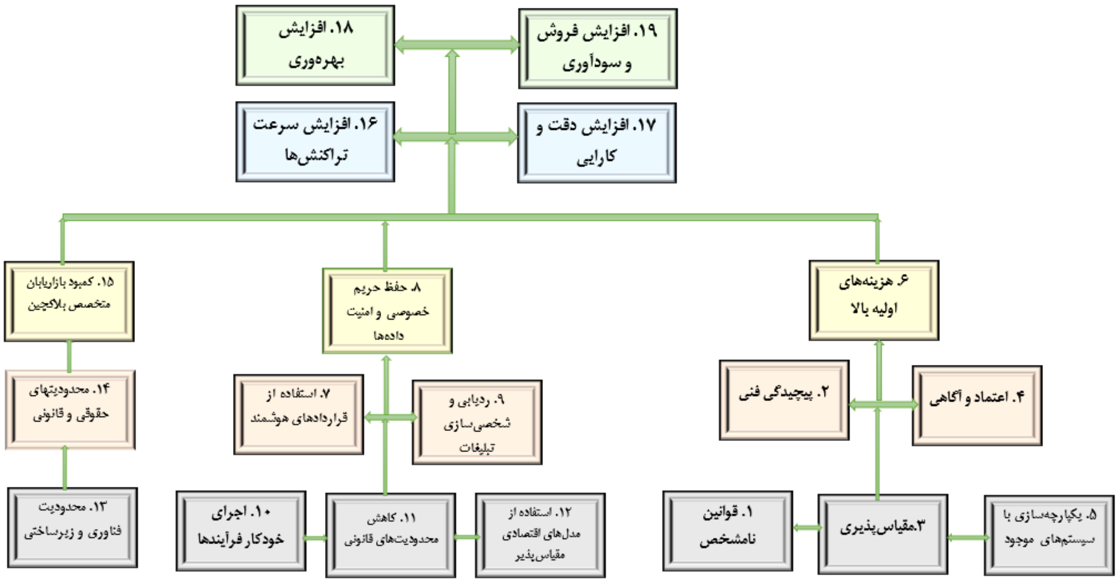

Figure (1): Final ISM model

By categorizing the components into the main dimensions, an integrated model is obtained (Figure 2).

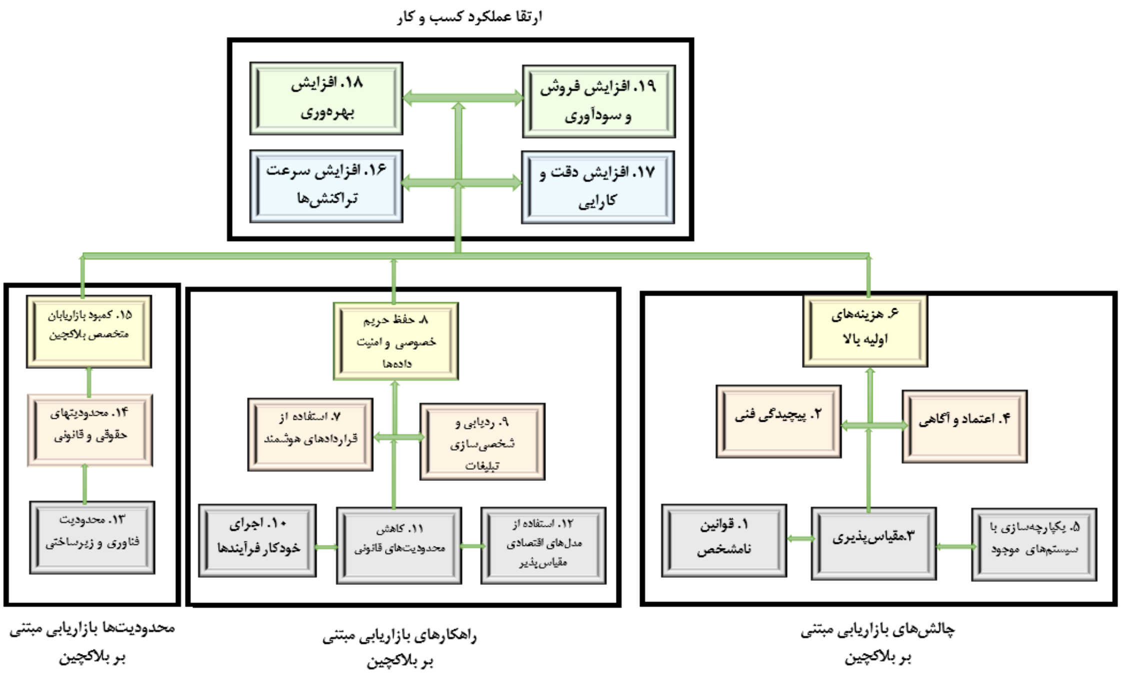

Figure (2): Blockchain-based marketing model based on challenges and solutions to improve business performance

As shown in Figure 2, components 1 to 6 are categorized as “Blockchain-based marketing challenges”, components 8 to 12 as “Blockchain-based marketing solutions”, components 13 to 15 as “Blockchain-based marketing constraints”, and components 16 to 19 as “Business performance improvement”.

Step 7: Analyze the influence and dependency (MICMAC diagram)

In this step, the components are classified into four groups. The first group includes autonomous components (Area 1) that have weak influence and dependency. These components are somewhat isolated from other components and have little connection. The second group includes dependent components (area 2) that have weak influence but high dependency. The third group is the linked components (area 3). These components have high influence and dependency. In fact, any action on these components leads to changes in other components. The fourth group is the independent components (area 4). These components have high influence and low dependency. Components that have high influence are called key components. It is clear that these components are placed in one of the two groups of independent or linked components. By adding up the entries of "1" in each row and column, the influence and degree of dependency of the components are obtained. Accordingly, the influence-dependency diagram is drawn.

Using the data from the fourth step, the studied components can be categorized into the following four levels based on the influence of each component on other components and the degree of dependence of each component on other components:

1) Autonomous: Components that have minimal dependence and influence on other components.

2) Dependent: Components that have a high dependence on other components.

3) Linked (connected): Components that have a two-way relationship with other components.

4) Independent (influence): Components that have a significant influence on other components.

To determine the coordinates of each component in the MICMAC matrix, the influence and degree of dependence of that component should be used. These values are obtained from the final access matrix. Table 8 shows the influence and degree of dependence of each component.

Table (8): Influence and degree of dependence of each component

Power of influence	Degree of dependency	Components	row
10	3	Uncertain rules	1
7	5	Technical complexity	2
10	3	Scalability	3
7	5	Trust and awareness	4
10	3	Integration with existing systems	5
5	6	High initial costs	6
7	5	Use of smart contracts	7
5	6	Preserving data privacy and security	8
7	5	Tracking and personalizing advertising	9
10	3	Automated execution of processes	10
10	3	Reducing legal restrictions	11
10	3	Using scalable economic models	12
7	1	Technological and infrastructure limitations	13
6	2	Legal and regulatory restrictions	14
5	3	Lack of blockchain expert marketers	15
4	17	Increasing transaction speed	16
4	17	Increasing accuracy and efficiency	17
2	19	Increasing productivity	18
2	19	Increasing sales and profitability	19

Using the component coordinates shown in Figure 3, the MICMAC matrix is formed.

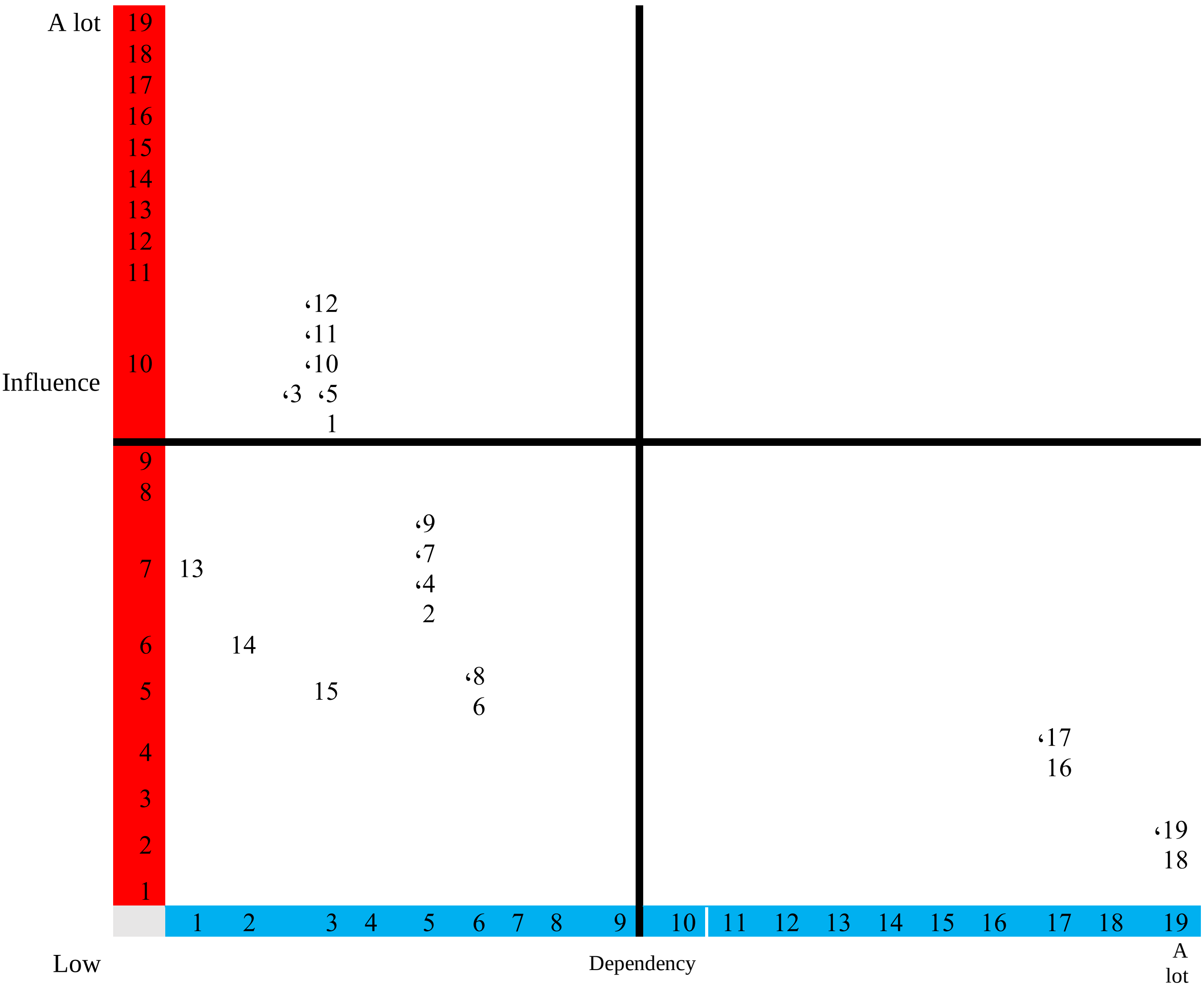

Figure (3): MICMAC Matrix

As can be seen in the MICMAC matrix, components 16, 17, 18 and 19 are in the dependent region, which means they have low influence but high dependence on other components. Components 1, 3, 5, 10, 11 and 12 are in the influence region. These components have high influence with minimal dependence. Components 2, 4, 6, 7, 8, 9, 13, 14 and 15 are in the autonomous region, which means they have low influence and low dependence. Here, the interpretive structural modeling process for developing a blockchain-based marketing model based on challenges and solutions to improve business performance ends.

Conclusion

Based on expert opinions and interpretive structural modeling, it was shown that the challenges of blockchain-based marketing include unclear rules, technical complexity, scalability, trust and awareness, integration with existing systems, and high initial costs. Blockchain-based marketing solutions include the use of smart contracts, data privacy and security, tracking and personalization of advertisements, automated execution of processes, reducing legal restrictions, and the use of scalable economic models. Limitations of blockchain-based marketing include technological and infrastructural limitations, legal and regulatory restrictions, and a shortage of expert blockchain marketers. Finally, it can be said that blockchain-based marketing, using solutions and overcoming the challenges and limitations of blockchain marketing, can lead to improved business performance by increasing the speed of transactions, increasing accuracy and efficiency, increasing productivity, and increasing sales and profitability. To address the challenges of blockchain-based marketing, these practical suggestions can be useful; Cooperating with legal institutions to develop transparent and unified laws and regulations. Providing specialized training for employees and using expert consultants in blockchain technology. Using scalable economic models such as payment channels and side chains. Running educational campaigns to increase public awareness and trust in blockchain technology. Using smart contracts to integrate with existing systems. Using scalable economic models and collaborating with technology partners to reduce costs. These measures can help solve the challenges of blockchain-based marketing and fully utilize the benefits of this technology. To address the limitations of blockchain-based marketing, companies must first invest in developing technology infrastructure and, in collaboration with technology experts, design blockchain platforms in a way that is scalable and integrates with existing systems. At the same time, it is necessary to establish close cooperation with legal and regulatory bodies and define standards that both protect user privacy and are compatible with current laws such as GDPR. To address the shortage of experts, companies should conduct training programs and specialized courses in the field of blockchain and familiarize current employees with the necessary skills to use this technology. Also, attracting experienced blockchain experts and creating cross-functional teams can help reduce implementation challenges. This integrated approach can help companies benefit from the full potential of blockchain-based marketing. To improve business performance through blockchain-based marketing, companies should use smart contracts to automate advertising and customer reward processes, which both reduce costs and increase transparency. Data privacy and security through advanced blockchain encryption should be prioritized to gain customer trust and comply with legal regulations such as GDPR. Accurate tracking of customer behavior and use of blockchain-based immutable data can help personalize advertising and improve the customer experience. Also, automating marketing processes by reducing intermediaries increases efficiency and reduces regulatory constraints. Finally, the use of scalable economic models such as digital tokens can help create new revenue streams and increase flexibility in marketing strategies. This integrated approach can help companies benefit from the full potential of blockchain to improve business performance. For future research in the field of providing a blockchain-based marketing model, it is suggested that more studies focus on practical applications of this technology in different industries and evaluate its impact on performance indicators such as customer satisfaction, cost reduction and improved supply chain efficiency. Also, examining the legal and regulatory challenges arising from the use of blockchain in marketing, especially in relation to data privacy and compliance with global laws such as GDPR, can pave the way for the development of appropriate legal frameworks. Additionally, future research could explore the role of peripheral technologies such as AI and IoT in combination with blockchain to create smarter marketing models. Also, empirical studies on small and medium-sized enterprises with limited access to technology resources could provide solutions adapted to the needs of this sector. Finally, the development of standard metrics to evaluate the success of blockchain-based marketing models could help to more accurately compare results and continuously improve these models.

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