# A framework for IoT and Blockchain Based On Marketing Systems with an Emphasis on Big Data Analysis

**Alireza Aliahmadi[1] , Hamed Nozari[2], Javid Ghahremani-Nahar[3]**

[1]*Professor of Management & Industrial Engineering, Iran University of Science & Technology,Tehran,Iran,*
*aaliahmadi@iust.ac.ir*
[2]*Faculty of Industrial Engineering, Iran University of Science and Technology,Tehran,Iran,*
*ham.nozari.eng@iauctb.ac.ir*
[3]*Faculty member of ACECR, Tabriz, Iran*
*j.ghahremani@acecr.ac.ir*

| **A R T I C L E   I N F O** | **A B S T R A C T** |
|---|---|

In today's world, huge amounts of information affect all aspects of our lives and play an important role in our decisions. The importance of big data in business, like other key processes in the organization, has not hidden from experts. Access to big data can play an important role in understanding audience behavior, planning advertising campaigns, deciding on a marketing mix such as changing a product and selecting its distribution channels, implementing e-marketing strategies, content production strategies, and many other micro and macro decisions. The Internet of Things as a transformative technology is one of the most important sources of big data production. The use of social networks and online platforms in marketing, allows companies to interact with consumers in a targeted manner and provide the required information as soon as possible. In addition to high volume, IoT data also has high accuracy and purity, based on performance. Despite all the positive features of IoT-based smart marketing and the presence of big data, the disclosure of private information is the main problem. Therefore, it is necessary to pay attention to methods, approaches and technologies that can help eliminate this complication. It seems that blockchain technology with features such as tracking, transparency and security enhancement, can help to eliminate this problem and improve the performance of the digital marketing industry. For this reason, this chapter of the book provides a conceptual framework for demonstrating the causal relationships of the elements that make up an intelligent marketing system based on these evolving technologies. Understanding this framework will help implement a smart and capable marketing system.

# 1. Introduction

With the overgrowth of industries, one of the most important basic requirements of managers in order to develop and increase profitability is the sale of products that are in urgent need of marketing. Sales is one of the most important topics in marketing (Samadi, 2021). For services firms in the market, regardless of the ownership issue of prices is very important. As both vendors and consumers change over time in line with new trends and technologies, it is important for marketing science to keep up with these changes (Liu et al., 2022). The growth of the Internet along with emerging technologies has had a significant impact on the composition of traditional marketing. Traditional marketing has given way to digital marketing. This model of marketing has its own details. Modern marketing is very much dependent on information. Meanwhile, the importance of big data is becoming more important every day. With the help of big data, new information can be discovered to create completely new products and services (Aydınocak, 2022).

Big data, broadly and increasingly, refers to increasing information given the volume, variety, speed, and complexity of data generated in the digital ecosystem system. Large customer datasets are based on the Internet of Things and are generated based on your online shopping, web clicks, social media activities, connected smart devices, geolocation, and more (Gong, 2016). Customers create new information at every stage of the buying process. When clicking on websites or decentralized data, when posting comments on Facebook, and most importantly, using the tools and products of this Big data is generated by connected systems. Using big data techniques and methods of analysis and using technological tools such as artificial intelligence and machine learning, marketers can consider both types of information in real time, and combine and analyze them (Nozari et al. (a), 2021). This can help them discover hidden patterns, such as how different groups of customers communicate and how to make purchasing decisions. Companies can equip themselves with these insights and tools to get information about their target customers, then they can develop their targeted marketing campaigns that prepare for the individual and personal preferences of their customers. Technological advances in information acquisition and storage, as well as the growth of massive free information exchange distribution systems, have provided many opportunities for marketers and companies to acquire large data sets. These large information systems facilitate fast data access in a cost-effective manner and perform real-time and accurate data analysis (Chou et al., 2022).

Each time a person enters a transaction, they enter a web of detailed information about their identity, shopping preferences, spending habits, credit card details, and other personally identifiable information (Aliahmadi et al., 2013). In terms of privacy, the situation has worsened over the years as information collection methods have become more flexible and pervasive. Online businesses are not able to meet regulatory requirements on a regular basis and there has been frequent leaks of privacy, which has a lasting effect on consumer confidence (Keogh et al., 2020). In this regard, the use of new technology such as blockchain can help to eliminate this complication. Therefore, it can be concluded that the simultaneous presence of transformational technology can increase marketers' understanding of the big data created and increase the accuracy and precision of data and analytics (Saidali et al., 2019).

According to the above, in this study, we have tried to discuss the capabilities and role of IoT and blockchain technologies with emphasis on big data in improving the smart recovery industry. Despite the growing literature on the potential applications of these technologies in smart marketing, more in-depth research is needed to demonstrate how these evolving technologies can potentially provide a foundation for increasing power and accuracy, increasing transparency and trust in marketing activities. This study also provides a conceptual framework for understanding the key elements of smart marketing based on IoT-based and blockchain technology.

## 2. Big data and marketing

"Big data" refers to data sets that are beyond the capabilities of conventional technologies to record, store, manage, and analyze; Therefore, given the importance of technology advancing over time, the size of the data set that is considered "big data" will also grow. The definition of "big data" in different industries will also vary according to the type of common technologies and the dimensions of the data set in a particular industry (Nozari et al. (b), 2021). Thus, "big data" in many industries today will vary from a few terabytes to several petabytes (thousands of terabytes). Big data generally has three characteristics: volume, variety and vlocity. Behind each of these three words is technology that allows them to be analyzed. Of course, two other features, veracity and value, have been added to the basic features of big data. These important features of big data, known as 5v, are shown in Figure 1.
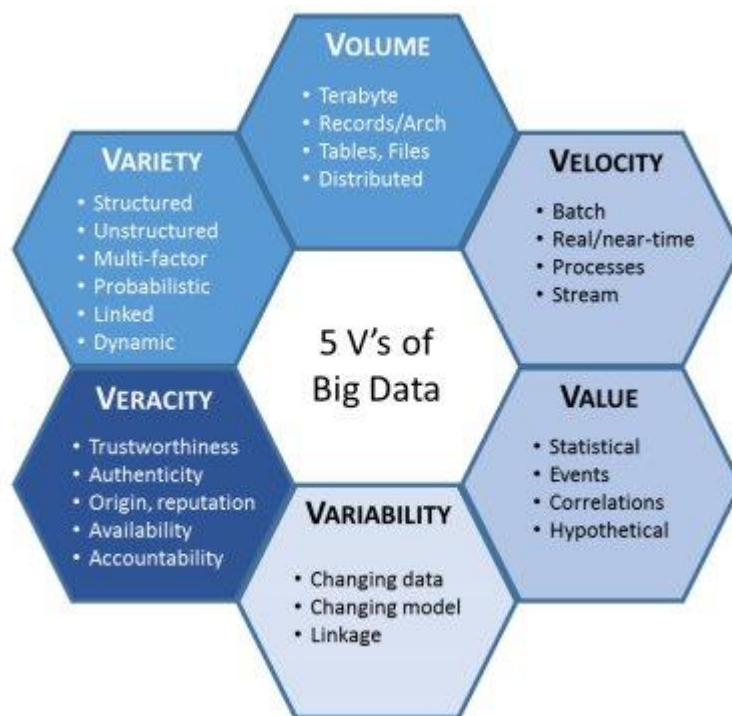


**Fig.1. Features of big data (Shaqiri, 2017)**

Using advanced analytics, businesses can achieve greater insight, increase operational efficiency and deliver business transformation with their big data streams. It also allows organizations to find new services for customers and new ways to grow their business. Potential control of big data is an important topic of discussion in large marketing companies. When and how they should enter Big Data collections and what to do with them (Lies, 2019).

In fact, the role of Big Data in marketing is such that it offers a great opportunity for marketers to achieve the goal of attracting customers. Retailers have used advanced analytics such as operational research to offer their recommendations to consumers. Communication providers use big data techniques in marketing to reduce customer dissatisfaction. Retail banks use big data analytics to prevent fraud. High-level analytics solutions have been able to offer new approaches to address some of the key marketing requirements and achieve effective results (Cao et al., 2022). These solutions can change the role of traditional marketing and improve the way Big Data functions in essential marketing. Marketers are

gathering information generated from a variety of customer contact points to get a complete picture of each customer's behavior. Big data analysis in marketing enables marketers to fine-tune customer segmentation models and take advantage of approaches to developing customer engagement strategies and improving the value of customer interactions (Chen, 2022).

Machine-generated content or IoT data is a valuable source of big data. This data is usually generated from sensors connected to electronic devices. Resource capacity depends on the ability of sensors to provide accurate information in real time (Tang, 2022). The Internet of Things is now accelerating and includes large amounts of data, not just from computers and smartphones, but from almost any device that can transmit data. Companies use advanced statistical techniques to analyze sensor data and provide solutions by analyzing causes and predicting potential hazards. It can be useful for large business networks to analyze data to take corrective action to increase customer service. Another important application of Big Data in marketing is monitoring the use of devices and products by customers and providing warnings and suggestions at the right time to upgrade and modernize products.

# 3. IoT and Marketing

Today, the desire of people to shop online is expanding. Sustainability and success in the field of industry requires meeting the needs of customers in a desirable and economical way. Customers are no longer looking to meet their basic needs, wants and desires, they need to be part of the product, that is, to be able to participate and interact with products, to share their experiences, these factors call for a new generation of Marketing is the fourth generation of marketing (Ghahremani-Nahr et al., 2021). Marketing is not about goods today. Internet and marketing empower interaction with goods, value their products, and offer more data to customers (Najafi et al., 2022).

The use of the Internet of Things in marketing enables marketers to deliver fully text-to-customer messages, such as in relation to digital signage in physical situations such as stores or via mobile phones or other devices in digital interactions. Using the Internet of Things makes tracking data much easier, more real-time, and better, allowing marketers to accurately understand customer behavior and needs (Wang, 2022). This understanding enables such professionals to change their marketing campaigns very quickly and offer more personalized advertising for the product. Now let's take a closer look at how the IoT works and marketing through the concept of 4Ps: product, price, place, and promotion (Yakut, 2022).

• product

With the help of RFID (Radio Frequency Identification) and WSN (Wireless Sensor Network Technologies), the organization can track how customers respond to the color / shape of the product, how they use it, the features they prefer, and more in real time. By going through all these steps, the customer becomes the creator of the product features to some extent.

• Price

The number of purchases made, how recently the customer buys the product and how much it costs - all of these have a significant impact on price formation. With massive data collected and quickly analyzed via the Internet of Things, you can take this process to the next level.

• Place

In terms of location, we can consider two areas: online and physical outlets. The RFID and WSNs listed above allow the marketer to define a better place to distribute the product by understanding the customer segmentation. The Internet of Things can significantly reduce the time it takes to collect and analyze data, thereby helping companies increase revenue.

- Promotion

In the field of marketing and the Internet of Things, personalization is still a growing and very promising trend. With so much data collected through the IoT solution, a company can target its customer in the best possible way, change their preferences, examine buying patterns, and create content that perfectly meets their needs. Customer specific match. Such advertising methods are a significant part of the IoT marketing strategy (Rajput et al., 2022).

Therefore, it can be seen that since the main power of the Internet of Things is in receiving and analyzing environmental data, and given the importance of environmental information in innovation, data from the Internet of Things can be an important source for innovation in the organization and innovation in marketing activities. To be. In addition, marketing capacities can create value by combining innovative approaches to the market (Nozari et al., 2021).

# 4. Blockchain and Marketing

Simply put, the blockchain is a kind of information and reporting system. The difference with other systems is that the information stored on this type of system is shared among all members of a network. With the use of data encryption and distribution, the possibility of hacking, deleting and manipulating recorded information is virtually eliminated. The technology itself is a chain of blocks with information that is added sequentially and instantly and stored on the devices of all network members. The entry of any transaction and any additional information into the chain requires the approval of all participants. This eliminates the possibility of falsifying information in the chain. It also protects it well against external interference, because even if 90% of all devices fail, the remaining 10% of information remains in its original form (Yan et al., 2021).

Another advantage of blockchain that can be used in the marketing industry is the elimination of intermediaries. According to various sources, most of the advertising revenue is in the hands of monopolists such as Google and Facebook. Although such companies pursue honest policies without deceiving customers, what many unknown sites do is costly for advertisers to work with. An alternative and solution to this problem is the blochchain (Hong, 2015). Due to the transparency of this technology, the customer is always sure that their budget is not used on the robots, the ads are placed on a previously agreed source, and the services are fully provided. At the same time, the customer does not spend money on intermediaries because the blockchain allows direct interaction between the customer and the contractor, in which all processes from execution to payment are completely transparent and controlled (Jain et al., 2021).

In addition, the blockchain allows you to spend the budget on real people and potential customers. Each participant in the network has their own digital signature, which proves that they are not a robot or a machine algorithm, but a real person. Thanks to an excellent identification system, robotic interference in the blockchain ecosystem is eliminated. Another advantage of using a blockchain in marketing is the ability to work with smart contracts. Also, with blockchain, marketers can have real numbers to track keywords. A tracker built on the blockchain can describe all the inconsistencies that marketers encounter when summarizing their research. This type of technology can track the position of keywords on all devices and in any location. Marketers can use this information to create accurate, data-driven campaigns (Coita et al., 2019). Blockchain technologies ultimately provide greater transparency for consumers. Using this technology, consumers know who has their data and how these people have access to this information. This will allow marketers to have more data for their campaigns. Although marketers may need to pay users to obtain the information they want, the data obtained in this way will be real and usable. Figure 2 shows the effects of blockchain on marketing.
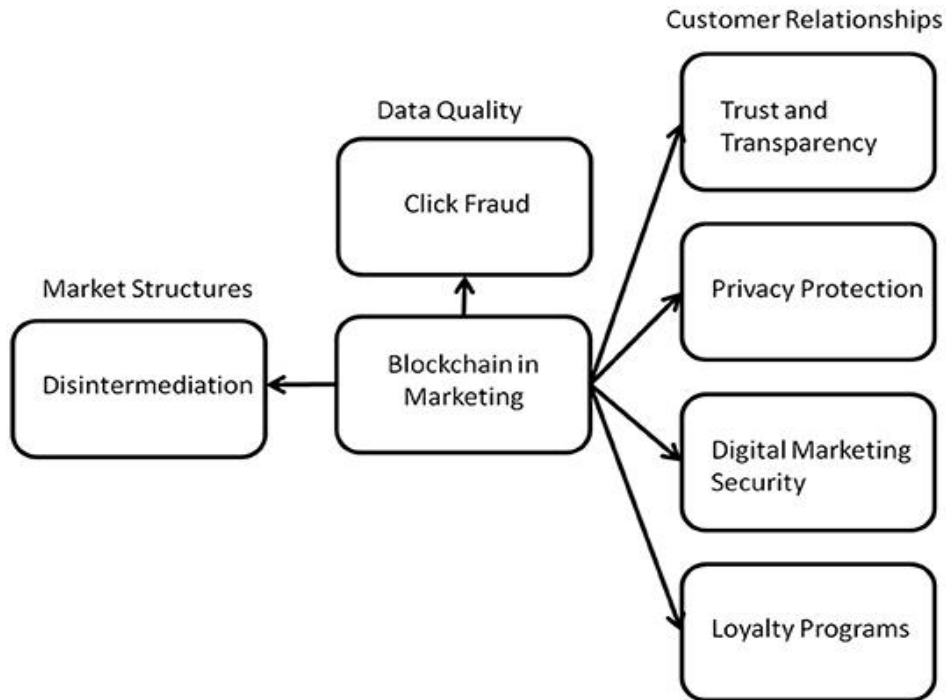
**Fig.2. Impact of blockchain on marketing (Rejeb et al., 2020)**

# 5. IoT and blockchain based marketing

The Internet of Things (IoT) and big data are interconnected. Although they are not the same, it is very difficult to talk about one without the other. Billions of "objects" connected to the Internet will, by definition, generate large amounts of data. Data protection is a multifaceted issue that cannot be solved by technology alone. Rather, governments, international organizations, global standards, general policies, and the public need to realize the importance of this issue. Blockchain technology is a powerful technology that can help secure this IoT data (Nahr et al., 2021).

Blockchain is a decentralized digital transaction office for data storage. This technology captures the data in a way that prevents data hacking and alteration; This duplicates transactions and distributes data across network groups. Blockchain allows you to complete contracts known as smart contracts in a decentralized and automated way and create a network of connected devices (Nozari et al., 2022). The nature of the use of blockchain is based on the anti-tampering of all information and data contained in it. For example, the parties to a contract, by implementing that contract on the basis of this network, will no longer worry about trust, transparency and information security. You should know that all data that enters a large volume of IoT devices is out of the control of another person, and its encryption makes it virtually impossible for everyone to rewrite existing data records. Using blockchain to store IoT data creates a layer of security that hackers have to go through to access the network. Blockchain technology provides a much stronger level of encryption that makes it virtually impossible to rewrite existing data records. Blockchain can enable fast transaction processing and coordination between billions of connected devices. With the increase in the number of interconnected devices, distributed office technology is a convenient solution to support the processing of a large number of transactions (Wang et al., 2021).

The vast amount of data in the IoT ecosystem and blockchain is collected from industries such as retail, wearables, medical implants, self-driving cars, smart doors, control equipment, smart home appliances,

and more. Each of these industries carries a huge amount of financial benefits. If data management in these industries is done properly, it will open up new business opportunities for business owners. Depending on the type of business and the data collected from different environments, different values can be considered for such data. Many businesses use big data as a golden opportunity to optimize and grow their business (Liu, 2021).

Simply put, the simultaneous presence of these technologies can increase the analytical power of marketing systems and increase the understanding of marketers. The Internet of Things is the most important source of big data. Using the Internet of Things, data is extracted from different paths of customer data and the extent of their desires. In addition, since the data is based on goods and devices and based on performance, so the data will be more accurate. Also, the presence of IoT and blockchain technologies can increase the security of data by maintaining accurate and decentralized data records. Also, the presence of analytical technologies such as artificial intelligence and machine learning can increase the analytical power of marketing systems. Figure 3 provides a conceptual framework for showing the relationships of different supply chain elements based on transformational technologies.
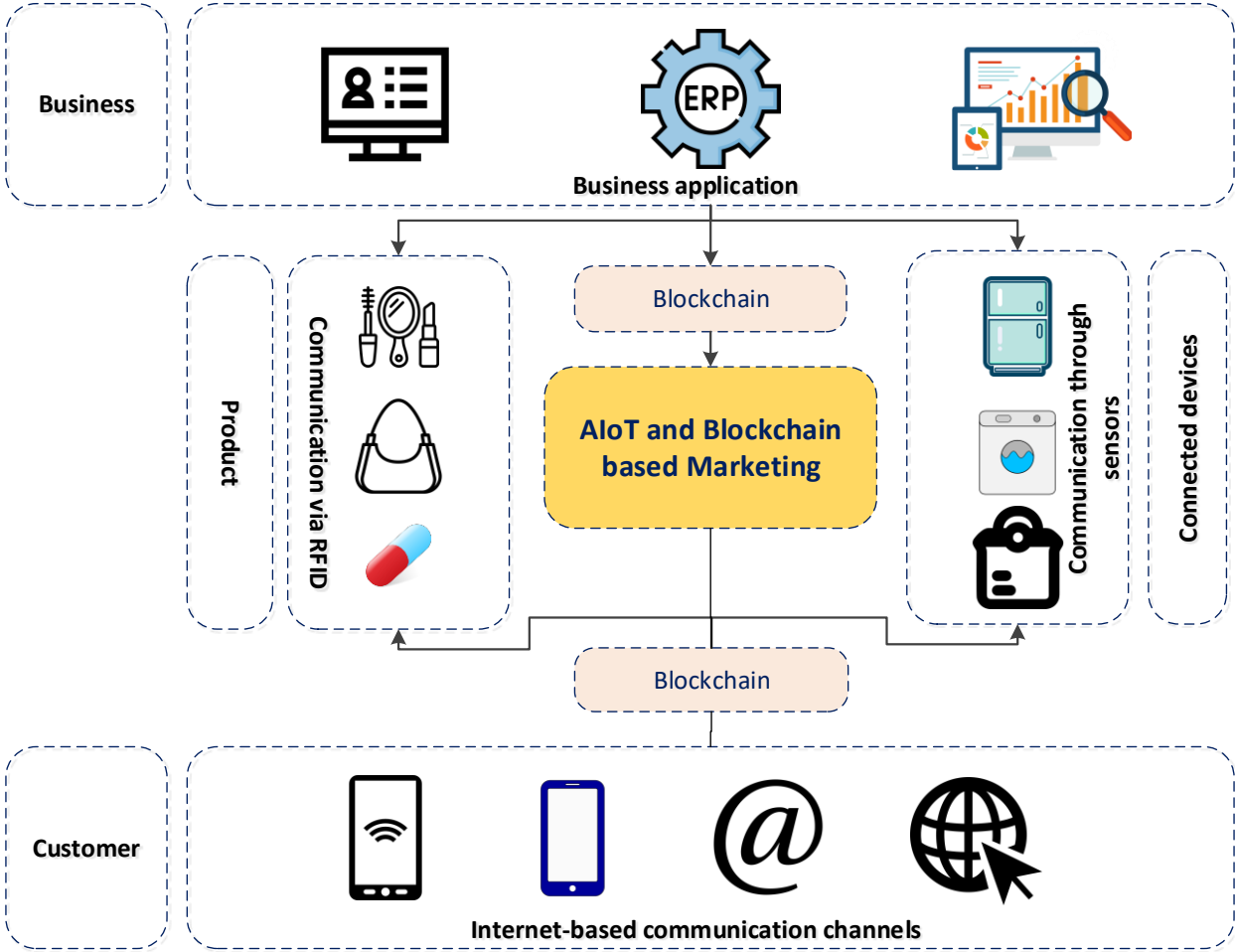


**Fig.3. IoT and blockchain based marketing**

This framework shows the key dimensions, components and indicators of this intelligent marketing system that can be used to implement and understand this system.

# 6. Conclusion

Today, the Internet of Things and evolving technologies have brought about change in all aspects of life, including business. It has provided for this change and has created a new generation of marketing called smart marketing. IoT-based intelligent interactive marketing has several advantages for marketers that influence the user's decision to choose and buy a product. Also today, brands are increasingly using technology to increase their global reach by penetrating new markets and generating consumer demand. In the process, the Internet enables marketers to reach consumers through advanced electronic communications and interactive media. At the same time, consumers are becoming more aware of the offers available and can make informed decisions more easily. Businesses have used data mining and big data techniques to draw conclusions about consumer needs and wants. Big data set analysis helps businesses gain practical insights through predictive analytics. Blockchain technology is a technological breakthrough that can help brands better understand and target their customers, but at the same time allow customers to regain control of their identifiable personal information.

In this study, we discussed the presence of the Internet of Things and blockchain with an emphasis on big data analysis in the marketing perspective and introduced the effective dimensions of each. The world of online marketing today is full of intermediaries (or so-called electronic intermediaries) who fail to configure active alliance networks and lock brands and consumers on platforms with limited capabilities. By doing so, they disrupt the creativity of brands and deprive consumers of the potential benefits of direct interaction. In this regard, the Internet of Things promises the production of big data and the basis for its analysis, and Blockchain technology promises unmediated markets in which consumers can trade directly without passing through intermediate layers. Instead of operating in a non-transparent environment where information asymmetry prevails and dominates the relationship between brands and consumers, Blockchain technology can create a new topology of increased transaction trust and information transparency, leading to more reliable and customer-centric campaigns. It becomes. In addition, the high level of technological complexity and inherent features of the blockchain have demonstrated the ability to protect consumer privacy and increase security in digital marketing. Thus, in addition to receiving and analyzing data, these technologies can help combat the widespread phenomenon of click fraud, thus creating a healthier marketing environment for consumers, brands and other participants in the value creation and delivery process. At the same time, these technologies can bring a new approach to building, integrating, and promoting marketing programs. In this research, a conceptual framework for an Internet of Things and blockchain based marketing system is presented that can guide marketing managers in understanding the dimensions, components and key indicators of this system.

# References

- Aliahmadi, A., Jafari-Eskandari, M., Mozafari, M., & Nozari, H. (2013). Comparing artificial neural networks and regression methods for predicting crude oil exports. International Journal of Information, Business and Management, 5(2), 40-58.

- Aydınocak, E. U. (2022). Internet of Things (IoT) in Marketing Logistics. In Logistics 4.0 and Future of Supply Chains (pp. 153-169). Springer, Singapore.

- Cao, G., Tian, N., & Blankson, C. (2022). Big data, marketing analytics, and firm marketing capabilities. Journal of Computer Information Systems, 62(3), 442-451.

- Chen, L. (2022, March). Research on Quanzhou E-commerce Enterprise Network Marketing Strategy Based on Big Data Precision Marketing. In 7th International Conference on Economy, Management, Law and Education (EMLE 2021) (pp. 20-23). Atlantis Press.

- Chou, S. F., Horng, J. S., Liu, C. H., Yu, T. Y., & Kuo, Y. T. (2022). Identifying the critical factors for sustainable marketing in the catering: The influence of big data applications, marketing innovation, and technology acceptance model factors. Journal of Hospitality and Tourism Management, 51, 11-21.

- Coita, D. C., Abrudan, M. M., & Matei, M. C. (2019). Effects of the blockchain technology on human resources and marketing: an exploratory study. In Strategic Innovative Marketing and Tourism (pp. 683-691). Springer, Cham.

- Ghahremani-Nahr, J., & Nozari, H. (2021). A Survey for Investigating Key Performance Indicators in Digital Marketing. International journal of Innovation in Marketing Elements, 1(1), 1-6.

- Gong, W. (2016). The Internet of Things (IoT): What is the potential of the internet of things (IoT) as a marketing tool? (Bachelor's thesis, University of Twente).

- Hong, S. K. (2015). An explorative study on the features of activity trackers as IoT based wearable devices. Journal of Internet Computing and Services, 16(5), 93-98.

- Jain, D., Dash, M. K., Kumar, A., & Luthra, S. (2021). How is blockchain used in marketing: a review and research agenda. International Journal of Information Management Data Insights, 1(2), 100044.

- Lies, J. (2019). Marketing intelligence and big data: Digital marketing techniques on their way to becoming social engineering techniques in marketing. International Journal of Interactive Multimedia & Artificial Intelligence, 5(5).

- Liu, D., Huang, C., Ni, J., Lin, X., & Shen, X. S. (2022). Blockchain-Cloud Transparent Data Marketing: Consortium Management and Fairness. IEEE Transactions on Computers.

- Liu, Y. (2021, December). Enterprise Brand Marketing Strategy under the Background of Artificial Intelligence. In 2021 International Conference on Forthcoming Networks and Sustainability in AIoT Era (FoNeS-AIoT) (pp. 115-119). IEEE.

- Nahr, J. G., Nozari, H., & Sadeghi, M. E. (2021). Green supply chain based on artificial intelligence of things (AIoT). International Journal of Innovation in Management, Economics and Social Sciences, 1(2), 56-63.

- Najafi, S. E., Nozari, H., & Edalatpanah, S. A. (2022). Investigating the Key Parameters Affecting Sustainable IoT-Based Marketing. In Computational Intelligence Methodologies Applied to Sustainable Development Goals (pp. 51-61). Springer, Cham.

- Nozari, H., Fallah, M., Kazemipoor, H., & Najafi, S. E. (b) (2021). Big data analysis of IoT-based supply chain management considering FMCG industries. Бизнес-информатика, 15(1 (eng)).

- Nozari, H., Szmelter-Jarosz, A., & Ghahremani-Nahr, J. (2021). The Ideas of Sustainable and Green Marketing Based on the Internet of Everything—The Case of the Dairy Industry. Future Internet, 13(10), 266.

- Nozari, H., Szmelter-Jarosz, A., & Ghahremani-Nahr, J. (2022). Analysis of the Challenges of Artificial Intelligence of Things (AIoT) for the Smart Supply Chain (Case Study: FMCG Industries). Sensors, 22(8), 2931.

- Nozari, H., Szmelter-Jarosz, A., & Ghahremani-Nahr, J. (a) (2021). The Ideas of Sustainable and Green Marketing Based on the Internet of Everything—The Case of the Dairy Industry. Future Internet, 13(10), 266.

- Rejeb, A., Keogh, J. G., & Treiblmaier, H. (2020). How blockchain technology can benefit marketing: Six pending research areas. Frontiers in Blockchain, 3, 3.

- Rejeb, A., Rejeb, K., & Keogh, J. G. (2020). Potential of Big Data for Marketing: A Literature Review. Management Research and Practice, 12(3), 60-73.

- Saidali, J., Rahich, H., Tabaa, Y., & Medouri, A. (2019). The combination between big data and marketing strategies to gain valuable business insights for better production success. Procedia Manufacturing, 32, 1017-1023.

- Samadi-Parviznejad, P. (2021). Simulation of Sales Scenarios in Chain Store Marketing with a Futuristic Approach. *International journal of Innovation in Marketing Elements*, *1*(1), 7-17.

- Shaqiri, B. (2017). Exploring techniques of improving security and privacy in big data (Doctoral dissertation, Ph. D. thesis, University of Information and Technology-Ohrid).

- Tang, L., Li, J., Du, H., Li, L., Wu, J., & Wang, S. (2022). Big Data in Forecasting Research: A Literature Review. Big Data Research, 27, 100289.

- Wang, G., Tang, I. L., Chan, E., & Chan, W. H. (2021). The coverage of AIOT based functional service: Case study of Asian futuristic hotel. University of South Florida M3 Center Publishing, 5(2021), 99.

- Wang, L. (2022). Big Data Precision Marketing Approach under IoT Cloud Platform Information Mining. Computational Intelligence and Neuroscience: CIN, 2022.

- Yakut, E. (2022). Effects of Technological Innovations on Consumer Behavior: Marketing 4.0 Perspective. In Industry 4.0 and Global Businesses. Emerald Publishing Limited.

- Yan, C., Zhu, J., Ouyang, Y., & Zeng, X. (2021). Marketing Method and System Optimization Based on the Financial Blockchain of the Internet of Things. Wireless Communications and Mobile Computing, 2021.