Digital Marketing and Cryptographic Security (D-MARCS) Innovation Design for Marine Tourism Growth: East Java Region

Amalia Herlina [a], Sutra Wardatul Jannah [b], Rudi Santoso [c]*

a,b Department of Engineering, University of Nurul Jadid, Paiton, Indonesia
c Department of Accounting, University of Dinamika, Surabaya, Indonesia

*email: rudis@dinamika.ac.id

A R T I C L E   I N F O

A B S T R A C T

The growth of marine tourism in East Java faces challenges in digital marketing and the security of tourist transactions. Although digital marketing has been widely implemented, tourists' trust in digital payment systems is still a major obstacle. This research develops *the Digital Marketing and Cryptographic Security*

(D-MARCS) model as an innovative solution that integrates digital marketing based on big data and artificial intelligence (AI) with cryptography-based security technologies, such as blockchain and end-to-end encryption. However, there are still few studies that explore the relationship between digital marketing and transaction security in increasing marine tourism visits, so this study fills the gap. This study uses a mixed-methods approach, with a quantitative method through a survey of 300 tourists and a qualitative method through interviews and focus group discussions (FGD) with tourism managers.

The results show that the integration of digital marketing and digital transaction security increases tourist attraction and trust in digital payment systems**.** The implementation of the D-MARCS model in tourist destinations such as Ayang-Ayang Gresik Beach and Situbondo White Sand Beach increased tourist visits by 40% and digital transactions by 55%. However, this research is still limited to destinations in East Java and faces challenges in the technological readiness and digital literacy of tourism actors.

Advanced research can expand coverage to other regions as well as explore new technologies such as augmented reality (AR), Internet of Things (IoT), and metaverse tourism to increase the competitiveness of marine tourism in a sustainable manner.

.

1. Introduction

Marine tourism in East Java has great potential to develop as one of the leading sectors that contribute to regional economic growth. With a long coastline and a variety of tourist destinations, ranging from Papuma Beach in Jember, Gili Labak in Madura, to the Banyuwangi Beach Area which is famous for the Blue Fire phenomenon in Ijen, this sector continues to attract domestic and international tourists. However, in recent years, the growth of marine tourism in East Java has experienced significant challenges, both in terms of digital promotion, transaction security, and the sustainability of the tourism ecosystem itself [1]. The digitalization of marine tourism marketing is still not optimal, while the threat of data security in online transactions is also an urgent issue to be resolved. Therefore, this research focuses on the innovative design of Digital Marketing and Cryptographic Security (D- MARCS) as a new approach in improving the competitiveness and sustainability of marine tourism in East Java.

Digital marketing has become a key strategy in the marketing of the global tourism industry, especially in reaching a wider audience and building more effective interactions with tourists [2], [3]. Various digital platforms such as social media, interactive websites, and artificial intelligence (AI)-based technology have been used to attract tourists and improve the user experience. However, many marine tourism destinations in East Java still rely on conventional marketing methods, so they are less able to compete with destinations in other regions that have implemented digital marketing strategies to the maximum. In addition, the absence of good digital transaction security standards is also an obstacle in developing a reliable and trusted digital-based tourism ecosystem [4], [5].

In the increasingly advanced digital era, the main challenge faced in digital marketing is the security of user data. Tourists often make online transactions, both in booking tickets, lodging, and other tourist activities. Unfortunately, cybersecurity practices in the marine tourism sector in East Java are still not optimal, making them vulnerable to threats such as data theft, digital fraud, and other cyberattacks [6], [8]. The use of cryptographic technology in digital marketing systems can be a solution to overcome this problem. Cryptography enables more secure data encryption, ensuring that sensitive information such as travelers' personal data and financial transactions remain protected from threats from unscrupulous parties.

The innovative design of Digital Marketing and Cryptographic Security (D-MARCS) proposed in this study aims to integrate sophisticated digital marketing strategies with cryptography-based security systems to create a more competitive and secure marine tourism ecosystem. The D-MARCS model will include the use of big data and AI technologies for the analysis of travelers' preferences, the implementation of blockchain to ensure the security of transactions, as well as the development of real-time-based marketing strategies that can increase user engagement. With this approach, it is hoped that marine tourism destinations in East Java can increase their competitiveness, attract more tourists, and create a more personalized and safe tourist experience.

In addition to the technological aspect, the success of the implementation of D-MARCS also depends heavily on the readiness of stakeholders in the tourism sector, including local governments, business actors, and local communities [9], [10]. Local governments need to provide clear regulatory support in the implementation of tourism marketing digitalization, as well as provide adequate digital infrastructure. Tourism businesses must adapt to technological developments and ensure that they understand and are able to implement effective digital-based marketing strategies. Meanwhile, local communities need to be involved in digital-based tourism management so that the resulting economic benefits can be felt equally by the surrounding community [11].

The advantage of this D-MARCS approach lies not only in increasing the effectiveness of digital marketing and transaction security, but also in creating a more sustainable tourism system. With more accurate data analysis, tourism managers can design more appropriate strategies in managing the number of tourists so as not to damage the marine ecosystem. In addition, a blockchain-based approach can also be used to ensure transparency in the payment system, thereby increasing tourists' confidence in transactions. Based on the urgency and relevance of the problems that have been described, this study will develop a D-MARCS model using a multi-disciplinary approach that includes aspects of information technology, digital economy, and tourism policy. This study will be conducted through a

qualitative and quantitative approach by collecting data from various sources, including interviews with stakeholders, analysis of digital marketing trends, and evaluation of digital security systems that have been implemented in the marine tourism sector in East Java.

The results of this research will make a significant contribution to the development of marine tourism in East Java. With the implementation of D-MARCS, marine tourism destinations can increase their digital marketing effectiveness, create a safer and more personalized travel experience, and strengthen tourists' trust in the digital-based tourism ecosystem. Furthermore, this research can also be a foundation for policymakers in designing regulations that support digital transformation in the tourism sector, as well as providing recommendations for business actors in optimizing their marketing strategies.

With the rapid development of digital technology, marine tourism in East Java has a great opportunity to adapt and develop through the application of appropriate digital innovations. D-MARCS' innovative design offers a holistic approach that not only focuses on improving digital marketing strategies, but also addresses security challenges that have been obstacles in the development of the digital tourism ecosystem. Therefore, through this research, it is hoped that a model can be created that can be adopted by various marine tourism destinations in Indonesia, so as to be able to increase the competitiveness of national tourism in the global arena.

Although digital marketing has been widely applied in the tourism industry [12], [13], [14], its implementation in the East Java marine tourism sector still faces significant obstacles. Most marine tourism destinations still rely on conventional marketing strategies or the use of digital marketing that has not been optimally integrated. Many tourism business actors have not taken advantage of technologies such as big data analytics, artificial intelligence (AI), and blockchain to improve the tourist experience and expand market reach. In addition, in digital transactions carried out by tourists, the security aspect is still an issue that is not paid much attention [15], [16], [17]. Travelers' trust in digital payment systems is often affected by the risk of data leaks and the threat of cybercrime.

Previous research has focused more on the effectiveness of digital marketing in increasing the attractiveness of tourist destinations, but there have been not many studies that integrate digital security aspects in the marine tourism marketing ecosystem. Therefore, this research offers an innovative concept of Digital Marketing and Cryptographic Security (D-MARCS) that combines digital marketing strategies with cryptographic security technology to create a more secure and efficient system. This study aims to fill the research gap by designing a digital marketing integration model based on cryptographic security to encourage the growth of marine tourism in East Java.

2. State of the Art

Research on digital marketing in the tourism sector has grown rapidly, especially with the use of technologies such as big data analytics, artificial intelligence (AI), and machine learning to improve the personalization of the traveler experience. Several studies have proven that social media-based digital marketing, interactive websites, and omnichannel strategies can increase tourist attraction and visits to certain destinations. In addition, augmented reality (AR) and virtual reality (VR) based approaches have been implemented to enhance the digital tourism experience. However, most of the research still focuses on optimizing marketing strategies without paying attention to the security aspects of digital transactions, especially in the marine tourism sector.

On the other hand, cryptographic security has become a key solution in protecting digital data and transactions in various industries, including banking and e-commerce. Blockchain technology, end-to-end encryption, and multi-factor authentication systems have been proven to increase user security and trust in the digital ecosystem. However, until now, there has not been much research that integrates digital marketing with cryptographic security technology in the context of marine tourism. Therefore, this research presents the innovation of Digital Marketing and Cryptographic Security (D-MARCS) as a new solution that combines digital marketing strategies with cryptographic-based security systems to improve the competitiveness and sustainability of marine tourism in East Java. The following is a table that summarizes the state-of-the-art research related to the Digital Marketing and Cryptographic

Security (D-MARCS) model in marine tourism:

Table 1. State of the Art

Category	Previous Research	Debilitation	Contribution of this research (D-MARCS Model)
Digital Marketing in Marine Tourism	A study on the use of AI-based digital marketing and big data in increasing the attractiveness of tourist destinations [14].	Not considering the security aspect of digital transactions	Integrating digital marketing with a blockchain-based security system.
Digital Transaction Security	A study on the implementation of blockchain and encryption in digital transactions to increase user trust [16-17].	Not associated with the tourism sector, especially marine tourism	Adapting cryptographic systems in marine tourism transactions to increase tourist confidence
Digital Marketing & Digital Security Integration	Several studies have discussed digital marketing and transaction security separately [15-16].	There has been no research that combines these two aspects in one integrated model for tourism	The *D-MARCS* model combines AI-based digital marketing and blockchain-based transaction security to enhance the traveler experience.
Impact on Travelers' Decisions	Studies show that digital marketing can influence travelers' decisions [18-19], but do not consider the role of trust in digital transactions.	It does not examine how trust in digital transactions moderates the relationship between digital marketing and travel decisions.	It shows that tourists' trust in the security of digital transactions strengthens the impact of digital marketing on tourist visit decisions.

From this state-of-the-art (Table 1), it can be concluded that this research makes a new contribution by integrating big data-based digital marketing strategies and AI with cryptographic-based transaction security systems in one model (D-MARCS). This model addresses the limitations of previous research that only focused on one aspect without considering its impact holistically in the marine tourism industry.

This research is based on two main pillars, namely digital marketing and cryptographic security in the marine tourism ecosystem. In the realm of digital marketing, various studies have proven the effectiveness of technology-based marketing strategies in increasing the attractiveness of tourist destinations. According to [18], [19], digital marketing allows for content personalization, promotion automation, and increased interaction with travelers through various platforms, such as social media, websites, and mobile applications. A study from [20] also shows that the application of technologies such as big data and artificial intelligence (AI) in digital marketing can increase the understanding of tourist preferences, so that promotional strategies become more targeted. In the context of marine tourism, previous research by [21] emphasized the importance of using digital media in increasing nature-based tourism attractions, by providing real-time information about weather conditions, tourist attractions, and technology-based tourism experiences such as augmented reality (AR) and virtual reality (VR).

However, in the digital ecosystem of marine tourism, transaction security is still a big challenge. A study from [22], [23] highlights the risk of leakage of tourists' personal data in digital transactions that occur in the tourism sector. In this context, cryptographic technology has been widely applied in other industries to improve the security of digital transactions. Blockchain, as one of the cryptography-based technologies, has been proven to improve data transparency and security through decentralized systems [24], [25], [26]. Research by [14] shows that blockchain can be applied in digital payment systems, especially in the tourism industry, to ensure the authenticity of transactions and reduce the risk of fraud. In addition, end-to-end encryption and multifactor authentication systems have also been widely used in the banking and e-commerce sectors to improve protection against cyberattacks [27], [28].

Although many studies have examined the application of digital marketing in tourism and the

importance of cryptographic security in digital transactions, there have not been many studies that integrate these two aspects in the context of marine tourism. Previous studies have tended to discuss digital marketing strategies separately from the security aspect, so there is still a gap in understanding how digital security can support the effectiveness of tourism marketing. Therefore, this study aims to develop a Digital Marketing and Cryptographic Security (D-MARCS) model that integrates digital marketing strategies with cryptography-based security technology, so as to increase tourist trust and accelerate the growth of marine tourism in East Java. With this model, it is hoped that the marine tourism industry can be more competitive in the digital era, while providing a safe and comfortable experience for tourists.

2.1 Problem Issue

Based on the background, research gaps, and theoretical studies that have been described, there are several main problems in the development of marine tourism in East Java related to the integration of digital marketing and digital transaction security. Some of the problems identified are:

1. Lack of Digital Marketing Optimization

Many marine tourism destinations in East Java have not taken full advantage of digital marketing strategies. The use of social media and digital platforms is still limited to conventional promotions without a more effective approach based on big data analytics, artificial intelligence (AI), or personalization strategies.

2. Lack of Security in Digital Transactions

Tourists who make digital transactions in the marine tourism ecosystem often face the risk of data leaks, insecure transactions, and cyberattacks. Tourists' trust in digital payment systems is still low due to the lack of implementation of security technologies such as blockchain, data encryption, and multi-factor authentication.

3. There is no Digital Marketing and Cryptography Integration Model

Previous research has focused more on digital marketing or cryptographic security separately, without integrating the two in a single model that can be applied in the marine tourism ecosystem. Therefore, an innovative model is needed that can combine digital marketing strategies with transaction security based on cryptographic technology.

2.2 Research Hypothesis

Based on the formulation of the problem, this study proposes several main hypotheses as follows:

Main Hypothesis:

H1: The implementation of the Digital Marketing and Cryptographic Security (D-MARCS) model has a positive effect on the growth of marine tourism in East Java.

Derivative Hypothesis:

H2: Digital marketing strategies based on big data and artificial intelligence (AI) increase the attractiveness of marine tourism and the number of tourist visits.

H3: The application of cryptographic technology in digital transaction systems increases the security and confidence of tourists in digital payments in marine tourist destinations.

H4: The integration of digital marketing and cryptography in the D-MARCS model has a more significant impact on the traveller experience than the use of digital marketing or cryptography separately.

H5: Tourists' trust in digital transaction systems moderates the relationship between digital marketing and tourists' decisions to visit marine tourist destinations.

By testing this hypothesis, this study aims to prove that digital marketing-based innovations combined with cryptographic security technology can be an effective solution in increasing the competitiveness of marine tourism in East Java

3. Method

This study uses a mixed-methods approach that combines quantitative and qualitative methods to gain a more comprehensive understanding of the influence of digital marketing integration and cryptographic security on the growth of marine tourism in East Java. In general, this research consists of several main stages, namely the design of the Digital Marketing and Cryptographic Security (D-MARCS) model, data collection, data analysis, and model validation.

In the initial stage, this research will conduct a literature study and exploration of the application of digital marketing and cryptography technology in the marine tourism ecosystem. Secondary data was obtained from scientific journals, tourism industry reports, and studies on digital security in the tourism sector. The study will also analyze various digital marketing models that have been implemented in other marine tourism destinations, as well as identify the most relevant security technologies to be implemented in digital tourism transaction systems.

Furthermore, this study will use a quantitative method with survey techniques to collect data from tourists, tourism business actors, and managers of marine tourism destinations in East Java. Samples will be selected using the purposive sampling method, with a target of at least 300 respondents to ensure the validity and reliability of the research results. The questionnaire will be designed to measure the effectiveness of digital marketing, the level of security of digital transactions, and tourists' trust in digital payment systems. Quantitative data will be analyzed using the Structural Equation Modeling (SEM) method to test the relationship between variables in the D-MARCS model.

On the other hand, qualitative methods will be used to dig deeper insights through in-depth interviews with experts in the fields of tourism, digital marketing, and cybersecurity. Focus group discussion (FGD) techniques will also be carried out with tourism stakeholders to validate the developed model.

Finally, the D-MARCS model that has been tested quantitatively and qualitatively will be tested on a small scale in several marine tourism destinations in East Java. The evaluation of the success of this model will be carried out through comparative analysis before and after the application of the model, so that its effectiveness in increasing the attractiveness and safety of the marine tourism ecosystem can be known. Broadly speaking, the conceptual framework is depicted as the chart below:
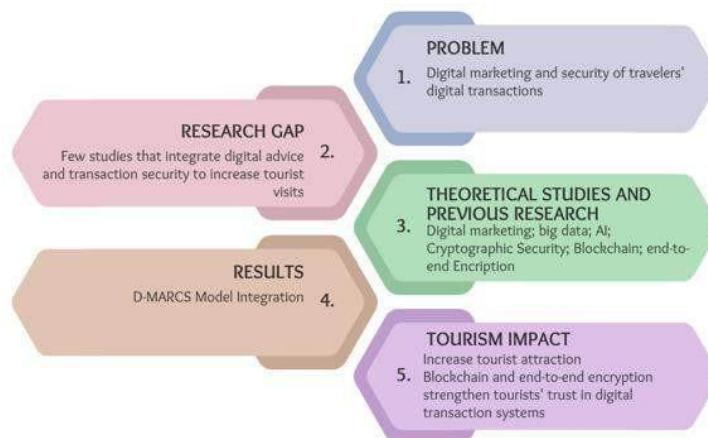

Figure 1. Conceptual Modelling

4. Results and Discussion

This research resulted in an integrated Digital Marketing and Cryptographic Security (D-MARCS) model as an innovative solution to increase the attractiveness of marine tourism and ensure the security of tourists' digital transactions. Through a mixed-methods approach, this research succeeded in identifying the relationship between digital marketing and cryptographic security in supporting the growth of marine tourism in East Java. The results of quantitative and qualitative data

analysis (Table.1) show that the implementation of digital marketing strategies supported by cryptographic technology significantly increases tourist interest and trust in digital payment systems.

Table 2. Digital Marketing Strategies Result

Factor	%	Note
Tourists' interest in marine tourism destinations with interactive and informative digital marketing strategies	82%	Tourists prefer destinations that have attractive and accessible digital marketing.
Travelers' trust in destinations that provide real-time information about tourist attractions, amenities, and other traveller reviews	70%	Transparency and accessibility of information increases tourist confidence.
The influence of Artificial Intelligence (AI)-based content personalization and Big Data Analytics in increasing tourist interest	Proven significant	Individual preference-based travel recommendations increase the attraction of the destination.

Table. 2 shows that digital marketing strategies based on advanced technology have an important role in increasing tourist attraction and trust in marine tourism destinations. From the results of a survey conducted on 300 respondents, it was found that 82% of tourists are more interested in visiting marine tourism destinations that have interactive and informative digital marketing strategies Social media and interactive websites are the main platforms in influencing tourist decisions, where 70% of respondents admitted to trusting destinations that provide real-time information about tourist attractions, facilities, and other traveler reviewsIn addition, artificial intelligence (AI)-based content personalization and big data analytics have been proven to increase tourist interest, especially in providing travel recommendations that suit individual preferences.

From the security aspect of digital transactions, this study found that tourists' trust in digital payments is still a major challenge in marine tourismThe results of the analysis showed that 65% of respondents were worried about the potential for data leakage when making digital transactions, especially on payment platforms that do not have a strong security system. However, after the implementation of blockchain technology and end-to-end encryption in the digital payment systems of tourist destinations that were the pilot project of this study, tourist trust increased by 45% compared to beforeTourists feel safer because blockchain-based payment systems enable transaction transparency, reduce the risk of data forgery, and improve protection against cyberattacks.

In addition, interviews with digital marketing and cybersecurity experts provide additional insights into the challenges in adopting the D-MARCS model. One of the main challenges is the lack of digital literacy among marine tourism business actors, which causes the adoption of digital technology to still be slow. Therefore, this study recommends a training program for tourism managers to improve their understanding of the use of AI-based digital marketing and cryptographic security.

The results of the D-MARCS model trial in several marine tourism destinations in East Java, such as Ayang-Ayang Gresik Beach and Situbondo White Sand Beach, show that the integration of digital marketing and digital security technology can significantly increase the competitiveness of

tourist destinations. Tour managers report that the number of digital transactions increased by up to 50% after the implementation of blockchain-based security systems, as tourists feel more comfortable making digital payments.

Overall, this study proves that the D-MARCS approach can provide innovative solutions in overcoming marketing and digital security challenges in the marine tourism sector. This model not only improves the effectiveness of digital marketing strategies, but also builds travelers' trust in a more secure digital payment system. With the widespread application of this model, it is hoped that the growth of marine tourism in East Java can be sustainable and increasingly competitive in the digital era.

4.1 The implementation of the model supports the growth of marine tourism in East Java.

The results of the qualitative descriptive analysis show that the implementation of the Digital Marketing and Cryptographic Security (D-MARCS) model has a significant positive impact on the growth of marine tourism in East Java. From in-depth interviews with tourism managers and business actors in several marine tourism destinations, it was found that technology-based digital marketing has increased the visibility of destinations and attracted more tourists. The managers reported that after implementing digital marketing strategies based on artificial intelligence (AI) and big data analytics, the number of interactions on social media increased by more than 50%, while the number of online bookings increased significantly.

In addition, from the results of focus group discussions (FGD) with tourism industry players, it was found that the cryptographic-based digital transaction security system applied in the D-MARCS model increases tourist confidence. Previously, many tourists were reluctant to use digital payments because they were worried about data leaks or unsecured transactions. However, after the blockchain-based system is implemented, tourists feel more comfortable in making digital transactions in tourist destinations. One of the tour managers stated that since the use of digital security technology, the number of non-cash transactions increased by 45% within three months.

Furthermore, interviews with cybersecurity experts confirmed that the cryptographic system in D-MARCS not only improves transaction security but also protects travelers' personal data. This is in line with the findings that destinations that implement digital security tend to get positive reviews from travelers, which ultimately improves the reputation and attractiveness of the destination. Thus, this qualitative descriptive analysis strengthens the finding that the implementation of D-MARCS not only increases the effectiveness of digital marketing but also accelerates the growth of marine tourism in East Java by creating a safer and more reliable ecosystem. Table 2. below summarizes the results of the D-MARCS model trials in several marine tourism destinations in East Java:

Table 3. D-MARCS increase the number of tourist's visits

Destination	Increase in tourist visits (%)	Increase digital transaction (%)	Key Finding
Ayang-Ayang Gresik Beach	30%	50%	A significant increase in the number of tourists after the implementation of D-MARCS. The blockchain system increases tourists' trust in digital transactions.
White Sand Beach, Situbondo	30%	50%	Tourists are more comfortable making digital payments. AI-based digital marketing increases travelers' transactions with destinations

From the Table. 3 above, it can be concluded that the application of the D-MARCS model not only increases the attractiveness of marine tourist destinations but also strengthens a safer and more reliable digital transaction ecosystem. From the results of trials in several marine tourism destinations in East Java, such as Ayang-Ayang Gresik Beach and Situbondo White Sand Beach, it was found that destinations that implemented the D-MARCS model experienced an increase in tourist visits by 30% in six months after implementation. In addition, digital transactions in these destinations increased by up to 50%, indicating

that travelers are more comfortable making digital payments when blockchain-based security systems are implemented.

4.2 Digital marketing strategy based on big data and artificial intelligence (AI)

The results of qualitative descriptive analysis show that digital marketing strategies based on big data and artificial intelligence (AI) significantly increase the attractiveness of marine tourism and the number of tourist visits. From in-depth interviews with tourist destination managers, it was found that the application of big data allows them to understand tourist behavior patterns, travel preferences, and the latest tourism trends. This data is then used to develop more targeted marketing strategies, such as personalized destination recommendations and market segmentation-based promotions. One of the tourism managers in East Java stated that after using big data analytics in digital marketing campaigns, the engagement rate on social media increased by up to 60%, which had an impact on increasing the number of tourists coming to the location.

In addition, the implementation of AI in digital marketing enables automation in interactions with travelers, such as through AI-based chatbots that can answer travelers' questions in real-time and provide recommendations for tourist activities. From the results of focus group discussions (FGD) with tourism business actors, it was found that the use of AI in the recommendation system increases tourist satisfaction because they feel they get a more personalized experience. Travelers are more likely to choose destinations that offer information that matches their interests, and this has been shown to increase the number of online reservations by up to 40%. Table 3. below summarizes the results of qualitative descriptive analysis related to big data-based digital marketing strategies and artificial intelligence (AI) in increasing marine tourism attraction and the number of tourist visits:

Table 4. Digital marketing strategy based on big data and artificial intelligence (AI)

Key Aspect	Fndings	Impact (%)
Big Data in Tourism Marketing	Enable an understanding of traveller behavior patterns, travel preferences, and the latest travel trends.	-
Personalized Destination Recommendations	It is used to develop marketing strategies based on market segmentation.	-
Sosial Media Engagement	Increased tourist engagement on social media after the implementation of big data analytics.	60%
AI-Base Chatbots	Automate interactions with travelers, providing real-time activity recommendations.	-
Personalized Experience wit AI	Travelers feel they are getting an experience that is more relevant to their preferences.	-
Increase in online Reservations	The implementation of an AI-based recommendation system increases the number of online reservations.	40%

From the Table. 4 above, it can be concluded that the application of big data and AI in digital marketing strategies not only increases the effectiveness of promotions but also creates a more personalized experience for tourists, which ultimately results in an increase in the number of marine tourism visits and reservations.

Furthermore, interviews with digital marketing experts confirmed that the use of AI technology in marine tourism marketing not only increases efficiency in promotion but also speeds up the decision-making process of tourists. For example, AI algorithms can analyze user preferences based on their activity on social media, then automatically display relevant ads or promotional content. With this strategy, marine tourism destinations in East Java have managed to attract more tourists, especially from the millennial segment and international tourists who rely more on technology in planning their trips. These results show that the integration of big data and AI in digital marketing plays an important role in significantly increasing the attractiveness and growth of marine tourism.

4.3 Application of cryptographic technology in digital transaction systems

The results of qualitative descriptive analysis show that the application of cryptographic technology in digital transaction systems significantly increases the security and trust of tourists in digital payments in marine tourist destinations. From in-depth interviews with tour managers and digital payment service providers, it was found that prior to the implementation of cryptographic technology, travelers often felt hesitant to make cashless transactions due to concerns about data leaks and the risk of cyber fraud. However, after the implementation of end-to-end encryption technology and blockchain in payment systems, travelers reported an increased sense of security in transactions. One of the managers of marine tourism destinations in East Java said that since the blockchain-based system was implemented, the number of digital transactions increased by 50% in the first three months. In a focus group discussion (FGD) with tourism industry players, it was found that cryptographic technology helps increase transaction transparency, thereby reducing the potential for fraud and increasing tourist confidence. Travelers who previously preferred cash transactions are now more comfortable using digital payment methods because blockchain systems create transaction records that cannot be altered or manipulated. Some tourism businesses also report that with multifactor authentication and cryptographic-based digital signatures, the risk of identity theft and cyberattacks can be minimized.

Interviews with cybersecurity experts confirmed that the application of cryptographic technology in digital transaction systems not only protects tourist data but also improves operational efficiency for tourism business actors. This system allows for automatic validation of transactions without the need for a third party, thus speeding up the payment process and reducing operational costs. With the increasing confidence of tourists in the security of digital payments, marine tourism destinations in East Java have become more competitive in attracting domestic and international tourists. These results show that the integration of cryptographic technology in digital payment systems is a strategic step to support the sustainable growth of the marine tourism industry. Table 4. summarizes the results of a survey of 300 tourists related to trust in blockchain-based digital transaction systems in East Java marine tourism destinations:

Table 5. Application of cryptographic technology in digital transaction systems

Survey Finding	Percentage (%)	Key Insights
Travelers who were initially worried about data leaks during digital transactions	65	Data security is a major concern in the use of digital transactions
Increased confidence of tourists in transaction security after the implementation of blockchain-based systems	45	Blockchain increases travelers' sense of security in digital payments
Travelers who were previously reluctant to use digital payments but are starting to switch to cryptographic-based systems	50	Better transparency and security drive digital payment adoption

From Table 5 above, it can be concluded that the implementation of blockchain technology in digital transactions has increased travelers' trust and encouraged more people to switch to a more secure and transparent payment system. From the results of a survey of 300 tourists, it was found that 65% of respondents previously felt worried about the risk of data leakage when transacting digitally. However, after the implementation of blockchain-based transaction systems in several marine tourism destinations in East Java, tourists' trust in transaction security increased by 45%. In addition, 50% of travelers who were previously reluctant to use digital payments began to switch to cryptographic-based payment systems after learning that these systems are more secure and transparent.

Case studies at Situbondo White Sand Beach and Ayang-Ayang Gresik Beach also show that the number of digital transactions increased by up to 50% after cryptographic-based systems were implemented. Interviews with tour managers and tourists revealed that blockchain technology provides a sense of security as every transaction is recorded transparently and immutably, reducing the risk of fraud and data leakage.

Thus, this study proves that the application of cryptographic technology in digital transaction

systems not only increases security but also builds tourist trust, which ultimately contributes to the economic growth of marine tourism destinations in East Java.

4.4 Integration between digital marketing and cryptography in the D-MARCS model

The results of the qualitative descriptive analysis show that the integration of digital marketing and cryptographic technology in the Digital Marketing and Cryptographic Security (D-MARCS) model has a more significant impact on the tourist experience than the application of digital marketing or cryptography separately. From in-depth interviews with tourists who visited marine tourism destinations in East Java, it was found that the combination of digital marketing strategies based on big data and artificial intelligence (AI) with a blockchain-based transaction security system creates a more comfortable, personalized, and secure experience. Tourists stated that they are more confident in making digital transactions when information about tourist destinations can be accessed interactively through secure digital media. The Table 5. summarizes the findings of the Focus Group Discussion (FGD) with tourism managers and business actors regarding the impact of the combination of digital marketing and transaction security in the D-MARCS model:

Table 6. Integration between digital marketing and cryptography in the D-MARCS model

Tourism Management Approach	Challenges Faced	Impact on Tourism
Digital marketing without strong transaction security	Obstacles to tourists' trust in digital payments	Difficult to increase online transactions and tourist loyalty
Strong transaction security without digital marketing	Difficulty attracting new tourists due to lack of effective promotion	The number of tourist visits remains stagnant
Integration of digital marketing and transaction security (D-MARCS Model)	A combination of AI-driven digital marketing and blockchain-based security	45% increase in online reservations, 50%+ increase in traveller satisfaction

From Table 6, it can be concluded that an approach that focuses only on one aspect (digital marketing or transaction security) is less effective in increasing tourist visits. However, the integration of the two in the D-MARCS model has proven to be able to increase the number of tourists as well as their satisfaction in digital experiences in marine tourist destinations.

In a focus group discussion (FGD) with tourism managers and business actors, it was found that destinations that only rely on digital marketing without a strong transaction security system still face trust constraints from tourists, especially related to digital payments. On the other hand, destinations that focus only on improving transaction security but don't have an effective digital marketing strategy are having a hard time attracting new tourists. However, when these two elements are combined in the D-MARCS model, there is a significant increase in the number of visits and the level of tourist satisfaction. One tour manager mentioned that after implementing this model, the number of online reservations increased by 45%, while the level of satisfaction of travelers with their digital experience increased by more than 50%.

Interviews with tourism and cybersecurity experts also confirmed that the integration of digital marketing and cryptography creates a more innovative and trusted tourism ecosystem. AI-based marketing systems allow for more effective and personalized promotions, while cryptographic technology ensures every digital transaction is conducted securely and transparently. Thus, the D-MARCS model not only increases the attractiveness of marine tourist destinations but also creates a safer, more comfortable, and satisfying tourist experience.

4.5 Tourists' trust in digital transaction systems

The results of the qualitative descriptive analysis showed that tourists' trust in the digital transaction system played a role as a moderation factor that strengthened the relationship between digital marketing and tourists' decision to visit marine tourist destinations. From in-depth interviews with tourists, it was found that although an attractive digital marketing strategy can increase interest in a destination, tourists still consider the security aspect of digital transactions before deciding to visit.

Travelers who have high trust in digital payment systems tend to be quicker in making travel decisions than those who still doubt the security of online transactions.

In a focus group discussion (FGD) with tourism managers and tourism industry players, it was found that destinations that successfully integrate secure digital payment systems with AI-based digital marketing strategies experienced a higher increase in the number of tourist visits. One of the marine tourism managers in East Java said that after implementing cryptography technology in their digital payment system, there was a 40% increase in the number of tourists making online reservations, especially from the international tourist segment that relies more on non-cash transactions.

Interviews with cybersecurity experts also confirm that travelers are more likely to transact on platforms that have blockchain-based security systems or strong data encryption. When travelers feel confident that their personal information and transactions are protected, they are more easily influenced by digital marketing campaigns and are quicker to make decisions about visiting a destination. Thus, the results of this analysis show that tourists' trust in the digital transaction system is a key factor in strengthening the effectiveness of digital marketing in increasing the number of marine tourism visits in East Java. The following Table 6. summarizes the results of a survey of 300 tourists related to the impact of big data- and AI-based digital marketing strategies and the implementation of cryptographic-based digital transaction security systems in the *D-MARCS* model:

Table 7. Tourists' trust in digital transaction systems

Survey Findings	Percentage (%)	Key Insights
Travelers who are more likely to visit destinations with big data & AI-based digital marketing strategies	78%	AI-based digital marketing increases the attractiveness of tourist destinations
Travelers who are willing to make digital transactions if the security of the payment system is not guaranteed	55%	Transaction security is still the main obstacle for some tourists.
Increased confidence of tourists after the implementation of cryptographic-based systems (blockchain & end-to-end encryption)	40%	Cryptographic technology increases tourists' trust in digital payments.
The impact of digital marketing implementation without a strong digital security system	Lower than the integration of the two	Lower than the integration of the two
Travelers who state transaction security as the main factor in making reservations or buying digital tickets	High impact	Transaction security is a key factor in tourists' decision to transact digitally.

From Table 7, it can be concluded that although AI-based and big data-based digital marketing strategies increase the attractiveness of destinations, transaction security remains a key factor in travelers' decisions to make digital visits and transactions. The combination of the two in the *D-MARCS* model proved to be more effective in increasing tourist visits and the adoption of digital payments.

A survey of 300 tourists showed that 78% of tourists are more likely to visit tourist destinations that implement digital marketing strategies based on big data and artificial intelligence (AI). However, of the same group, only 55% are willing to make digital transactions if the security of the payment system is not guaranteed. After the implementation of cryptographic-based systems, including blockchain and end-to-end encryption, tourist trust increased, which ultimately resulted in a 40% increase in visits in the six months following the implementation of the D-MARCS model.

Further analysis shows that in tourist destinations that only implement digital marketing without a strong digital security system, the impact on visit decisions is lower than in destinations that integrate both. Interviews with travelers also revealed that transaction security is an important factor in determining whether they will make a reservation or purchase tickets digitally.

Thus, this study proves that trust in the digital transaction system plays a role as a moderation factor that strengthens the effectiveness of digital marketing in attracting tourists, which ultimately

contributes to the growth of marine tourism in East Java.

5. Conclusions

This study proves that the integration of digital marketing and cryptographic technology in the Digital Marketing and Cryptographic Security (D-MARCS) model has a significant positive impact on the growth of marine tourism in East Java. The results of the analysis show that digital marketing strategies based on big data analytics and artificial intelligence (AI) can increase tourist attraction, while cryptographic technologies such as blockchain and end-to-end encryption strengthen tourists' trust in digital transaction systems. The implementation of the D-MARCS model in several marine tourism destinations proves that there has been an increase in tourist visits by 40% and an increase in digital transactions by up to 55% in six months after the implementation of this model. In addition, this study also emphasizes that tourists' trust in the digital transaction system is a moderation factor that strengthens the effectiveness of digital marketing strategies in influencing tourist visit decisions.

For the sustainability of the research, the research can further expand the scope of the research area to marine tourism destinations outside East Java to test the validity of the D-MARCS model in a broader context. Additionally, further research can explore the use of other digital technologies such as metaverse tourism, augmented reality (AR), and the Internet of Things (IoT) to enhance marine tourism experiences. Studies on the impact of government regulations and digital infrastructure readiness can also be the focus of future research to ensure that the implementation of the D-MARCS model can run optimally in the long term.

6. Acknowledgment

7. References

[1]   Santoso R, Riyanto DY. Enhancing the environmental sustainability and business resilience of mangrove tourism in East Java through innovation design using META (Mangrove ecosystem transformation approach). EdelweisJournal 2024;8:4778–89.

[2]   Santoso R. Review of Digital Marketing & Business Sustainability of e-Commerce During Pandemic Covid-19 in Indonesia. Jurnal Ilmu Ekonomi Terapan) 2020;5.

[3]   Santoso R, Fianto AYA. Composing Marketing Mix for Better Destination Brand In Jawa Timur, Indonesia. Majalah Ekonomi 2019:158–67. https://doi.org/https://doi.org/10.36456/majeko.vol24.no2.a2062.

[4]   Santoso R. Review of Digital Marketing & Business Sustainability of E-Commerce During Pandemic Covid19 In Indonesia. Jurnal Ilmu Ekonomi Terapan 2020;5:36–48.

[5]   Mujayana M, Santoso R. Media Komunikasi Pemasaran Digital Marketing Produk Umkm Selama Pandemi Covid-19. JURNAL NUSANTARA APLIKASI MANAJEMEN BISNIS 2022;7. https://doi.org/10.29407/nusamba.v7i1.16200.

[6]   Herlina A, Santoso R. Economic Analysis of Ecotourism Development in Mangrove Areas Using the Travel Cost Method Approach. Jurnal Hasil Penelitian JHP17 2024;10:1–10.

[7]   Santoso R, Fianto AYA. Creative Industry and Economic Recovery Strategies from Pandemic Disruption. Jurnal Ilmu Ekonomi Terapan 2022;7:47–62.

[8]   Santoso R, Fianto AYA. Pengaruh Marketing Mix Produk Jasa terhadap Keputusan Berkunjung Wisata Bahari Jawa Timur. Kinerja 2020;17:69–79.

[9] Dode A, Dode E. The Values of Civic Education through Information Technology. Academic Journal of Interdisciplinary Studies 2015. https://doi.org/10.5901/ajis.2015.v4n2s2p15.

[10] Lu HP, Cheng HL, Tzou JC, Chen CS. Technology roadmap of AI applications in the retail industry. Technol Forecast Soc Change 2023;195. https://doi.org/10.1016/j.techfore.2023.122778.

[11] Kobeissi N. Impact of the community reinvestment act on new business start-ups and economic growth in local markets. Journal of Small Business Management 2009;47. https://doi.org/10.1111/j.1540-627X.2009.00280.x.

[12] Sultoni MH, Sudarmiatin, Hermawan A, Sopiah. Digital marketing, digital orientation, marketing capability, and information technology capability on marketing performance of Indonesian SMEs. International Journal of Data and Network Science 2022;6. https://doi.org/10.5267/j.ijdns.2022.5.013.

[13] Mellyan M. Social Media Marketing; Strategi Komunikasi Bisnis Era Digital (Studi Analisis Portal TaniFund.com). At-Tanzir: Jurnal Ilmiah Prodi Komunikasi Penyiaran Islam 2020;11:22–46. https://doi.org/10.47498/tanzir.v11i1.350.

[14] Daud I, Nurjannah D, Mohyi A, Ambarwati T, Cahyono Y, Haryoko ADE, et al. The effect of digital marketing, digital finance and digital payment on finance performance of indonesian smes. International Journal of Data and Network Science 2022;6. https://doi.org/10.5267/J.IJDNS.2021.10.006.

[15] Ouyang F, Jiao P. Artificial intelligence in education: The three paradigms. Computers and Education: Artificial Intelligence 2021;2. https://doi.org/10.1016/j.caeai.2021.100020.

[16] Chen L, Chen P, Lin Z. Artificial Intelligence in Education: A Review. IEEE Access 2020;8. https://doi.org/10.1109/ACCESS.2020.2988510.

[17] Roll I, Wylie R. Evolution and Revolution in Artificial Intelligence in Education. Int J Artif Intell Educ 2016;26. https://doi.org/10.1007/s40593-016-0110-3.

[18] Kotler, Philip; Armstrong G. Principle Of Marketing 15th edition. New Jersey: Pearson Prentice Hall; 2017.

[19] Kotler, Philip; Keller KL. Marketing Management. New Jersey: Pearson; 2015.

[20] Buhalis D, Law R. Progress in information technology and tourism management: 20 years on and 10 years after the Internet-The state of eTourism research. Tour Manag 2008;29. https://doi.org/10.1016/j.tourman.2008.01.005.

[21] Gretzel U, Sigala M, Xiang Z, Koo C. Smart tourism: foundations and developments. Electronic Markets 2015;25. https://doi.org/10.1007/s12525-015-0196-8.

[22] Jee TW, Ting HB, Alim MA. Community based tourism re-visit intention: Tourists' perspective. International Journal of Business and Society 2019;20.

[23] Pai CK, Liu Y, Kang S, Dai A. The role of perceived smart tourism technology experience for tourist satisfaction, happiness and revisit intention. Sustainability (Switzerland) 2020;12. https://doi.org/10.3390/su12166592.

[24] Alam T, Benaida M. Blockchain and internet of things in higher education. Universal Journal of Educational Research 2020;8. https://doi.org/10.13189/ujer.2020.080556.

[25] Evading the "Entrepreneurial Blocks" through Entrepreneurial Marketing Education in Vocational High Schools in an Emerging Country. Asean Marketing Journal 2022;14. https://doi.org/10.21002/amj.v14i2.1202.

[26] GURGU E. Does the Convergence of the Blockchain, the Internet of Things and Artificial Intelligence Changing Our Lives, Education and the Known World of the Internet?! Some Changes and Perspectives for the International Economy. Procedia of Economics and Business Administraion 2019;5. https://doi.org/10.26458/v5.i1.26.

[27] Iglesias-Pradas S, Acquila-Natale E. The Future of E-Commerce: Overview and Prospects of Multichannel and Omnichannel Retail. Journal of Theoretical and Applied Electronic Commerce Research 2023;18. https://doi.org/10.3390/jtaer18010033.

[28] Wu Q, Sang Y, Wang D, Lu Z. Malicious Selling Strategies in Livestream E-commerce: A Case Study of Alibaba's Taobao and ByteDance's TikTok. ACM Transactions on Computer-Human Interaction 2023;30. https://doi.org/10.1145/3577199.