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The Influence of Explainable AI (XAI) and Smart Contracts on Consumer Trust and Acceptance of Decentralised Escrow Services

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Escrow

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Abstract **Original Research Article**

Poor market penetration and consumer skepticism are the hindrances to the radical transformation of the financial services sector by decentralised finance (DeFi) and Smart Contracts (SCs). This is largely linked to the black box phenomenon, as even the code logic of SCs, although publicly recorded in a ledger, is incomprehensible to the average reader of it, which makes perceived trust lower. This opacification is also complicated by the Artificial Intelligence (AI) applications in the SC processes, such as vulnerability detection and dispute resolutions. This paper is a systematic review of secondary literature that proves the hypothesis that Explainable AI (XAI), used in combination with Smart Contracts (SCs), can contribute to a significant increase in the perceived trust, transparency, and uptake of decentralised escrow and automated financial services. The systematic review of market research, consumer surveys, and case studies published after 2020 were taken into account as the methodology, and the results were sorted according to Security, Transparency, and Cost-Efficiency. The findings affirm that the strategic combination of XAI and SCs is a direct solution to the black box phenomenon. XAI converts the black-box, de facto judgements of SC-based escrow systems into transparent, verifiable, and human-comprehensible judgements. This visibility of execution is also essential at the time of such important events as the release of funds or the cancellation of a contract, which directly improves consumer confidence, which is a key factor of purchase in digital finance. Moreover, the XAI-SC framework has economic benefits related to the minimisation of the cost of operation and legal overheads, easing dispute resolution mechanisms, and enabling human-centric adherence to regulations. This paper concludes that XAI should be integrated to overcome consumer distrust and accelerate the spread of decentralised escrows in the mass market.

Keywords: XAI, Contracts, DeFi, Escrow, Trust, Transparency, Adoption, AI, Security, Cost, Scepticism, Blackbox, Judgements, Regulations, Vulnerability

INTRODUCTION

The radical transformation of the financial services sector is motivated by the active development of decentralised finance (DeFi) that aims to substitute the centralised intermediaries and the vulnerability of these intermediaries to fraud, chargebacks, and delays (Tolamise, 2025). The most crucial aspect of such a change is the blockchain technology and its implementation, the Smart contract (SC). SCs are automated, self-verifiable contracts, and they are part of the blockchain and automate multi-party transactions (Gec et al., 2023; Vijay, 2025). It is a programmable trust mechanism that will improve security, efficiency, and transparency (Chatterjee, 2025), especially in high-value,

trust-critical use cases like e-commerce escrow and e-commerce settlement of real estate (Tolamise, 2025; Olumide, 2024).

Although they have the potential to transform, consumer scepticism and poor market penetration are the factors that impede mainstream adoption. Although the ledger is abstract conceptually and publicly accessible, the code logic behind it is not visible to the majority of users, which introduces a major black box issue (Bathaee, 2018). This is the absence of transparency that lacks the user-friendliness that decentralisation is meant to inculcate. This complication is further added by the complexity and security concerns of designing and deploying resilient SCs (Gamage 2025; Upadhya et al., 2024). Besides, the growing adoption of Artificial Intelligence (AI), which is applied in such areas as code optimisation, vulnerability detection, and automated dispute resolution (Misbah et al., 2025; Zhu et al., 2025), creates complicated algorithmic choices that could increase the pressure on accountability and transparency.

In order to deal with this vital deficiency of trust and speed up adoption, an integration of such technologies is needed. The core Hypothesis, on which the current study is based, states as follows: The concept of Explainable AI (XAI), introduced in the case of a systematic interaction with Smart Contracts, can be of substantial help when it comes to enhancing the perceived trust, the perceived transparency, and thus the market adoption of decentralised escrow and automated financial services.

Based on the principles of XAI (Akpan et al., 2024), the given approach will provide a way to turn the opaque black box of the smart contract into a reliable system, giving a clear and human-understandable explanation to all crucial, automated decisions.

LITERATURE REVIEW

The concept of Smart Contracts (SCs) and Artificial Intelligence (AI) integration is a new paradigm in the field of automated digital agreements, which requires a specific analysis of its implementation, a concept of trust the new algorithm is supposed to solve, and a transparency mechanism that is offered by Explainable AI (XAI) (Adeyeri 2024).

Smart Contract Applications in E-commerce and Real Estate Escrow

SCs have become disruptive in high-value, trust-intensive sectors, especially in automating those transactions historically dependent on central 3rd-party intermediaries (Hua 2019). The most common use of SCs in e-commerce is as an automated, decentralised alternative to traditional payment systems to simplify payment transactions, enforce contractual agreements, and eliminate fraud, chargebacks, and delays (Ouyang, Yuan and Wang (2022). It is essential in regard to automated escrow services, in which money is deposited, and released only after the fulfillment of specified, mutually-agreed-upon criteria, which increases security and efficiency in transactions (Tolamise, 2025).

In addition to e-commerce, the real estate industry has also been able to use SCs to settle property deals using automation and high security (Olumide 2024). The applications of SC are ever-growing, and frameworks that will encompass the automation of escrows and recognition of the supply chains by sophisticated technologies, including Non-Fungible Tokens (NFTs) and IoT-based supply chain verification, are already being developed, including the ones that are implemented in the automotive sector (Archana, Singh and Alotaibi 2026). The natural construction of SCs, consequently, puts them in a central position of securing digital transactions in both consumer and industrial markets (Ouyang, Yuan and Wang 2022).

Trust in Blockchain and Decentralized Systems

In its simplest form, blockchain technology offers a system to build trust without having an intermediary (Ait, Laaz and Mbarki 2025). SCs are autocoded, autoprovable and entrenched in the blockchain, a decentralised and unchangeable record. This architecture removes the possibility of trusted third-party systems and will result in fewer administrative costs and risks related to security (Dai et al., 2022).

Nevertheless, transfer of interpersonal trust (at a bank or lawyer) to systemic trust (at the code) brings new difficulties (Gupta et al., 2020). Although the ledger is open, the code logic behind the ledger is frequently obscure and difficult to understand for a typical user, and this introduces a big black box issue (Hong, Zhang and AghaKouch 2022). This irrelevant transparency is a direct detriment to perceived trust, which is one of the most important barriers to mass market adoption (Gupta et al., 2020). Since the use of AI is extending to code optimisation and automatic dispute resolution, its sophisticated algorithmic decision-making only exacerbates the need to have accountability and transparency (Vijay, 2025; Misbah et al., 2025).

Explainable AI (XAI) in Increasing Transparency in Automated Decision-Making

The new area of XAI provides a solid remedy to the black box problem of the complex SC and AI integrations. XAI aims at creating models and methods that would generate human-understandable results and therefore make algorithmic decisions transparent and responsible (Akpan et al., 2024).

Within the framework of smart contracts, AI is becoming a crucial component of the lifecycle, with the mention of multimodal representation to identify security vulnerabilities (Upadhya et al., 2024) being used to monitor behaviour and govern diligently in virtual environments through the use of Natural Language Processing (NLP) models (Facklasur et al., 2024). Since AI is assigned very important tasks, e.g., paying a bill or identifying a fraud case, it is the capacity to provide reasons why a choice has been made that is most critical (Abbaszade, Naeemi and Kohani 2025). The frameworks to combine SCs with XAI, including the ones used in cybersecurity with Zero Touch Networks (ZTN), make use of explainability tools such as SHapley Additive exPlanations (SHAP) (Kumar et al., 2024). Through a systematic combination of the XAI principles, opaque, automated judgements of an SC-based escrow system may be transformed into transparent, verifiable, and understandable results, which deal directly with consumer distrust and enhance market trust (Desai et al., 2024).

METHODOLOGY

The study was geared towards the synthesis of the existing information that would support the suggested hypothesis on XAI and SC adoption; therefore, a qualitative and systematic method that involves the use of secondary data was adopted. This was the suitable methodology to conduct an extensive review of the literature and come up with actionable insights without developing any primary data. The research was carried out in two primary steps: To find relevant secondary data, a systematic review was carried out in academic databases (IEEE Xplore, ScienceDirect), in industry reports, and in credible media sources on FinTech/blockchain. The search strategy included publications published in the past 20 years, and keyword searches included:

AND "consumer trust" AND "America" AND "Explainable AI" AND "financial services" "Decentralized escrow" AND "market penetration" AND "Blockchain transparency" AND "user perception" Three types of documents were put in priority in the selection process:

***Market Research & Reports*:** The documents offered quantitative information about FinTech and DeFi and adoption rates market size, and market behaviour.

***Consumer Surveys*:** These were direct surveys that measured user sentiment, skepticism, or trust in blockchain, smart contracts and systems powered by AI.

***Case Studies*:** These were actual applications of SC-based or AI-enhanced financial services (lending, insurance, escrow) that concentrate on the recorded result(s) of security attack(s), transaction velocity, or user response.

Categorization of Findings Based on Key Metrics

The systematic review allowed extracting all the relevant information that was then categorised and analysed by means of three fundamental

metrics that affected the adoption of FinTech and helped to resolve the issue of the black box:

Security: This measure entailed evaluating the results in terms of the quantity and the severity of the smart contract vulnerabilities, the effectiveness of AI-based security systems (QuadraCode AI detecting the vulnerabilities), and the indication of the reduction of the fraud compared to the conventional systems.

***Transparency*:** The category evaluated data points that were a measure of access to, and understanding of, SC logic and AI decision-making by users. Among the high-transparency results, the positive impact of XAI tools (SHAP) on the understanding of the user was identified, and low-transparency results supported the presence of the so-called black box problem and its relationship with user hesitancy (Hong, Zhang and AghaKouchak 2022).

Cost-Efficiency: This measure entailed the classification of data on the cost structure of the decentralised services. This covered the results of administrative cost-cutting (Dai et al., 2022), the effects of optimised SCs (Gamage, 2025) on the gas/transaction fees, and the general economic benefit over the centralised escrow services.

This classified analysis gave the empirical foundation of hypothesis validation of finding a distinct relationship between system design factors (XAI, SCs) and vital market adoption measures (trust, security, Cost).

RESULTS AND DISCUSSION

The synergy between Explainable AI (XAI) and Smart Contracts (SCs) can be used to address the core barriers to the adoption of decentralised finance. The following discussion relying on the synthesis of the current market reports and research findings demonstrate that the market penetration is directly influenced by the transparency and clarity as promoted by the XAI.

Correlation between Transparency and User Adoption

The recent market data from various sources suggests that transparency has ceased to be the secondary attribute but is the primary cause of consumer behaviour in digital finance:

Purchase Driver: Trust: It has been reported that consumers in their dealings with digital businesses make trust an even more important priority; consumers tend to spend more with a brand they trust (Qualtrics, 2025).

Transparency as a Trust Catalyst: Transparent SC-based insurance experienced considerable changes in the adoption rate in the emerging markets due to accessible information on the automated payout terms available in a publicly available ledger (Abayomi et al., 2025).

Negative Effect of Opacity: The decrease of the trust in digital services has become a global issue, with no industry achieving the most significant level of approval (over 50 cent) of the transparency of data and decisions making. This highlights the issue of the black box described by Shafik (2026), in which black box code logic reduces trust.

Efficiency Gains: Automated systems with transparency have the potential to cut operation costs in different sectors of industries through manual verification (Desai et al., 2024).

XAI implementation in the Escrow Process.

In a bid to align systemic trust (code-based) and perceived trust (user-based), XAI needs to be incorporated in particular phases of the escrow lifecycle to gain consumer trust:

The logic of Execution and Cancellation Explanation.

Although the SCs provide the logic of if-this-then-that, the binary characteristic of the code can be inefficient in providing the rationale to a non-technical consumer. Clarity of execution In an e-commerce or real estate escrow, XAI can convert the complex data points, including the delivery verification through IoT, into a format that can be read and understood by humans. As an example, instead of a generic message about the release of funds, an XAI-enhanced dashboard will be able to describe the exact reasons behind the fulfilment of conditions.

***Dispute Resolution and Cancellation*:** XAI can be essential in eliminating the possibility of automation bias and frustration among users in situations when a contract is terminated. XAI models are able to give a disaggregation of the failure that occurred, e.g., a fraud risk anomaly was detected, or a failure in parametric conditions (weather data did not exceed a threshold to get an insurance payment). The results confirm the postulation that XAI provides the requisite mechanism of facility to adopt mass SC. According to Kumar et al. (2024), the erosion of trust is due to the complexity of the code language. XAI is explicitly the opposite of this; it transforms black-box decisions made by algorithms into responsibilities. XAI allows saving money on legal intermediaries that can be costly. It has been reported that SC implementations may cut down operational costs and settlement times in capital markets by a great deal (McKinsey & Company, 2024). New regulations insist on the fact that companies have to provide explicit pricing and decision information. It is these human-centric regulatory requirements that XAI enables decentralised escrows to fulfil and maintain technical efficiency. The integration will support the requirement of transparent and verifiable outputs to be understood by the user and comply with the regulations (FCA, 2025; Trawnih et al., 2025).

CONCLUSION

This systematic review confirms the thesis statement that the strategic combination of Explainable AI (XAI) and Smart Contracts (SCs) is the key to ensuring that a consumer will no longer be sceptical and that the mass-market will be quickly ready to start using decentralised escrows and financial services. As market data show, consumer trust is the key to purchase intention, and the actual lack of transparency embedded in the SC code, namely, the so-called black box problem, is a serious obstacle to its development (Bathaee, 2018).

XAI is the direct antipode to the "black box" phenomenon since it transforms an unclear decision made by complex algorithms into a transparent and understandable explanation (Kumar et al., 2024). This execution visibility plays a crucial role in the escrow lifecycle and especially at the point of crucial events such as the release of funds or cancellation of the contract.

The XAI-SC framework is not only human-focused in terms of regulatory compliance (FCA, 2025; Taherdoost, 2022), but also economical. It saves on the expensive legal intermediaries by creating clarity and the process of dispute resolution becomes more straightforward, which can help save a lot of money on operations (McKinsey and Company, 2025).

Implications for Product Marketing Managers (PMMs) in Escrow Space.

In the case of a PMM of a decentralised escrow application, such as Payluk, the findings change the value proposition and marketing strategy of the product fundamentally. The fundamental marketing message has to shift to verifiable trust (user benefit) as opposed to the promotion of decentralisation (technical feature). The blockchain ledger should not be marketed by the PMMs; it is the XAI-enabled dashboard that should be marketed, as it shows clearly why the money was released or why the transaction was flagged. Most effective marketing content must be centred on frictional and anxious moments. The PMM should emphasise the explanation available via the XAI: the reason behind every Escrow Decision: Know Exactly Why: Every Escrow Decision Comes with a Verifiable Reason. This directly responds to the anxiety of automation bias and frustration on the part of the user in case of a cancellation. The cost-efficiency and regulatory alignment advantage (cutting of the cost of operation and adherence to the conditions of transparency) should be used with the targets of B2B or institutional customers (real estate companies, large e-commerce solutions). The product is not only being sold as a technology but also as a compliance tool reducing long-term legal overheads. XAI tools should be a fundamental investment in a product. The task of the PMM is to make the technical output simplified in terms of clear non-technical language to the end-user. The product will be successful depending on the ease with which a complicated explanation is read.

Future Work

Further studies need to be conducted in the area of primary data collection, i.e., controlled experiments, to determine user behaviour. This involves A/B testing of escrow interfaces (one which has XAI explanations and one which does not) to measure the exact growth in the number of users who report feeling more trustful, the rates at which transactions complete, and the decrease in the number of customer support requests when dealing with a transaction dispute. Additional discussion of the legal and jurisdictional issues of implementing XAI-generated explanations to international dispute courts would also be essential to implement on the mass-market level.

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