



Security Assessment Framework for Smart Card Users: A Survey-Based Risk Scoring Model for Enhanced Forensic and Cybersecurity Applications

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Abstract

Smart card technology has become integral to secure authentication and identity management across various sectors including finance, healthcare, and public services. Despite their widespread implementation, smart cards remain vulnerable to both technical threats and user-related security lapses. This study evaluates the level of user awareness and behavioural security practices among smart card users through a structured questionnaire administered to 100 participants. A risk scoring model was developed to classify users into low, moderate, and high-risk categories based on their responses. The results indicate that while the majority of users apply basic authentication measures such as PINs, a significant proportion lack awareness of key threats and do not employ multi-factor authentication. These findings underscore the need for enhanced user education, stricter organisational policies, and improved authentication mechanisms. The study contributes to existing literature by proposing a practical user-centric risk assessment framework and highlights its relevance in forensic investigations involving identity fraud and unauthorised access.

Keywords:

Smart card security, user awareness, authentication practices, risk assessment, forensic analysis, cybersecurity

1. Introduction

Smart cards have emerged as a pivotal element in modern authentication systems, offering convenience, speed, and security in a variety of applications [1]. From electronic payments to personal identification, smart cards facilitate protected access to sensitive resources. Their embedded microprocessors and cryptographic capabilities make them more secure than traditional magnetic stripe cards. However, their increasing adoption also brings heightened exposure to a range of cybersecurity threats [2].

While considerable advancements have been made in securing smart card hardware and communication protocols, the human element remains a significant vulnerability [3]. Users may unknowingly weaken the security posture of smart card systems through poor practices such as PIN reuse, failure to implement multi-factor authentication (MFA), or careless storage of the cards [4]. In many cases, organisational policies are either poorly communicated or inconsistently enforced, exacerbating these risks [5].

This study focuses on bridging the gap between technical smart card security and user behaviour. It aims to assess the level of awareness and common usage patterns among smart card users through a structured, survey-based approach. Using the data collected, a risk scoring model is proposed to classify users based on their likelihood of being compromised. The model not only identifies high-risk behaviours but also provides a foundation for tailored recommendations. Importantly, the study highlights the role of such assessments in forensic investigations where understanding user vulnerability can aid in attributing identity misuse or fraud [6].

2. Materials and Methods

2.1 Research Design

The research adopted a quantitative approach through the deployment of a structured questionnaire [7]. The survey assessed user awareness of smart card threats, authentication practices, storage behaviours, and perceptions of security.

2.2 Sampling Method

Purposive sampling was used to select 100 smart card users across various sectors such as banking, government ID systems, and corporate access control [8].

2.3 Inclusion and Exclusion Criteria

Inclusion: Smart card users above 18 years of age actively using the cards for transactions or identification.
Exclusion: Non-users and incomplete responses were not considered.

2.4 Survey Instrument

The questionnaire included sections on demographics, awareness, usage habits, authentication methods, and perceived security. Data was collected anonymously to ensure privacy [4].

2.5 Risk Scoring Model

Responses were assigned weighted scores based on predefined risk indicators (e.g., no PIN, no MFA, shared cards). The total score placed users in low, moderate, or high-risk groups [9].

2.6 Data Analysis

Descriptive statistics were used to calculate the prevalence of key behaviours. Risk scores were computed and analysed for correlations between awareness, habits, and risk level [7].

3. Results

Among 100 participants:

- 60% always used PINs, 30% sometimes, 10% never.
- 50% used MFA, 20% didn't know what it was, and 30% never used it.
- 20% had RFID-blocking wallets; 80% stored cards in pockets or desks.
- Risk categorisation: 30% low-risk, 50% moderate-risk, 20% high-risk [10].

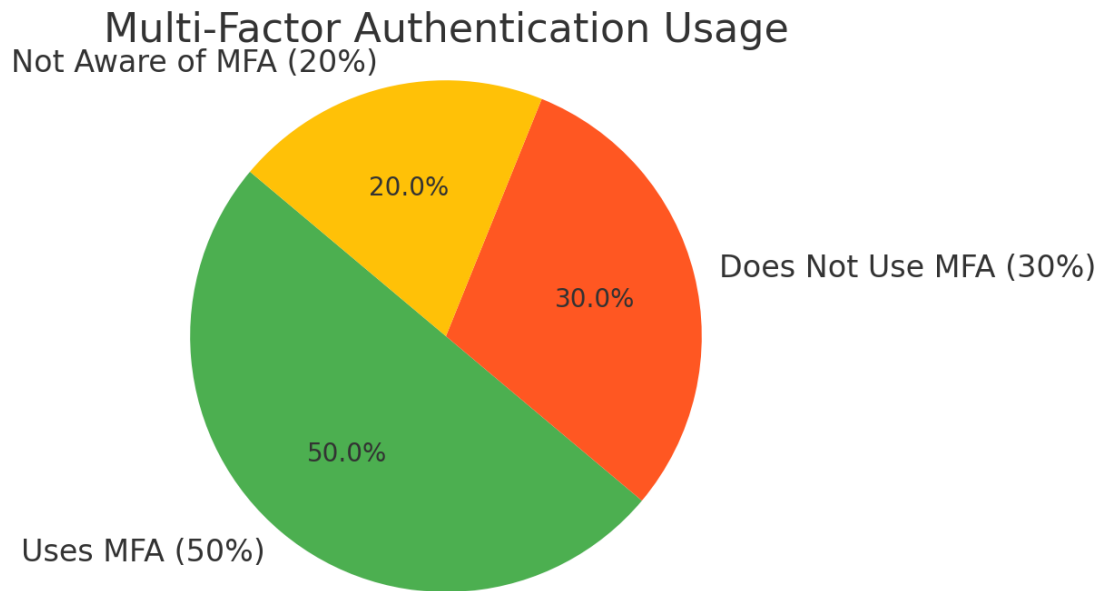


Figure 1: Multi-Factor Authentication Usage among Participants

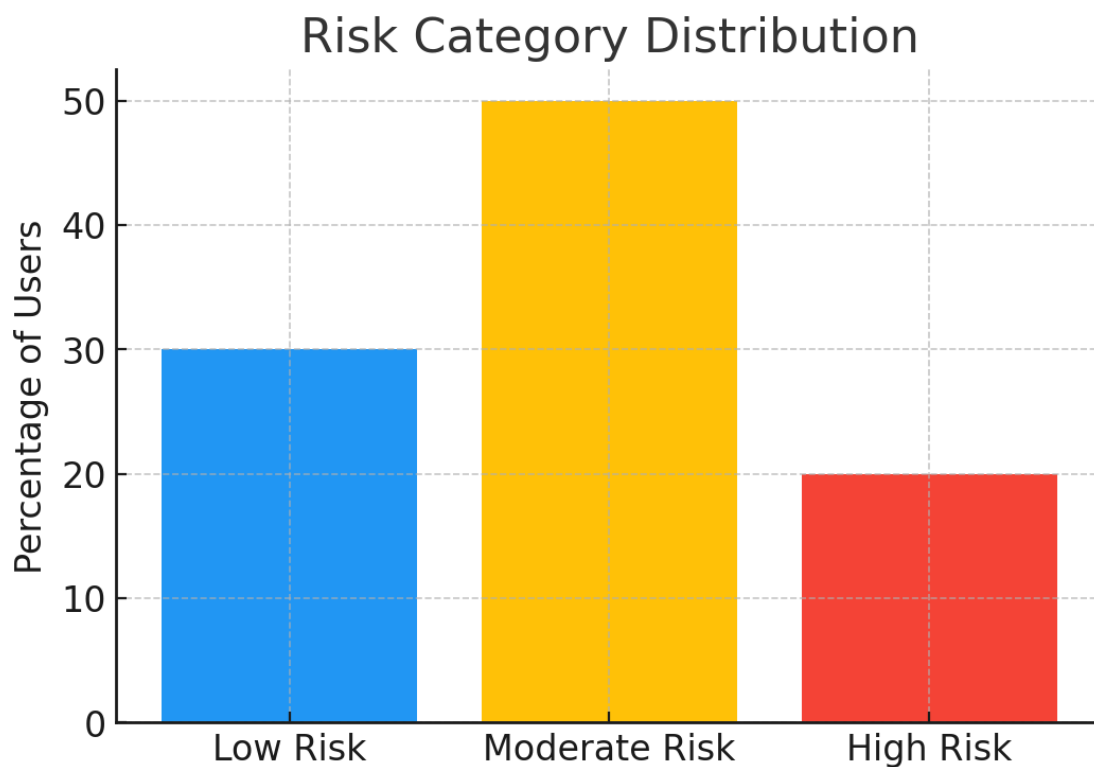


Figure 2: Distribution of Participants by Risk Category

4. Discussion

The results demonstrate that while basic security measures like PINs are in use, there is a considerable lack of awareness around MFA and safe storage practices [11]. High-risk users often showed poor handling behaviour and shared card information. These patterns align with earlier studies that describe user negligence as a primary vulnerability in smart card ecosystems [3]. The proposed risk scoring model successfully identified such users and can be applied in corporate and forensic settings [6].

5. Conclusion

This study shows that user behaviour significantly influences smart card security. The null hypothesis, which proposed no relationship between user practices and risk, is rejected. The alternative hypothesis is accepted: there is a clear correlation between poor practices and increased vulnerability [7]. The survey-based scoring framework developed here allows for early identification of high-risk individuals and provides actionable insights for organisations and forensic analysts [10].

6. Limitations

- The study is limited to 100 participants and may not represent global usage.
- Self-reported data may contain bias.
- No technical validation of smart cards was conducted.
- Limited geographic diversity among respondents.
- Did not analyse organisational security policy enforcement.
- Risk model weights are empirically defined, not standardised.
- Only current card users were surveyed; lapsed users were excluded.

7. Applications in Forensic Science

- Smart card behaviour profiling can support digital identity forensics.
- Risk scores can flag compromised users during breach investigations.
- PIN sharing and MFA lapses provide evidentiary support in cybercrime cases.
- Survey tools can aid forensic interviews and user verification.
- Storage behaviour analysis helps reconstruct physical compromise.
- Risk models may inform courtroom reporting for digital evidence authentication.
- Forensic validation of access logs improves attribution accuracy.

8. Scope of the Study

- Can be expanded across institutions and nations for comparative analysis.
- Integration with biometric and blockchain authentication systems is possible.
- Risk model can be standardised for commercial deployment.
- Future studies may use AI to automate user risk classification.
- Could inform e-governance and public sector ID policies.
- Behavioural training modules can be designed from this framework.
- Potential to integrate with zero-trust security architectures.

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