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BEHAVIORAL FACTORS OF CUSTOMERS AS A TOOL FOR RISK MANAGEMENT IN THE USE OF BANK CARDS

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ABSTRACT. This study examines the influence of customer behavioral factors on the risks associated with bank card usage in the context of the digitalization of banking services. Particular attention is paid to customers' financial literacy and cybersecurity awareness, bank card usage patterns, responses to suspicious messages and links, and compliance with security requirements when conducting digital transactions. Statistical and correlation analyses are employed to assess the relationship between customers' awareness levels and their behavior in potentially fraudulent situations. The findings identify key behavioral factors contributing to card-related risks and provide recommendations for improving risk management mechanisms by incorporating customer behavioral characteristics into the monitoring and prevention of fraudulent transactions.

Keywords: behavioral factors, bank cards, financial risks, card fraud, financial literacy, cybersecurity, digital payments, social engineering.

ANNOTATSIYA. Bank xizmatlarini raqamlashtirish sharoitida mijozlarning xulq-atvor omillarining bank kartalaridan foydalanish bilan bog'liq risklar darajasiga ta'siri tadqiq etilgan. Mijozlarning moliyaviy savodxonligi va kiberxavfsizlik bo'yicha xabardorligi, bank kartalaridan foydalanish xususiyatlari, shubhali xabarlar va havolalarga munosabati, shuningdek, raqamli operatsiyalarni amalga oshirishda xavfsizlik talablariga rioya etish darajasiga alohida e'tibor qaratilgan. Statistik va korrelyatsion tahlil usullari asosida mijozlarning xabardorlik darajasi hamda ehtimoliy firibgarlik holatlaridagi xulq-atvori o'rtasidagi o'zaro bog'liqlik baholangan. Tadqiqot natijalari asosida bank kartalaridan foydalanish bilan bog'liq risklarning yuzaga kelishiga ta'sir etuvchi asosiy xulq-atvor omillari aniqlangan hamda firibgarlik operatsiyalarini monitoring qilish va ularning oldini olish jarayonlariga mijozlarning xulq-atvor xususiyatlarini integratsiya qilish orqali risklarni boshqarish mexanizmlarini takomillashtirish bo'yicha tavsiyalar ishlab chiqilgan.

Kalit so'zlar: xulq-atvor omillari, bank kartalari, moliyaviy risklar, bank kartalari bilan bog'liq firibgarlik, moliyaviy savodxonlik, kiberxavfsizlik, raqamli to'lovlar, ijtimoiy muhandislik.

АННОТАЦИЯ. В условиях цифровизации банковских услуг исследуется влияние поведенческих факторов клиентов на уровень рисков, связанных с использованием банковских карт. Особое внимание уделяется финансовой грамотности и осведомлённости клиентов в области кибербезопасности, особенностям использования банковских карт, реакции на подозрительные сообщения и ссылки, а также соблюдению требований безопасности при проведении цифровых транзакций. На основе статистического и корреляционного анализа оценивается взаимосвязь между уровнем осведомлённости клиентов и их поведением в потенциально мошеннических ситуациях. По результатам исследования выявлены ключевые поведенческие факторы, способствующие возникновению рисков при использовании банковских карт, и разработаны рекомендации по совершенствованию механизмов управления рисками посредством учёта поведенческих характеристик клиентов в процессах мониторинга и предотвращения мошеннических транзакций.

Ключевые слова: поведенческие факторы, банковские карты, финансовые риски, мошенничество с банковскими картами, финансовая грамотность, кибербезопасность, цифровые платежи, социальная инженерия.

INTRODUCTION

In the context of the accelerating digitalization of the financial sector, customer behavioral factors are becoming increasingly significant in the formation of risks associated with the use of bank cards. The expansion of cashless payments, mobile and internet banking, remote banking services, and electronic payment instruments enhances the convenience and accessibility of banking services while simultaneously increasing the importance of the human factor in ensuring the security of financial transactions. Contemporary research on fraud detection also emphasizes the need for continuous transaction analysis and the adaptation of control methods to changing behavioral patterns among users and fraudsters.

For the Republic of Uzbekistan, this issue is particularly relevant due to the rapid expansion of digital banking channels. According to the Central Bank of the Republic of Uzbekistan, as of October 1, 2025, the number of registered users of remote banking systems reached 74.18 million, of whom 72.49 million were individuals. The growth in the number of users of digital banking services indicates an increase in the number of transactions independently conducted by customers through mobile applications and other remote banking channels.

Under these conditions, customers become not only consumers of banking services but also direct participants in ensuring their security. Behavioral characteristics, such as the level of financial literacy, knowledge of cybersecurity rules, the ability to recognize phishing messages and suspicious links, compliance with banking security requirements, and the willingness to disclose card details and authentication codes to third parties, may significantly influence the likelihood of fraudulent transactions.

The issue of social engineering is of particular importance. In such cases, fraudsters directly influence customers and encourage them to perform certain actions independently, such as clicking on malicious links, disclosing confidential information, or confirming unauthorized transactions. Therefore, the management of card-related risks requires consideration not only of the technical characteristics of transactions but also of users' behavioral characteristics.

For the banking sector of Uzbekistan, the need for such an approach is also associated with the development of mechanisms for combating fraud. The Central Bank is improving information and cybersecurity mechanisms and developing tools to counter fraudulent transactions in digital financial services. Under these conditions, the consideration of customer behavioral characteristics can serve as an additional component of an early-warning system for potentially risky transactions.

At the same time, digitalization does not automatically eliminate risks. The increasing number of remote transactions further emphasizes the importance of appropriate user behavior. Even when technical protection mechanisms are in place, risks may persist if customers voluntarily disclose confidential information or confirm transactions without verifying their authenticity. Therefore, improving the financial and cybersecurity literacy of the population should be considered alongside the technological development of banking systems.

The relevance of this study is determined by the need to develop a more comprehensive approach to risk management in bank card transactions, in which customer behavior is considered one of the factors in risk assessment. The use of information on habitual transaction patterns, payment frequency and timing, geographical characteristics, devices used, and user actions makes it possible to identify deviations from normal behavioral patterns and generate additional signals for transaction monitoring systems.

The purpose of this study is to determine the influence of customer behavioral factors on the level of risks associated with the use of bank cards and to develop approaches to improving risk management by taking users' behavioral characteristics into account.

To achieve this objective, the study addresses the following tasks: identifying the main behavioral factors influencing the occurrence of risks in card transactions; examining the relationship between customers' levels of financial and cybersecurity literacy and their behavior in potentially fraudulent situations; identifying the main forms of risky behavior among bank card users; and determining the possibilities of using behavioral indicators in card transaction monitoring systems.

The object of the study is the process of risk management in transactions conducted using bank cards. The subject of the study comprises customer behavioral factors and their relationship with the occurrence of financial and fraud-related risks associated with the use of bank cards.

The scientific significance of the study lies in developing approaches to card-related risk management through the comprehensive consideration of the financial, technological, and behavioral characteristics of transactions. Its practical significance lies in the potential application of the research findings by commercial banks to improve anti-fraud systems, transaction monitoring, financial literacy programs, and customer awareness initiatives concerning bank card security.

LITERATURE REVIEW

The issue of risk management in the use of bank cards is examined in contemporary academic literature at the intersection of finance, banking risk management, cybersecurity, behavioral economics, and data analysis. In recent years, particular attention has been paid to the fact that, with the expansion of digital payments, fraud risks arise not only from technological vulnerabilities but also under the influence of user behavior.

Among the fundamental researchers in the field of financial fraud detection are R. J. Bolton and D. J. Hand, who, in their study entitled "Statistical Fraud Detection: A Review," systematized statistical and machine-learning methods for detecting fraudulent transactions. The authors distinguish between fraud prevention and fraud detection and emphasize that fraudsters adapt their behavior to existing control mechanisms. Therefore,

detection systems need to be continuously improved and should account for changes in the behavioral patterns of participants in financial transactions [1].

An important area of research is associated with the use of data mining techniques. S. Bhattacharyya, S. Jha, K. Tharakunnel, and J. C. Westland investigated the application of data mining methods to credit card fraud detection. Their study demonstrates the potential of classification algorithms to distinguish between legitimate and fraudulent transactions. This approach is particularly important for modern banking systems, where the volume of transactions makes effective monitoring through traditional methods alone increasingly challenging [2].

Another research direction focuses on customer behavior as a source of information for risk assessment. This approach analyzes not only the transaction itself but also deviations in users' current actions from their normal behavioral patterns. Such characteristics include transaction frequency, payment timing, changes in the geographical location of card usage, the device being used, and other behavioral parameters.

A related approach is presented in the study by M. T. Kurbonbekova and S. T. Mashrapova, which focuses on enhancing the cybersecurity of plastic card transactions in the "My Card" mobile application. The authors used survey data from 520 users, as well as statistical analysis, correlation analysis, and machine-learning methods. The study considers transaction frequency, changes in geographical location, and identification of the device used as digital behavioral indicators. The authors demonstrate the potential of using such parameters to detect anomalous transactions in real time [3].

From a theoretical perspective, the behavioral approach makes it possible to expand the traditional model of banking risk management. While conventional monitoring focuses primarily on transaction amounts, timing, location, and other transaction parameters, behavioral analysis additionally assesses whether a transaction is consistent with the customer's individual profile. For example, a sudden change in payment geography, the use of a new device, an unusually high transaction frequency, or a change in habitual spending patterns may be considered additional indicators of elevated risk.

Thus, the analysis of the academic literature demonstrates a gradual transition from purely transaction-based control toward comprehensive risk-oriented monitoring that combines transactional, technological, and behavioral data. While international research has primarily focused on fraud detection algorithms and machine learning, it is particularly relevant for Uzbekistan to study the relationship between financial literacy, cybersecurity awareness, customer behavior, and the occurrence of risks associated with the use of bank cards.

Based on the reviewed literature, it can be concluded that existing studies provide a methodological foundation for assessing behavioral factors. However, further quantitative research into customer behavior within the banking system of Uzbekistan remains necessary. This defines the direction of the present study, in which behavioral characteristics are considered not only as factors contributing to the emergence of risks but also as tools for their early detection and management.

RESEARCH METHODOLOGY

The study employs statistical, comparative, and correlation analysis methods. The empirical basis of the study consists of the results of a survey of 520 bank card users. The analysis examines customers' levels of financial and cybersecurity literacy, their responses to suspicious messages and links, and their compliance with security rules when using bank cards. The Pearson correlation coefficient was used to determine the relationship between behavioral factors and the level of risk. In addition, official statistical data from the Central Bank of the Republic of Uzbekistan were used.

ANALYSIS AND RESULTS

To assess the role of behavioral factors in risk management when using bank cards, data from a survey of bank card users and official information from the Central Bank of the Republic of Uzbekistan were examined. When interpreting the results, the data from the empirical study were distinguished from official statistics, since the latter characterize the banking sector as a whole and cannot be directly used as indicators of individual customer behavior.

As part of the empirical study, a sample of 520 bank card users was used. The questionnaire examined customers' responses to common situations associated with card fraud, including receiving suspicious SMS messages and links, attempted logins from unknown devices, requests for confidential information, and cases of social engineering. A similar sample of 520 users was used in a study on the cybersecurity of plastic card transactions in the "My Card" mobile application [4].

Table 1

Structure of Identified Risky Situations Among 520 Respondents¹

Type of risky situation	Number	Share, %
Suspicious SMS messages and links	212	40.8
Login from an unknown device	86	16.5
Request for or disclosure of user data	74	14.2
Social engineering	110	21.2
Other situations	38	7.3
Total	520	100.0

The largest share of responses was associated with suspicious SMS messages and links, accounting for 40.8%. This indicates that phishing messages represent one of the most common channels through which customers may encounter potential risks. The second-largest category comprised situations involving social engineering, accounting for 21.2%. At the same time, these indicators reflect the responses of the study participants rather than the official distribution of fraud cases across the entire banking system of Uzbekistan.

An important finding is the relationship between users' knowledge and their behavior. According to the correlation analysis, the correlation coefficient between customers' level of cybersecurity knowledge and their responses to potential threats was $r = 0.62$ ($p < 0.01$). This value indicates a statistically significant positive relationship between the variables within the study sample.

In addition, the correlation between customers' understanding of bank warnings and the correctness of their actions in potentially fraudulent situations was $r = 0.54$ ($p < 0.01$). Thus, within the study sample, a higher level of understanding of bank warnings was associated with safer customer behavior. However, correlation does not establish a causal relationship; therefore, this result should be interpreted specifically as a statistical association.

The findings are consistent with studies in which behavioral characteristics are considered an additional source of information for identifying suspicious transactions. In particular, M. A. Ubaydullayeva emphasizes the need to integrate user behavioral parameters into banking transaction monitoring systems. The study by M. T. Kurbonbekova and S. T. Mashrapova also considers transaction frequency, changes in geographical location, and characteristics of the device used as behavioral indicators that can be applied to the detection of anomalous transactions [3].

The survey results should also be considered in the context of the situation concerning card fraud in the country. According to the 2025 Annual Report of the Central Bank of the Republic of Uzbekistan, in 2024, as a result of measures taken in response to citizens' complaints concerning bank card fraud, funds amounting to UZS 9.5 billion were blocked. In addition, the Central Bank received 2,502 requests from law enforcement agencies for information constituting bank secrecy in cases of fraud related to bank cards.

At the same time, the Central Bank is implementing measures aimed at improving the financial and digital literacy of the population. In 2024, financial literacy projects, including digital financial literacy programs, were implemented jointly with commercial banks. In 2025, educational programs were expanded to 71 remote districts, with particular attention paid to digital financial literacy and raising public awareness of cybersecurity [5].

Thus, the results of the study indicate that customer behavior can be considered an additional factor in managing card-related risks. In practical terms, this means that, when improving anti-fraud systems, it is advisable to consider not only the amount, timing, and location of a transaction but also changes in the user's habitual behavioral patterns, characteristics of the device being used, and the customer's response to bank warnings. Such an approach can complement technical transaction controls with behavioral analysis.

At the same time, the findings cannot be generalized to all bank card users in Uzbekistan without additional research based on a representative sample. Therefore, the reported figures of 40.8%, 21.2%, 16.5%, and other indicators should be interpreted exclusively as results from the research sample of 520 respondents rather than as official statistics for the banking sector.

The results also demonstrate the importance of combining technological measures with customer education. Improving cybersecurity awareness may help reduce the likelihood of customers disclosing confidential information, following suspicious links, or confirming unauthorized transactions. Consequently, financial and cybersecurity literacy should be considered an integral component of the broader risk management system.

The findings are also relevant in the context of the development of digital banking in Uzbekistan. The

¹ Source: Compiled by the author based on the results of a survey of 520 users.

growing number of remote banking users increases the importance of systems capable of identifying unusual behavior at an early stage. Therefore, banks can use behavioral indicators alongside traditional anti-fraud parameters to improve the accuracy of risk assessment and reduce the likelihood of both fraudulent transactions and unnecessary blocking of legitimate customers.

Nevertheless, the results have several limitations. The survey included 520 respondents and, therefore, cannot automatically be considered representative of all bank card users in Uzbekistan. In addition, correlation analysis identifies statistical associations but does not establish causal relationships. Further research should, therefore, use larger and more representative samples and, where possible, longitudinal transaction data from banking systems.

Overall, the analysis demonstrates that customer behavior can serve as an additional source of information for managing card-related financial risks. The integration of behavioral indicators into anti-fraud systems can strengthen early detection mechanisms, particularly when behavioral, transactional, technological, and security-related characteristics are analyzed jointly.

CONCLUSION AND RECOMMENDATIONS

The study examined the influence of customer behavioral factors on the risks associated with bank card usage in the context of the digitalization of banking services. The findings indicate that customers' financial literacy, cybersecurity awareness, responses to suspicious messages and links, and compliance with security requirements are important factors to consider when assessing and managing card-related risks. The results also highlight the potential of integrating behavioral indicators into existing transaction monitoring and fraud prevention mechanisms.

The analysis of survey data from 520 bank card users identified suspicious SMS messages and links as the most frequently reported category of risky situations, accounting for 40.8% of responses. Social engineering accounted for 21.2%, followed by attempted logins from unknown devices (16.5%), requests for or disclosure of user data (14.2%), and other situations (7.3%). These findings describe the distribution of responses within the study sample and should not be interpreted as representative statistics for the entire banking sector of Uzbekistan.

The correlation analysis revealed a statistically significant positive relationship between customers' cybersecurity knowledge and their responses to potential threats ($r = 0.62$, $p < 0.01$). A statistically significant positive relationship was also identified between customers' understanding of bank warnings and the correctness of their actions in potentially fraudulent situations ($r = 0.54$, $p < 0.01$). These results indicate that higher levels of cybersecurity awareness and understanding of security warnings are associated with safer customer behavior within the study sample. However, the identified relationships are correlational and do not establish causality.

The findings support the consideration of customer behavioral characteristics as an additional source of information for assessing card-related risks. Integrating behavioral indicators with transactional and technological parameters may contribute to the identification of unusual transaction patterns and the improvement of fraud prevention mechanisms.

Based on the findings, the following recommendations are proposed:

1. Commercial banks should consider incorporating behavioral indicators, including transaction frequency, payment timing, geographical characteristics, device identification, and deviations from customers' habitual transaction patterns, into existing fraud detection and transaction monitoring systems.

2. Financial institutions should strengthen customer awareness initiatives concerning phishing, social engineering, suspicious links, confidentiality of authentication codes, and the verification of transaction requests. Particular attention should be paid to improving customers' understanding of security notifications and their ability to respond appropriately to potentially fraudulent situations.

3. Banks should consider developing risk-oriented monitoring mechanisms that combine transactional, technological, and behavioral indicators. Such an approach may facilitate the identification of potentially suspicious transactions while supporting the appropriate verification of legitimate customer activities.

4. Financial and cybersecurity literacy programs should be further developed through cooperation between commercial banks and relevant institutions. Educational initiatives should focus on practical security skills, including the recognition of fraudulent messages, protection of confidential information, and safe use of digital banking services.

5. The effectiveness of behavioral risk indicators should be assessed through further empirical research using larger and more representative samples. Where possible, future studies should incorporate longitudinal transaction data and examine the relationship between customer behavior, cybersecurity awareness, and actual fraud-related outcomes.

The study contributes to the development of a comprehensive approach to card-related risk management

by emphasizing the importance of considering customer behavior alongside traditional transactional and technological risk indicators. The integration of behavioral analysis, customer education, and technological security mechanisms provides a basis for further improving fraud prevention and transaction monitoring practices in the banking sector of Uzbekistan.

REFERENCES

1. Bhattacharyya S. Data mining for credit card fraud: A comparative study / S. Bhattacharyya, S. Jha, K. Tharakunnel, J. C. Westland // *Decision Support Systems*. – 2011. – Vol. 50, No. 3. – P. 602–613. – DOI: [10.1016/j.dss.2010.08.008](https://doi.org/10.1016/j.dss.2010.08.008).
2. Bolton R. J. Statistical fraud detection: A review / R. J. Bolton, D. J. Hand // *Statistical Science*. – 2002. – Vol. 17, No. 3. – P. 235–255. – DOI: [10.1214/ss/1042727940](https://doi.org/10.1214/ss/1042727940). – URL: [Project Euclid — Article and Full Text](#).
3. Central Bank of the Republic of Uzbekistan. Annual Report of the Central Bank of the Republic of Uzbekistan for 2025 [Electronic resource]. – URL: [Central Bank of Uzbekistan — Annual Report 2025](#). – Bibliographic details and publication status require additional verification.
4. Kurbonbekova M. T. Enhancing cybersecurity of plastic card transactions in the “My Card” mobile application / M. T. Kurbonbekova, S. T. Mashrapova // *Innovation Science and Technology*. – 2025. – Vol. 1, No. 10. – DOI: [10.5281/zenodo.18859691](https://doi.org/10.5281/zenodo.18859691). – URL: [Innovation Science and Technology — Article](#).

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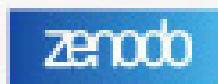
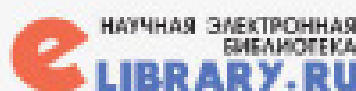
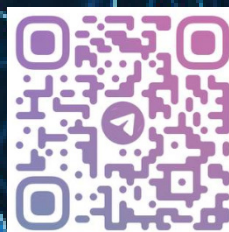
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