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# The identification of factors influencing the adoption of virtual banking and its consequences

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**Abstract**

In today's world, virtual services play a major role in commerce, including banking activities. Virtual banking is currently the most extensive and newest form of banking services, offering a wide range of services to customers. The present study was conducted to identify factors influencing the adoption of virtual banking and its consequences. This research is applied in terms of its purpose and is considered a descriptive survey study based on its type. It was conducted using a mixed-method approach (qualitative-quantitative). The statistical population of the qualitative section includes 14 academic and banking experts, consisting of experienced university professors and banking specialists from Tehran Province, selected through purposive sampling. In the quantitative section, 350 employees and 385 customers of Saderat Bank branches in Tehran Province were selected using cluster and convenience sampling, respectively. In this research, the tool for collecting qualitative data was semi-structured interviews, and the tool for collecting quantitative data was a researcher-designed questionnaire. Experts confirmed the questionnaire's face, construct, and content validity, and Cronbach's alpha coefficient was used to determine its reliability. This coefficient was calculated to be 0.976 for the research questionnaire, which is statistically acceptable. To validate the model in the quantitative section, structural equation modelling with a partial least squares (PLS) approach was used, through Smart PLS3 software. In the qualitative section, the data from the interviews, through open, axial, and selective coding, led to the development of a grounded theory in virtual banking adoption. The model designed in this study includes 36 subcategories within 6 main categories, demonstrating causal factors, contextual factors, intervening factors, core phenomena, strategies, and outcomes. In the quantitative section, the significance and standard coefficient of the model components were also confirmed for model validation.

Keywords: virtual banking, Iran's banking industry, grounded theory
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## 1 Introduction

Almost every decade, e-commerce capabilities are developed in line with the information technology of that era. While ATMs and credit cards became mainstream in the first two decades, the second era saw the introduction of electronic data interchange and international banking systems. However, in the third era, the development of the

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internet and its commercial applications not only brought about a fundamental transformation [15] but also led to the rapid growth of the banking industry. This is because it effectively helps banks serve their customers [3].

The evolution of electronic banking began with the use of ATMs, and Finland was the first country in the world to pioneer electronic banking services. As a result of this transformation and the expansion of technology, the business environment in the financial sector has become highly dynamic and has experienced rapid changes [39]. The development of electronic banking activities, accompanied by high levels of security and efficiency and low costs, based on information and communication technology, has led to the emergence of a new type of bank, known as the virtual bank, which is the latest model of banking. This model, as a substitute for traditional banking, is continuously expanding [27]. Virtual banks represent a new generation of banks that, by utilizing the latest advancements in information and communication technology, offer a wide range of banking services and products to the public without the need for physical branches [13].

However, any new technology must be localized according to the culture, traditions, and infrastructure of each country, while considering the needs and desires of the people to ensure its acceptance and increase customer satisfaction [18]. The adoption of this type of banking leads to significant economic benefits, such as reducing costs, increasing the profitability of banks, improving the quality of services provided to customers, overcoming time and place limitations, and expanding the scope of organizational activities [32]. Although the banking industry in Iran has made significant strides in utilizing electronic banking services over the past two decades, it still lags in the concept of virtual banking. Therefore, practical solutions and strategies are needed to design a model for the adoption of virtual banking and to facilitate its increasing appeal.

Currently, the Internet has become a vast platform for conducting commercial transactions and marketing, especially in banks. The use of Internet banking services, as one of the new achievements of the information age, has greatly transformed global trade and reshaped business rules, bringing significant advantages to business methods [41]. Online banking services have evolved due to advancements in information and communication technology in both developing and developed countries [31].

For the future development of any type of technology, users must accept and trust it. Acceptance refers to a positive decision to adopt an innovation [36]. The adoption of virtual banking is a crucial issue in the competitive banking environment that requires careful consideration. In recent years, various theories have been used to understand the factors influencing the acceptance and use of technology and Internet banking. Among them, the Technology Acceptance Model [10], the Theory of Reasoned Action [2], and the Theory of Planned Behavior [1] have been widely applied in research. These theories have been successfully used to predict technology acceptance behaviour [26]. The Technology Acceptance Model (TAM) is one of the most influential and widely used theories in examining information systems [5]. Numerous studies have employed TAM to investigate the acceptance of various electronic banking channels from the consumers' perspective and have made modifications and adjustments to it [21, 29]. Many researchers consider this model as a foundational framework and have expanded it by adding other variables depending on the technologies being studied [7]. Other prominent theories in this field include the Diffusion of Innovations Theory [30] and the Unified Theory of Acceptance and Use of Technology (UTAUT) [4], which are based on technology acceptance models. The customer acceptance process extends beyond perceived ease of use and perceived usefulness of technology, as well as ease of intention to accept [19]. Rogers' Diffusion of Innovations Theory [33] suggests that the adoption or acceptance of innovation grows slowly and gradually, followed by a period of rapid growth that is brief, then stabilizes, and eventually declines. This theory also considers the timing and attitude toward innovation [25]. Additionally, the acceptance of an innovation is considered a cognitive activity that develops over time. The attitude towards the innovation also influences its acceptance or rejection after it has been chosen. Rogers, in his Diffusion of Innovations Theory, states that potential users make decisions to accept or reject an innovation based on the beliefs they form about it. According to this theory, the formation of beliefs or acceptance of the innovation by the user occurs through five stages: knowledge, persuasion, decision, implementation, and confirmation [22]. Recently, researchers such as Karakara and Osabuohien [17], Mushtaq and Bruneau [24], Tchamyou, Erreygers and Cassimon [37], and Dhaggara, Goswami and Kumar [11] have examined the use of information and communication technology and the development of new technologies in the financial and banking industry. All emphasize the necessity of technology adoption in the banking sector. Therefore, banking policymakers must have accurate knowledge of the factors influencing users' decisions to use or not use technology. Understanding potential users' perspectives on adopting new technology can significantly facilitate its implementation and lead to the evaluation and prediction of user responses, optimal design and development, and effective future planning [16].

On the other hand, studies on the adoption of virtual banking have mostly relied on established technology acceptance models, as previously mentioned. For example, Sanaye'ei et al. [34] demonstrated that perceived benefits, trust, and government support impact the adoption of virtual banking, based on the Technology Acceptance Model

and its extensions. Kumari and Tharanga [20] found that the quality of online service delivery affects the adoption of virtual banking. Yavaran Bakshayesh and Badpa [40] confirmed the influence of attitude, subjective norms, and perceived behavioural control on the adoption of banking, based on the Theory of Planned Behavior. Previous studies have addressed the phenomenon of virtual banking adoption within limited categorizations of influencing factors and based on established technology acceptance models. There is a need to examine the phenomenon of virtual banking adoption more thoroughly, considering the factors mentioned in accepted technology acceptance models. This would involve identifying and discussing the factors influencing the adoption of virtual banking and the associated outcomes based on expert opinions, which is the aim of this research.

In Iran, the regulatory framework for establishing and operating virtual banks was provided with the approval of the relevant regulations in 2011 [28]. In recent years, the legislative sector for new banking services in Iran has been one of the most challenging areas of the banking industry, due to factors such as the activities and services of fintech companies, the emergence and proliferation of digital currencies, and banks' efforts to meet new user and business needs. However, regarding the licensing of virtual banks in Iran, only this single regulation has been approved. The Regulation for the Establishment and Operation of Virtual Banks was approved in the 1125th meeting of the Money and Credit Council on 2011.05.17, consisting of 61 articles and 15 notes. Even though more than 10 years have passed since the approval of this regulation, no license for the operation of virtual banks has been issued in Iran, except for one unsuccessful case (Arian Electronic Bank, Public Joint Stock). It might be said that a virtual bank, as a branchless bank, does not exist in Iran. However, the large number of banks that are intensely competing with each other offer many of their services electronically and virtually, with acceptable quality, through concepts such as mobile banking and internet banking. Therefore, potential future virtual banks in the Iranian market must clearly articulate their intended changes to create value in the current market conditions [35]. To develop a practical and innovative model for virtual banking in Iran, it is essential to examine user behaviour, as it is a crucial component of banking services in the country. This will enable the creation of a model for user acceptance of the system. Given that there has not yet been a comprehensive and localized study on virtual banking that is tailored to Iran's conditions, it can be claimed that the current research is among the first studies in this area, reflecting its innovation and novelty. Therefore, the question arises: What are the factors influencing the adoption of virtual banking and its outcomes?

## 2 Research methodology

In this study, semi-structured interviews were used to identify the factors affecting the adoption of virtual banking and its outcomes. The use of semi-structured interviews helped the interviewer obtain various realities from the interviewee, allowing the interviewee to express their opinions and views without being influenced by the interviewer's perspectives. Another goal of the expert interviews was to gain a better understanding of the research variables. The expert interviews were conducted with these two goals in mind, and to finalize the factors, a survey method involving experts (including university professors and specialists in banking management) was employed.

To validate and assess the applicability of the model within the target population, the designed model was tested in the relevant community. Scientific research is categorized based on its objective into three types: fundamental, applied, and developmental research. This study is classified as applied research because it aims to provide a model for the adoption of virtual banking. Given these aspects, this research is considered applied in terms of its objective and descriptive survey in terms of data collection. Given the paradigm and approach of this research, it consists of two sections: qualitative and quantitative. Each section will be conducted as follows:

The participants in the qualitative section include 14 experts from both the industry and academia who have substantial knowledge about virtual banking. This group was selected to identify the factors affecting the adoption of virtual banking and its outcomes, focusing on dimensions, components, and indicators, and to validate these factors. Purposive sampling was used to select this expert group for the qualitative phase. The criterion for determining the adequacy of the collected data and halting sampling is theoretical saturation, which means that the data no longer generates new or different categories or adds to the characteristics of existing categories. Based on previous experiences and commonly used approaches in grounded theory, it is suggested that theoretical saturation is typically achieved with between 20 to 30 samples, though this number is not fixed and may vary based on different factors. It is possible to reach theoretical saturation with fewer or more interviews [9]. In this study, theoretical saturation was achieved with 14 interviews.

The target population for the quantitative section of this research consists of bank customers and employees. Due to the widespread nature of the study population, the model validation was carried out among customers and employees of Saderat Bank in Tehran province. For the employee population, which includes those with over three years of experience totalling 3,870 individuals, a sample of 350 was selected based on the Morgan table. The target

population for the customer section includes all key customers of virtual banking at Saderat Bank in Tehran province. Specifically, this includes customers with the highest number of electronic financial transactions at the time of the study. The total number of such customers is 89,537, from which 385 were selected as the sample based on the Morgan table.

For the employee population, a cluster sampling method was used, while for the customer population, a convenience sampling method was employed. In this research, data was gathered using both field and library methods. The theoretical literature and review of prior studies were conducted through library research, including books, articles, relevant websites, progress reports, circulars, and guidelines. For the qualitative phase, data was collected through semi-structured, face-to-face, and in-depth interviews to design and determine the dimensions of the model. Sample interview questions are provided below.

1. What are the factors affecting the acceptance of virtual banking?
2. What are the outcomes of accepting virtual banking?

In the quantitative phase, a researcher-designed questionnaire with a 5-point Likert scale was used to test and describe the model and its dimensions. Following the experts in qualitative research [6, 12, 14, 23], a combination of criteria used in evaluating interpretive research and data-grounded theory methodology research was employed to assess the validity of the interviews. In this study, the criteria of Lincoln and Guba [23]—credibility, transferability, dependability, and confirmability—were used. To assess the reliability of the interviews, a test-retest method was used. In this approach, a few of the conducted interviews were selected as samples and each was recorded at a short and specific interval. The codes identified at two different times for each interview were then compared. In this study, after revisiting the interview texts and recoding, some codes unrelated to the topic were removed, and others were reformulated and revised.

The researcher-developed questionnaire was designed and prepared based on the findings from the qualitative phase. To determine the validity of the questionnaire, content validity, face validity, and construct validity were used. To ensure face validity, the researcher consulted with experts and specialists in the field to review the appearance and layout of the questionnaire. To assess construct validity, convergent validity indicators were utilized through factor analysis in structural equations modeling.

In this study, Cronbach's alpha and composite reliability were used to calculate reliability, with the results indicating that the Cronbach's alpha of the questionnaire is 0.976. To analyze the qualitative data in the study, content analysis was used. The main process in this method involves coding and categorizing raw data, extracting key concepts and categories, and identifying relationships between them within the framework of a researcher-developed theory. This approach is tailored to the conditions and context of the research [8]. Initially, all the interviews conducted by the researcher were transcribed, and based on the questions asked, they were typed out using audio recordings. Each line was reviewed, and then the analyses were conducted using three types of coding: open, axial, and selective. The final research model was developed through this process.

For the quantitative data analysis, the research utilized SPSS and SmartPLS3 software at both descriptive and inferential statistics levels. Descriptive statistics included measures such as mean, standard deviation, variance, and frequency distribution tables. For inferential statistics, content analysis and factor analysis (for research tools) were employed. Finally, structural equation modelling was used to evaluate the goodness-of-fit of the conceptual model of the research.

**Descriptive Statistics**

Mean ($\overline{x}$):

$$\overline{x} = \frac{1}{N} \sum_{i=1}^{N} x_i \tag{2.1}$$

where:

$N$ is the number of observations.

$x_i$ is each individual observation.

Standard Deviation ($s$):

$$s = \sqrt{\frac{1}{N-1} \sum_{i=1}^{N} (x_i - \overline{x})^2} \tag{2.2}$$

where, $\overline{x}$ is the mean, $N$ is the number of observations, and $x_i$ is each individual observation.

Variance ($s^2$):

$$s^2 = \frac{1}{N-1}\sum_{i=1}^{N}(x_i - \overline{x})^2 \tag{2.3}$$

**Factor Analysis**

Eigenvalues:

Eigenvalues are computed from the covariance matrix $C$. For a matrix $C$, the eigenvalue equation is:

$$Cv = \lambda v \tag{2.4}$$

where, $C$ is the covariance matrix, $v$ is the eigenvector, and $\lambda$ is the eigenvalue. Factor loadings are computed as:

$$L = UDV^T \tag{2.5}$$

where, $L$ is the matrix of factor loadings, $U$ and $V$ are matrices of eigenvectors, and $D$ is the diagonal matrix of eigenvalues.

**Reliability Analysis**

Cronbach's Alpha ($\alpha$):

$$n = \frac{\frac{Z^2pq}{d^2}}{1 + \frac{1}{N}\left(\frac{Z^2pq}{d^2} - 1\right)} \tag{2.6}$$

Composite Reliability ($\rho_c$):

$$\rho_c = \frac{\left(\sum_{i=1}^{n}\lambda_i\right)^2}{\left(\sum_{i=1}^{n}\lambda_i\right)^2 + \sum_{i=1}^{n}\epsilon_i} \tag{2.7}$$

where, $\lambda_i$ is the factor loading of item $i$, $\epsilon_i$ is the error variance of item $i$, and $n$ is the number of items.

**Structural Equation Modeling (SEM)**

Model Fit Indices:

Chi-Square ($\chi^2$):

$$\chi^2 = \sum_{i=1}^{m}\frac{(O_i - E_i)^2}{E_i} \tag{2.8}$$

where, $O_i$ is the observed frequency, $E_i$ is the expected frequency, and $m$ is the number of observed values. Root Mean Square Error of Approximation (RMSEA):

$$RMSEA = \sqrt{\frac{\chi^2 - df}{df(N-1)}} \tag{2.9}$$

Comparative Fit Index (CFI):

$$CFI = 1 - \frac{\chi^2 - df}{\chi^2_{null} - df_{null}} \tag{2.10}$$

where, $\chi^2$ is the chi-square statistic for the model, $df$ is the degrees of freedom for the model, $\chi^2_{null}$ is the chi-square statistic for the null model, and $df_{null}$ is the degrees of freedom for the null model.

## 3 Research findings

In this research, after conducting the interviews, concepts were identified and then categories were determined from among these concepts, resulting in the main categories of the model. In this study, all coding stages were performed manually.

87 indicators were identified in the context of causal factors for the acceptance of virtual banking, categorized into 13 components and 1 dimension.

46 indicators were identified in the form of 6 components and 1 dimension regarding the contextual factors affecting the adoption of virtual banking.

34 indicators within 5 components and 1 dimension were identified regarding the intervening factors of virtual banking acceptance.

Table 1: The coding related to identifying the causal factors for the acceptance of virtual banking

| Selective coding | Axial coding | Open coding |
|---|---|---|
| Causal factors | Financial and economic factors | Reduction in banking transaction costs; Ability for customers to regularly review transaction details and financial statements; Reduction or elimination of costs for customer access and connection to banking software; Economic issues related to the lack of electronic banking insurance; Continuous investment in the IT sector of electronic banking; Continuous investment in the IT sector of electronic banking; Funding for software updates and development; Funding for the development and maintenance of mobile banking applications; Funding for upgrading outdated hardware to meet banking needs; Funding for new incidental costs such as training, consulting, and banking advertising; Funding for new infrastructure and required banking communication networks; Funding for new human resources to maintain the banking system; Funding for new hardware for the bank's data center |
| | Data, Information, and Communication Security | Implementing Intrusion Prevention Systems (IPS) for Bank Systems; Implementing Intrusion Detection Systems (IDS) for Bank Systems; Reducing System Vulnerability Rates; Securing Online Transactions; Safe Data Transmission; Adequate Technical Capabilities |
| | Biometric Security | Multifactor authentication; Prevention of unauthorized third-party access to personal information; Electronic forms or signatures; Enhanced cryptographic complexity; Review and strengthening of current software encryption security |
| | Employee Characteristics | Intrinsic motivation of employees towards virtual banking; Interest in continuously learning virtual banking skills; Positive attitude of employees towards virtual banking; Positive attitude of employees towards knowledge sharing in virtual banking; Interest in professional challenges and continuous training in virtual banking; Strong attention to and interest in the work environment in virtual banking; Adaptability to various conditions in virtual banking; Awareness and understanding of complex issues in virtual banking; Ability to communicate and convey thoughts and feelings to others; Presence of skilled technical personnel |
| | Perceived Performance Quality | Custom, unique, and integrated financial services; Reduced level of interaction between staff and customers; Facilitation of loan payments; Decreased customer complaints through improved experience; Reduction in staff-related transaction errors; Shorter feedback time to customers; Higher service quality compared to traditional banking; Quick introduction of new banking services to customers; Greater accuracy in service delivery compared to traditional banking; Timely and appropriate information dissemination; Adequate support, especially during problems, by virtual banking operators |
| | Convenient and easy access | Convenient and user-friendly communication with the bank; Ease of use of banking systems for transactions; Simple learning and skill acquisition for using banking systems; Clarity of transactions and interactions with the bank; Simplicity of performing virtual transactions for users; Access to virtual banking services anytime and anywhere; Easy reminders on how to use the system; Simplicity in finding icons on the virtual banking website; Provision of detailed virtual banking services information to customers |
| | Design and content | Equipped with a search engine for virtual banking software; Clear display with easy-to-follow guidance in the virtual banking services section; Proper and clear layout of virtual banking portals for easy transactions; Attractive graphics and color settings in virtual banking portals; Availability of tools such as chat and discussion forums in virtual banking; Comprehensive and rich content on the banking website |
| | Government support | Government encouragement and promotion of internet use and e-commerce; Provision of infrastructure and facilities by the government, such as bandwidth expansion; Government support for virtual banks; Establishment of good laws and regulations for virtual banks by the government; Purchasing some government services exclusively through virtual banking |
| | User participation | Seeking opinions and participation of customers; User control over banking operations; User ability to customize information and processes |
| | Speed | Increased speed of transactions; Correction of failed transactions by the virtual banking system in minimal time; Responding to various user needs in the shortest time; Efficient transactions; High-speed response to complaints in virtual banking; Fast execution of banking exchanges |
| | Individual factors | Individual curiosity for better transaction methods; Desire for self-improvement through modern knowledge; Willingness to adopt virtual technology; Awareness of current virtual practices; Tendency to change user behavior in usage; Need for conducting online banking independently; Need to integrate online banking with lifestyle and work environment |
| | Perceived compatibility | Compatibility with beliefs and values; Compatibility with societal culture; Compatibility with work activities |
| | Perceived value | Added value of receiving virtual banking services; Ability to manage all accounts simultaneously; Societal efficiency; Individual efficiency |

43 indicators in the form of 8 components and 1 dimension were identified regarding the strategies for adopting virtual banking.

30 indicators within 4 components and 1 dimension were identified regarding the outcomes of virtual banking adoption.

5 indicators were identified in the form of 1 component and 1 dimension regarding the acceptance of virtual banking

Table 2: Coding related to identifying contextual factors for the acceptance of virtual banking

| Selective coding | Axial coding | Open coding |
|---|---|---|
| Contextual factors | Management-strategic factors | Strategic vision and long-term planning; Measuring progress with ongoing and continuous supervision; Managerial stability; Setting reasonable timeframes for advancing activities and tasks; Support from senior management; Business integration; Process reengineering to enable web capabilities; Risk tolerance of managers; International experience of managers; Adequate assessment of required resources; Precise identification of the current situation; Ability to forecast desirable future states |
| | Organizational factors | Having strong bank capital; Presence of strong specialized departments; Flexible organizational structure; Workload flexibility within the organization; Large size of the institution |
| | Applications, software, and database | Strengthening software layers for connecting to the national banking network; Increasing the accessibility and readiness of databases; Using various original and up-to-date software and programs in banking; Updating current software programs for conducting web-based financial transactions |
| | Infrastructure, network, hardware | Strengthening existing hardware systems for intrusion detection and prevention according to the needs of banking systems; Establishing suitable and stable network and internet connections for banking services (fiber optic, satellite, wireless, cloud); Providing backup and redundant storage solutions to cover potential disruptions in the bank's databases; Increasing the speed, availability, and reliability of storage equipment; Enhancing the readiness and reliability of hardware and network systems; Implementing updated network equipment with high capabilities across different layers with proper coding and encryption; Increasing the number of servers in the bank's data center; adequacy of current satellite networks; Optimal bandwidth of internet lines; Increasing the capability of telecommunication infrastructure and updating it with active participation from the private sector |
| | Social pressure | Recommendations from experts; Trust in knowledge; Searching for better methods; Use of virtual banking by acquaintances; Recommendations from acquaintances to use virtual banking; Provision of exclusive services by virtual banking; Society's attitude towards using virtual banking; Society's attitude towards eliminating paper; Social pressure to reduce unnecessary travel |
| | Globalization | Community reception of social networks; Global information dissemination by banks; Customer-to-customer communications; Elimination of national borders for conducting transactions via the Internet; Removal of limitations for conducting transactions via the Internet; Removal of limitations for establishing communications via the Internet |

Table 3: Coding related to identifying intervening factors in the adoption of virtual banking

| Selective coding | Axial coding | Open coding |
|---|---|---|
| Intervening factors | Cultural-Social Factors | Lack of cultural groundwork to familiarize people with the advantages of using cards instead of cash; Relatively low general literacy and knowledge of current technology; Self-censorship (reluctance) to disclose economic information due to tax evasion; Resistance to any form of change or transformation; Issues related to the language used on the internet; Limited internet access for the general population and low internet penetration rates in the country; Customs and traditions and reluctance to maintain electronic money; Lack of habit among people to remember PIN numbers; Rate of growth in computer access among individuals |
| | Environmental factors | Competition in the industry and difficulty in retaining customers; Technological advancements and smart tools; Increasing consumer preference for using smartphones for financial services; Entry of new players (fintechs and startups); Better acceptance of digitalization among younger generations |
| | Mental image of the bank | The image of the bank's track record; The image of the honesty of the bank's promises; The image of the bank's innovativeness; The image of the bank's treatment of customers; The image of the bank's longevity; The image of the bank's ethical standards; The image of the bank's reliability |
| | Perceived Risk | Fear of entering account information incorrectly; Fear of the virtual banking system crashing during use; Fear of account information being hacked; Fear of losing capital due to poor performance of the electronic system; Fear of wasting time learning the electronic banking system; Risk associated with online transactions |
| | Customer attitudes | Customers' mindset about the security of virtual banking; Customers' mindset about the value of virtual banking for them; Customers' mindset about the reliability of virtual banking; Customers' mindset about the importance of virtual banking for society; The ideal nature of using online services; The wisdom of using online services; The attractiveness and pleasantness of using online services |

as a central phenomenon.

The research model was finalized with 6 main categories, 36 sub-categories, and 245 final concepts.

From the standardized coefficient model, it can be inferred whether there is a significant correlation between latent variables and their corresponding indicators. Standardized coefficients represent the path coefficients or standardized factor loadings between factors and indicators. To ensure validity, there must be a significant correlation between variables and the items (questions) on the questionnaire. If the standardized factor loading is higher than 0.4, it

Table 4: Coding related to virtual banking adoption strategies

| Selective coding | Axial coding | Open coding |
|---|---|---|
| Strategies | Advertising | Implementing educational and promotional programs simultaneously to raise awareness about virtual banking services; Providing advertisements that address individuals' needs; Advertising with an emphasis on reducing customers' additional costs; Advertising with a focus on transaction speed; Advertising aimed at attracting customers; Extensive and high-volume advertising; Providing a positive image of the bank in advertisements; Choosing appropriate media for bank advertisements; Adequate information provision in offering virtual banking services; Emphasizing the initial benefits of using virtual banking in advertisements alongside the general benefits it provides |
| | Sales promotion | Offering differentiated and customized services and products; Waiving penalties for overdue payments by virtual banking customers; Special facilities for virtual banking customers; Customization of services for specific customers; Provision of electronic banking equipment for free; Gifting a mobile phone equipped with mobile banking; Offering special discounts; Free bill payments; Categorization of financial transactions; Providing daily, weekly, monthly, and annual financial statements |
| | Customer socialization | Child and adolescent banking literacy program; Virtual banking course unit |
| | Customer guide | Guidance by experts; Need for an experienced individual from within the bank |
| | Education | Training customers in virtual banking; The possibility of receiving virtual banking training in rural areas or at home; Training and encouraging bank employees to handle customer issues appropriately and resolve customer problems; Utilizing academic specialists and developing skilled experts and managers; Training bank employees in modern virtual banking skills |
| | Customer centricity | Identifying and better meeting new customer needs; Providing appropriate responses to new customer needs; Establishing suitable communication with customers; Prioritizing customer satisfaction; Proper handling of customer complaints; Adequacy of devices and kiosks for electronic banking services; Understanding customer buying behaviors |
| | Pro-innovation bias | Finding new ways to provide services; Introducing new electronic services; Increasing the diversity of services offered; Providing services beyond competitors |
| | Market development | Providing special electronic services to schools; Providing special electronic services to domestic and international travelers; Supporting the tourism industry with specific virtual banking services |

Table 5: Coding related to the identification of the outcomes of adopting virtual banking

| Selective coding | Axial coding | Open coding |
|---|---|---|
| Outcomes | Trust in virtual banking | Adherence to commitments and promises by the bank; Secure and confidential handling of transactions through bank channels; Confidentiality of personal information with the bank; Protection of assets held by the bank; Bank's ability to correct erroneous transactions; Bank's responsiveness to virtual inquiries; Previous experience with electronic banking services; Trust in account opening and deposit retention at the bank; Trust in compensation for security breaches to customers; Trust in the technology used in virtual banking; Trust in bank staff; Trust in the control of electronic banking services by the bank; Trust in the financial benefits and advantages of virtual banking |
| | Reduce costs | Prevention of fatigue from waiting; Saving on transaction costs; Saving on costs associated with customer travel to bank branches; Reducing administrative bureaucracy; Reducing wait times to receive services; Reducing the need for physical cash; Saving paper in transactions; Reducing the physical space occupied by customers in the bank |
| | Performance expectations | Increasing accuracy; Increasing speed; Increasing transparency; Increasing quality of service delivery; Increasing job efficiency; Providing the ability to manage assets more effectively and improving performance; Enhancing productivity and effectiveness of tasks and operations |
| | Planning | Providing a basis for planning based on accurate data; Enabling long-term planning |

Table 6: Coding related to the adoption of virtual banking as a central phenomenon

| Row | Axial coding | Open coding |
|---|---|---|
| 1 | Adoption of virtual banking | Intent to use online transactions; Intention to use online services in the future; Intention to use more services in the future; Preference for virtual banking services over traditional banks; Recommendation to others to use virtual banking |

indicates that the items have good explanatory power. The T-value indicates the significance of each parameter; if the absolute value of T is greater than 1.96 or the significance level is less than 0.05, the parameters of the model are considered significant. In this case, the construct validity of the measurement variables is confirmed at a significance level of 0.05. The T-value statistic between the items and their corresponding latent variables has been calculated to be more than 1.96 in all cases. Therefore, the significance of the relationships between the items and their corresponding variables is confirmed. Additionally, the standardized factor loading for all questionnaire items is above 0.4, and there is no need to remove any items from the model.

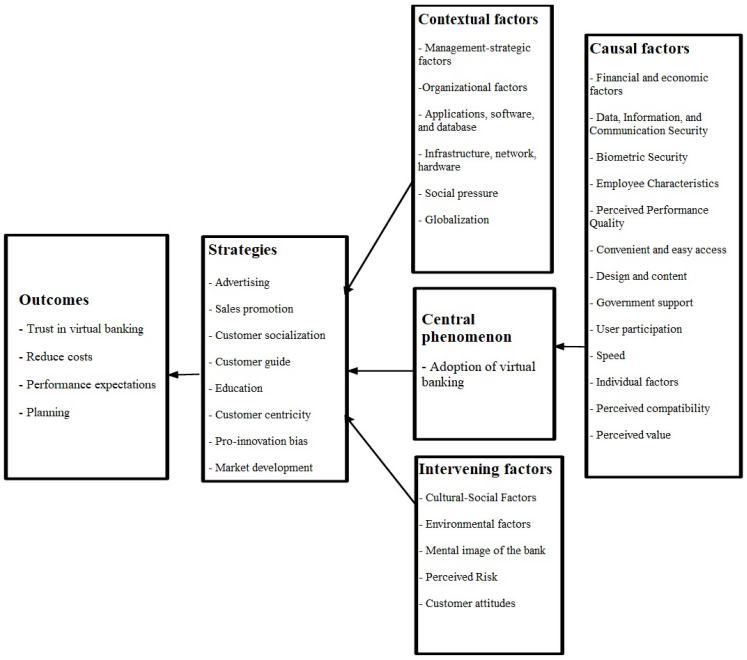


Figure 1: Paradigmatic model of research

As shown in the above table, the average scores of all the variables in the table are greater than 3 (the midpoint of the 5-point scale). Therefore, it can be concluded that most individuals selected options above 3. The lowest score of the variables is greater than 1, and the highest score is estimated to be less than 5, which indicates that the coding and data entry of the questionnaires into the software have been done correctly and without any errors.

Skewness Coefficient:

$$S = \frac{n}{(n-1)(n-2)} \sum_{i=1}^{n} \left( \frac{s_i - \bar{x}}{s} \right)^3 \tag{3.1}$$

where, $n$ is the number of data points, $x_i$ is each data point, $\bar{x}$ is the mean of the data, and $s$ is the standard deviation.

Kurtosis Coefficient:

$$K = \frac{n(n+1)}{(n-1)(n-2)(n-3)} \sum_{i=1}^{n} \left( \frac{s_i - \bar{x}}{s} \right)^4 - \frac{3(n-1)^2}{(n-2)(n-3)} \tag{3.2}$$

As shown in the table above, the skewness and kurtosis coefficients for all the variables under study fall within the safe range (-3 to +3), indicating that the data is normally distributed.

Composite Reliability (CR):

$$CR = \frac{(\sum \lambda_i)^2}{(\sum \lambda_i)^2 + \sum \theta_i} \tag{3.3}$$

Average Variance Extracted (AVE):

$$AVE = \frac{\sum \lambda_i}{n} \tag{3.4}$$

As observed, the values of Cronbach's Alpha and Composite Reliability for all variables are within an acceptable range, above 0.7. Additionally, the AVE values for all variables are higher than the threshold of 0.5. Therefore, it can be inferred that the reliability and convergent validity of the studied variables are at an acceptable and desirable level.

$Q^2$ value of the dependent variable:

$$Q^2 = 1 - \frac{SS_{res}}{SS_{tot}} \tag{3.5}$$

where $SS_{res}$ is the sum of squares of residuals (errors), and $SS_{tot}$ is the total sum of squares. For structural equation modeling, it is often computed using specific software and is related to the model's predictive capability.

$$GOF = \sqrt{\overline{communalities} \times \overline{R^2}} = \sqrt{0.348 \times 0.515} = 0.423 \tag{3.6}$$

Table 7: Descriptive Statistics of the Research Variables

| Variables | Sample Size | Mean | Standard deviation | Range of Scores Obtained | |
|---|---|---|---|---|---|
| | | | | Min | Max |
| Financial and economic factors | 735 | 3.6609 | 0.75456 | 1.00 | 5.00 |
| Data, Information, and Communication Security | 735 | 3.4204 | 0.79540 | 1.00 | 5.00 |
| Biometric Security | 735 | 3.3352 | 0.67452 | 1.20 | 5.00 |
| Employee Characteristics | 735 | 3.2267 | 0.87535 | 1.00 | 5.00 |
| Perceived Performance Quality | 735 | 3.3837 | 0.83946 | 1.00 | 5.00 |
| Convenient and easy access | 735 | 3.7058 | 0.73410 | 1.89 | 5.00 |
| Design and content | 735 | 3.7211 | 0.69751 | 1.67 | 5.00 |
| Government support | 735 | 3.2539 | 0.83613 | 1.00 | 5.00 |
| User participation | 735 | 4.0154 | 0.79892 | 1.67 | 5.00 |
| Speed | 735 | 3.5565 | 0.76516 | 1.67 | 5.00 |
| Individual factors | 735 | 3.4741 | 0.82894 | 1.00 | 5.00 |
| Perceived compatibility | 735 | 3.3728 | 0.93836 | 1.00 | 5.00 |
| Perceived value | 735 | 3.4551 | 0.68759 | 1.75 | 5.00 |
| Causal factors | 735 | 3.5063 | 0.54554 | 2.13 | 5.00 |
| Management-strategic factors | 735 | 3.3933 | 0.85241 | 1.00 | 5.00 |
| Organizational factors | 735 | 3.6131 | 0.79819 | 1.40 | 5.00 |
| Applications, software, and database | 735 | 3.7473 | 0.75857 | 1.50 | 5.00 |
| Infrastructure, network, hardware | 735 | 3.4993 | 0.87143 | 1.00 | 5.00 |
| Social pressure | 735 | 3.7654 | 0.68737 | 1.78 | 5.00 |
| Globalization | 735 | 3.4853 | 0.67004 | 1.83 | 5.00 |
| Contextual factors | 735 | 3.5839 | 0.56645 | 2.02 | 5.00 |
| Central phenomenon | 735 | 3.3641 | 0.82231 | 1.00 | 5.00 |
| Cultural-Social Factors | 735 | 3.3716 | 0.84763 | 1.00 | 5.00 |
| Environmental factors | 735 | 3.6024 | 0.79853 | 1.40 | 5.00 |
| Mental image of the bank | 735 | 3.4616 | 0.82976 | 1.00 | 5.00 |
| Perceived Risk | 735 | 3.4685 | 0.67705 | 1.83 | 5.00 |
| Customer attitudes | 735 | 3.7261 | 0.70200 | 1.71 | 5.00 |
| Intervening factors | 735 | 3.5261 | 0.57061 | 1.97 | 5.00 |
| Advertising | 735 | 3.6819 | 0.75125 | 1.00 | 5.00 |
| Sales promotion | 735 | 3.2184 | 0.87364 | 1.00 | 5.00 |
| Customer socialization | 735 | 3.1156 | 0.77131 | 1.00 | 5.00 |
| Customer guide | 735 | 3.3490 | 0.88911 | 1.00 | 5.00 |
| Education | 735 | 3.3480 | 0.82526 | 1.00 | 5.00 |
| Customer centricity | 735 | 3.7596 | 0.73298 | 1.86 | 5.00 |
| Pro-innovation bias | 735 | 3.7282 | 0.75636 | 1.50 | 5.00 |
| Market development | 735 | 3.5605 | 1.01573 | 1.00 | 5.00 |
| Strategies | 735 | 3.4702 | 0.58121 | 1.93 | 5.00 |
| Trust in virtual banking | 735 | 3.6385 | 0.73617 | 1.00 | 5.00 |
| Reduce costs | 735 | 3.7058 | 0.73274 | 1.88 | 5.00 |
| Performance expectations | 735 | 3.6844 | 0.66597 | 1.71 | 5.00 |
| Planning | 735 | 3.5653 | 0.99615 | 1.00 | 5.00 |
| Outcomes | 735 | 3.6485 | 0.58426 | 1.91 | 5.00 |

$$SRMR = \sqrt{\frac{\sum_{i,j}(\hat{R}_{ij} - R_{ij})^2}{n(n-1)}} = 0.068 \tag{3.7}$$

According to the results in the table above, it can be concluded that all paths in the model are found to be significant.

To assess the goodness of fit of the model using the Partial Least Squares (PLS) method, besides the SRMR index, there is an index called GOF. The GOF criterion was introduced by Tenenhaus et al. [38] and is calculated using the formula provided in the table. Values of 0.01, 0.25, and 0.36 are identified as weak, moderate, and strong for GOF, respectively. As observed in the table above, the GOF value obtained is 0.423, which indicates a strong fit of the model according to the specified categories. Additionally, the SRMR index is estimated to be 0.068, which is less than 0.08. The $Q^2$ values for all endogenous variables in the model are positive and at an acceptable level; therefore, the proposed model is suitable and exhibits high power.

## 4 Discussion and conclusion

Given the increasing use of the internet in today's world, attracting and retaining customers is of great importance. Organizations' use of Internet services allows them to achieve a sustainable competitive advantage and create unique

Table 8: Results of the Normality Test of the Data

| Variables | Normality Indices | | Results |
|---|---|---|---|
| | Skewness Coefficient | Kurtosis Coefficient | |
| Financial and economic factors | -0.948 | 1.108 | Normal |
| Data, Information, and Communication Security | -0.301 | -0.379 | Normal |
| Biometric Security | -0.39 | 0.800 | Normal |
| Employee Characteristics | -0.123 | -0.557 | Normal |
| Perceived Performance Quality | -0.200 | -0.514 | Normal |
| Convenient and easy access | -0.676 | -0.035 | Normal |
| Design and content | 0.360 | -0.046 | Normal |
| Government support | -0.439 | 0.312 | Normal |
| User participation | -1.019 | 0.770 | Normal |
| Speed | -0.441 | -0.277 | Normal |
| Individual factors | -0.572 | 0.139 | Normal |
| Perceived compatibility | -0.473 | -0.075 | Normal |
| Perceived value | 0.113 | 0.385 | Normal |
| Causal factors | -0.245 | -0.093 | Normal |
| Management-strategic factors | -0.254 | -0.528 | Normal |
| Organizational factors | -0.765 | 0.112 | Normal |
| Applications, software, and database | -0.455 | 0.239 | Normal |
| Infrastructure, network, hardware | -0.652 | 0.126 | Normal |
| Social pressure | -0.376 | 0.127 | Normal |
| Globalization | 0.199 | 0.370 | Normal |
| Contextual factors | -0.324 | -0.011 | Normal |
| Central phenomenon | -0.170 | -0.505 | Normal |
| Cultural-Social Factors | -0.204 | -0.628 | Normal |
| Environmental factors | -0.781 | 0.057 | Normal |
| Mental image of the bank | -0.488 | -0.013 | Normal |
| Perceived Risk | 0.187 | 0.389 | Normal |
| Customer attitudes | -0.383 | 0.208 | Normal |
| Intervening factors | -0.301 | 0.219 | Normal |
| Advertising | -0.965 | 1.180 | Normal |
| Sales promotion | -0.159 | -0.573 | Normal |
| Customer socialization | 0.143 | 0.421 | Normal |
| Customer guide | -0.184 | -0.689 | Normal |
| Education | -0.180 | -0.544 | Normal |
| Customer centricity | -0.843 | 0.278 | Normal |
| Pro-innovation bias | -0.422 | 0.117 | Normal |
| Market development | -0.730 | -0.198 | Normal |
| Strategies | -0.350 | -0.11 | Normal |
| Trust in virtual banking | -0.833 | 1.142 | Normal |
| Reduce costs | -0.717 | 0.034 | Normal |
| Performance expectations | -0.368 | 0.200 | Normal |
| Planning | -0.710 | -0.215 | Normal |
| Outcomes | -0.552 | 0.280 | Normal |

opportunities for businesses. With the advent of online banking and the rise of the Internet, users and consumers fulfil their needs through the Internet and online portals, particularly social networks, instead of traditional distribution channels, and use these as effective tools for information collection. Today, banks are in an era characterized by various terms, including the Knowledge Age, the Post-Industrial Age, the Information Society Age, the Temporary Society Age, and the Globalization Age. Therefore, they must discover and study customer behaviour to gain a competitive advantage. One of the advantages of using online banking services is that banks aim to reduce their costs by providing non-branch services and decreasing the number of branches, while also significantly increasing the speed of service utilization.

Today, one of the most widely used methods for financial transactions is the use of online banking services at various times throughout the day. With the rise of e-businesses and increased consumer trust in online shopping, online banking services have become one of the fastest and most reliable methods for financial exchange. However, gaining public trust in online banking services is not easy, and many people still prefer to visit banks for financial transactions. Nevertheless, once these individuals become acquainted with the benefits of online banking services, their opinions often change. Banks are continually striving to meet the expectations and needs of their future customers. Information technology facilitates communication with customers and enhances its speed and effectiveness, thus providing opportunities for improved performance and innovation in service delivery. Currently, the Internet has penetrated various domains and impacted all industries. One of these areas is Internet banking, which has emerged with the advent of the Internet.

Table 9: Results of Cronbach's Alpha Coefficient, Composite Reliability, and AVE

| **Variables** | **Cronbachs Alpha** ($\alpha > 0.7$) | **Composite Reliability** ($CR > 0.7$) | **Average Variance Extracted** ($AVE > 0.5$) |
|---|---|---|---|
| Causal factors | 0.972 | 0.973 | 0.500 |
| Financial and economic factors | 0.922 | 0.934 | 0.543 |
| Data, Information, and Communication Security | 0.872 | 0.904 | 0.612 |
| Biometric Security | 0.856 | 0.888 | 0.533 |
| Employee Characteristics | 0.786 | 0.875 | 0.700 |
| Perceived Performance Quality | 0.755 | 0.837 | 0.563 |
| Convenient and easy access | 0.802 | 0.859 | 0.507 |
| Design and content | 0.774 | 0.848 | 0.532 |
| Government support | 0.945 | 0.953 | 0.670 |
| User participation | 0.916 | 0.929 | 0.546 |
| Speed | 0.924 | 0.937 | 0.623 |
| Individual factors | 0.888 | 0.911 | 0.634 |
| Perceived compatibility | 0.877 | 0.910 | 0.670 |
| Perceived value | 0.783 | 0.873 | 0.696 |
| Contextual factors | 0.955 | 0.958 | 0.542 |
| Management-strategic factors | 0.927 | 0.938 | 0.559 |
| Organizational factors | 0.896 | 0.923 | 0.706 |
| Applications, software, and database | 0.886 | 0.921 | 0.746 |
| Infrastructure, network, hardware | 0.919 | 0.932 | 0.578 |
| Social pressure | 0.920 | 0.934 | 0.611 |
| Globalization | 0.853 | 0.885 | 0.563 |
| Central phenomenon | 0.781 | 0.852 | 0.537 |
| Intervening factors | 0.935 | 0.941 | 0.500 |
| Cultural-Social Factors | 0.900 | 0.919 | 0.562 |
| Environmental factors | 0.895 | 0.923 | 0.704 |
| Mental image of the bank | 0.855 | 0.888 | 0.553 |
| Perceived Risk | 0.855 | 0.886 | 0.566 |
| Customer attitudes | 0.888 | 0.912 | 0.599 |
| Strategies | 0.957 | 0.960 | 0.564 |
| Advertising | 0.904 | 0.921 | 0.541 |
| Sales promotion | 0.945 | 0.953 | 0.671 |
| Customer socialization | 0.712 | 0.874 | 0.776 |
| Customer guide | 0.747 | 0.887 | 0.798 |
| Education | 0.777 | 0.849 | 0.532 |
| Customer centricity | 0.914 | 0.931 | 0.660 |
| Pro-innovation bias | 0.886 | 0.921 | 0.744 |
| Market development | 0.875 | 0.924 | 0.803 |
| Outcomes | 0.945 | 0.950 | 0.571 |
| Trust in virtual banking | 0.929 | 0.939 | 0.542 |
| Reduce costs | 0.916 | 0.932 | 0.631 |
| Performance expectations | 0.895 | 0.915 | 0.608 |
| Planning | 0.753 | 0.890 | 0.802 |

Table 10: Fit indices of the model along with path coefficients and t-values for the relationships between the model variables

| **Paths** | **Path coefficient** | **T-statistic value** | **Significance level** | **Coefficient of determination of the dependent variable** | **$Q^2$ value of the dependent variable** |
|---|---|---|---|---|---|
| Causal factors → Central phenomenon | 0.572 | 22.515 | 0.00 | 0.327 | 0.171 |
| Contextual factors → Strategies | 0.327 | 11.673 | 0.00 | 0.608 | 0.307 |
| Central phenomenon → Strategies | 0.261 | 8.587 | 0.00 | 0.608 | 0.307 |
| Intervening factors → Strategies | 0.360 | 11.563 | 0.00 | 0.608 | 0.254 |

Internet banking offers numerous direct and indirect benefits for both banks and customers, with one of the most significant being the reduction in time wasted by customers and bank personnel. Despite all these advantages, this service has not yet gained widespread popularity.

For success in the competitive field of virtual banking, banks need to provide high-quality virtual banking services to their customers. This requires identifying the criteria that customers use for accepting virtual banking. By considering these criteria, significant steps can be taken to enhance the systems that deliver these services.

Based on the research results:

The causal factors affecting the acceptance of virtual banking include financial and economic factors; data, information, and communication security; biometric security; employee characteristics; perceived performance quality; suitable and easy access; design and content; government support; user participation; speed; individual factors; per-

ceived compatibility; and perceived value.

The contextual factors influencing the acceptance of virtual banking include managerial-strategic factors, organizational factors; application programs, software, and databases; infrastructure, networks, hardware; social pressure; and globalization.

The intervening factors influencing the acceptance of virtual banking include cultural-social factors; environmental factors; the bank's image; perceived risk; and customer attitudes. The strategies for adopting virtual banking include advertising; sales promotion; customer socialization; customer guidance; training; customer orientation; innovation orientation; and market development. The outcomes of adopting virtual banking include trust in virtual banking; reduced costs; performance expectations; and planning. Therefore, it is suggested:

1. Customers are concerned about issues such as hackers accessing their personal information, outdated security systems, and more during banking transactions. Therefore, banks need to pay special attention to security matters and enhance their security levels to the highest possible standards. The more security is ensured, the more customers will be inclined to use virtual banking services. In fact, the perception of security in electronic payment systems is a key factor in evaluating e-commerce in the market, and this issue becomes particularly important for virtual banks due to the absence of a physical building and communication solely through virtual space or electronic portals. Therefore, virtual banks must have a precise plan to gain people's trust.
2. In the field of infrastructure, considering that banking network services are based on terrestrial communications, the network currently faces issues such as network outages, slow expansion of banking services, time-consuming troubleshooting, and weak monitoring. To address these problems and create a suitable and efficient environment for banking communications, it is necessary to establish and expand the required infrastructure based on satellite technologies in the country.
3. Expanding the hardware and software systems of virtual banking by global standards and continuous investment in the IT sector will be effective in the development of virtual banking
4. Banks need to stay up-to-date with the latest technology and utilize devices that prevent system errors and subsequent financial losses. Actions such as requiring transaction re-confirmation during processing to reduce the chance of errors, as well as planning, implementing, and communicating policies for post-sale (service) compensation, are of great importance.
5. The institutionalization of a culture of using the facilities and capabilities of virtual banking in society will only be possible through appropriate cultural groundwork, building trust in this banking method, and implementing educational and promotional programs to raise awareness about virtual banking services.
6. In terms of training, the bank should educate its employees in modern virtual banking skills and encourage them through internships and continuing education programs to handle customer interactions effectively and resolve customer issues.
7. Banks can use their advertising to showcase the beneficial use of virtual banking by individuals such as doctors, engineers, managers, and other educated members of society to help improve customers' perceptions.
8. Free internet access at specified hours for online account status monitoring, free payment of utility bills at the beginning of each month, categorization of customers' financial transactions, and provision of daily, monthly, and annual reports, along with the use of online calculators, will be effective in attracting customers to virtual banking and motivating them.
9. Today, security and lack of trust are the most important and primary concerns for users of electronic and Internet banking. For users of online banking who connect to the internet to use such services, trust is of utmost importance. Therefore, managers should pay special attention to commitment to promises and customer interests in organizational decision-making. This characteristic should also be conveyed by managers to employees, as these employees are the ones who interact directly with customers and can better attract their opinions.
10. Customers should be given enough trust and assurance that the virtual banking system, like traditional banking systems, will protect their information and privacy.

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