Measurement of information technology service quality for the Faster Payment Systems in Peru

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Abstract. Faster payment systems (FPSs) are information technology (IT) services that enable individuals and businesses to transfer funds from one financial institution to another. However, factors affecting IT service quality and consequently customer satisfaction have been found. The objective of this research is to develop and validate a logical documentary instrument to measure the quality of FPS IT service in Peru. The ServQual model was used as a reference, to which the compliance dimension was incorporated. Using the instrument design validation guide, validation and measurement of the questionnaire developed for measurement of the FPS service in the extended ServQual dimensions were performed. Opportunities for improvement were also identified in responsiveness, security, and compliance dimensions.

Key words: Faster Payment Systems, Instant Payment, ServQual Model, Information Technology Service Quality Model.

1 Introduction

Faster payment systems or services (FPSs) are information technology (IT) services that enable individuals and businesses to transfer money quickly between bank accounts [1]. They have spread throughout the world. Particularly, FPSs are offered in Peru by 26 banks in the Peruvian financial system and supported by the Automated Clearing House (ACH) [2], among other regulatory institutions. These institutions regulate the service that guarantees the immediate delivery of funds between accounts of different financial entities. Likewise, there are regulatory requirements and obligations that apply to financial entities to ensure transparency and financial inclusion of customers. For example, the Peruvian Central Reserve Bank (BCRP) established key performance indicators and service levels due to the current degradation of the interoperable payment service [3].

In this context, services are exposed in different risk events where the prevention and reduction of security breaches seek to preserve public confidence in the payment system [4]. Likewise, the criticality of the service and reputational cost that a malfunction of the service causes to financial institutions are undeniable. However,

different factors that have affected the quality of the IT service and consequently impacted customer satisfaction have been found [5]. In the Peruvian financial system, the need to ensure IT service quality, and, in particular, to improve the perception that internal and external customers have for the FPS IT service has been identified.

Therefore, there is a need to measure the quality of the FPS service in the Peruvian system [6]. Service quality measurement is essential to improve the competence of organizations [7]. It is based on the service consumer's perception of the expectations fulfilled by the service [8].

The objective of this research is development of an instrument and its validation to measure FPS IT service quality based on the instrument design validation guideline [9] and measurement of FPS service quality of a financial institution in Lima, Peru. This paper is organized as follows. In Section 2, the fundamental concepts are introduced. In Section 3, related studies are discussed. In Section 4, the research methodology is developed. In Section 5, the results are shown. Finally, Section 6 presents the conclusions.

2   Background

This section introduces concepts relevant to the development of this study.
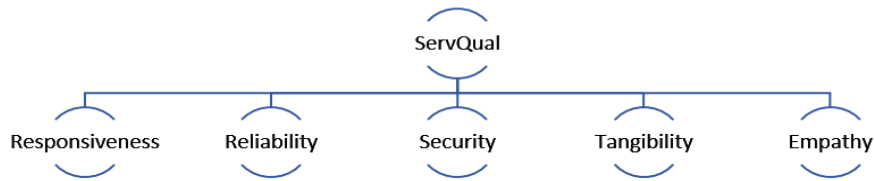
2.1   ServQual Model

In 1988, Parasuraman, Zeithaml, and Berry [8] developed the ServQual model, which is used to measure service quality in various sectors and contexts. According to [5], [8], [10], ServQual is based on five dimensions (Fig. 1): tangibility, which refers to the physical appearance where the service resides, reliability, which is the ability to execute the promised service in a reliable and careful manner, responsiveness, the willingness to help and provide a fast and efficient service upon problem solving, security, which inspires confidence in the service and generates credibility, and empathy, which is addressed to identify the difficulties that customers have when they use the service, to allow personalized attention.

2.2   Factors Hindering IT Service Quality

According to [11], the risk factors affecting the IT service quality are the criticality of the data exchanged in the service, access control to the database where access permissions to data schemas are managed, maintenance of a backup when it is required, and integrity and consistency of customer information. The risk of not having access control could lead to extraction of customer information and theft and fraud [11].

The unavailability of the online service leads to an immediate interruption of payment services; i.e., the transaction is cancelled or interrupted [12]. In addition, according to [11], there are the following problems in transactions. (i) If any failure occurs in the system, it affects the value chain of the service; i.e., this risk factor leads

to total unavailability of the service. (ii) Human errors may be evident when contingency procedures are activated as these manual activities are performed by the staff. (iii) Regulatory aspects may generate an operational risk in the management of the process. (iv) There are other factors in the infrastructure that may affect the assets of the organization, such as power failures, firewall problems, and quality of the hardware that supports the IT service.

Fig. 1. ServQual model dimensions [8].

3   Related Work

We present some studies from the existing literature focusing on service quality in different contexts and sectors. In [13], the ServQual model is used to assess the perception of service by both those who offer and those who receive it, and the significant discrepancy between the business owner's and customer's perception of service quality is highlighted. This underscores the importance of mutual understanding in improving customer satisfaction.

In [7], the service quality is analyzed as a key competitive factor, and it is concluded that the ServQual model is effective in identifying areas for improvement. In a technological context, in [14], the implementation of blockchain in interbank transfers in Colombia is explored, its benefits in security and efficiency are highlighted, and challenges such as scalability and transaction costs are identified.

In [4], the effects of speed and security on consumer payment behavior are investigated, and the importance of security in maintaining customer confidence is highlighted. In [15], a model is developed for the implementation of IT governance in banking entities, and its effectiveness is validated through expert judgments and self-assessment based on international regulations.

Regarding local academia, in [16], the dimensions of service quality in the Peruvian financial sector are researched, using ServQual to assess reliability, responsiveness, and empathy as determinants of customer satisfaction. Similarly, in [17], the ServQual model is employed to assess mobile banking applications, and deficiencies in responsiveness and security are highlighted. On the other hand, in [18], the bank's productivity is improved by emphasizing the measurement and continuous improvement. In [19], the impact of banking applications is explored, and the perception of security and trust generated by these digital platforms is highlighted.

The literature includes four studies that use ServQual in different contexts and sectors where discrepancies are found between the customer and service owner. Notably, everyone has a different perception of service quality. In addition, these studies highlight the benefits of ServQual to identify improvements. On the other hand, in [16] and [17], ServQual is applied in the financial sector and mobile banking, respectively, without altering the model; i.e., in the latter study, five dimensions are employed and opportunities for improvement are identified.

4   Design and Validation of the IT Service Quality Model Measurement Tool

A research method based on the guide for instrument validation research design was used in this study [9] as another study similar to [20], [21], [22]. For this purpose, the following iterative phases were established: content validity, construct validity, reliability, stability, criterion, and performance (Table 1). These phases allow the development and validation of a logical instrument to measure the quality of the FPS IT service. Below, the tasks of the guide applied to the design and validation of the measurement instrument of the FPS service quality model are shown.

Table 1. Phases and tasks for validation of an instrument from [9].

Phase	Task
F1. Content validity	(F1-1) Rational validity
	(F1-2) Validity of response
	(F1-3) Validity of expert judges
F2. Construct validity	(F2-1) Scanning factor analysis
	(F2-2) Confirmatory factor analysis
F3. Reliability	(F3-1) Internal validity
F4. Stability	(F4-1) Concurrent validity
F5. Criterion	(F5-1) Predictive validity
F6. Performance	(F6-1) Research assessment

(F1) Content validity: To create the logical measurement instrument, the content must first be ensured, as, without it, there is no communication [23]. Initially, a content review was performed to identify whether the concept is fully defined, partially defined, or undefined. An approach to the population was then employed to conceptualize the dimensions that are measured in the IT service, for the construction of items. Finally, the created items were submitted for validation by the judges.

(F1-1) Rational validity: This phase comprises a review of instruments used to measure the quality of the FPS service (construct). As there are no specific instruments, a literature review was conducted to identify, assess, and interpret the service quality models applicable to FPS, shown in Table 2 including the dimensions they define. According to this review, these models do not determine a specific model to measure the quality of the FPS service. In addition, it was identified that ServQual has been used in the banking context [24], [5], assessing other services such as credit cards [8], real-time transactions [25], mobile applications [17], exclusive services for financial

customers [16], banking services [26], and new support services with artificial intelligence in a financial institution [27]. Therefore, ServQual is used as a basis for definition of an ad-hoc instrument more contextualized to the reality of the FPS for the Peruvian financial ecosystem.

Table 2. Summary of dimensions for quality of service for identified models.

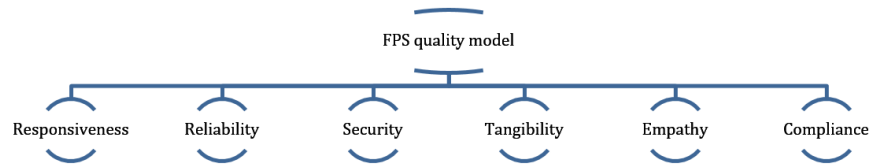| Model	Dimensions
ISO/IEC 25011	Suitability, usability, maintainability, tangibility, responsiveness, adaptability, reliability and empathy
ServQual	Empathy, security, responsiveness, reliability and tangibility
ServPerf	Empathy, security, responsiveness, reliability and tangibility
E-S-Qual	Efficiency, compliance, system availability and privacy

To define the new model, a mapping of the risk factors affecting the quality of IT services of transactional payment systems established in [15] was performed with respect to the ServQual dimensions (Table 3). The mapping introduces the dimension compliance, which is associated with the risk factor related to regulatory aspects.

Table 3. Mapping of risk factors affecting the dimensions of FPS quality of service [11].

FPS quality model	Risk factors
Responsive	Service availability
Reliability	Service availability
	System failures
	Inactivity of operations
Security	Database access control
	Database backup
	Theft and fraud
Tangibility	Supply failures or interruptions
	Firewall
	Hardware quality
	External factors
Empathy	Human error
Compliance	Regulatory aspects

(F1-2) Response validity: The population was approached to conceptualize the dimensions measured in the FPS service. Unstructured interviews and meetings of understanding were conducted with the owners of the service and monitoring team of a financial entity chosen for the measurement. The entity measures the availability of the service and response times of the IT service. In addition, with the experts in the service, it was possible to recognize that there are regulatory bodies that can sanction the service and affect the perception and reputation of the financial institution. Based on this premise, the need to include a new dimension that arises from the characterization variable compliance was determined. The FPS service has technological and financial components affected by national regulations. These regulators aim to ensure that FPSs are safe, protecting the consumer from abuse and fraud. Following this response validity, the IT service quality model with its dimensions

was updated (Fig. 2). In addition, items were proposed for each of the found dimensions, considering the ServQual-based questionnaires as a reference.

Fig. 2. Dimensions of the FPS quality model based on ServQual.

(F1-3) Validity of the expert judges: According to [23], the experts and judges independently assess the relevance, coherence, sufficiency, and clarity of the items. With the support of the two judges and three experts, it was possible to collect observations on the items and improve the clarity and consistency of the items for the dimensions of responsiveness, security, reliability, compliance, empathy, and tangibility. The profiles of the judges were professors and researchers in software engineering and usability. On the other hand, the experts were owners of the product, owners of the service, and managers of means of payment from different financial institutions. For this purpose, a 30-item instrument was designed and submitted for validation by judges (see Appendix A). On the other hand, this measurement instrument uses a Likert scale in which the study unit expresses its agreement or disagreement with each item. The judges recommended being more precise in the statements, considering that the terms were not clear, and thus the items were reformulated, leaving 28 items.

(F2) Construct validity: According to [23], construct validity consists of establishing groups of items that are defined as dimensions. For this research, a confirmatory factor analysis is applied as it is based on the construct already defined and supported as the concept of service quality. Finally, it was complemented with content validation, reinforcing the IT service quality construct for the FPS.

For this purpose, it was necessary to apply a pilot test, in which 39 people participated, and the clarity of the items was verified after validation with the expert judges. In addition, the recommendations to consider 50% of the favorable items and 50% of the unfavorable items were applied, necessary to improve the wording of the instrument. This pilot test enabled to identify the variability of the items, as they must express variability for the test to have discriminating capacity. On the other hand, the correlation, which indicates the strength and direction of a relationship between two variables, enabled to identify whether the data have been entered correctly in the data matrix, as there are no negative correlations. Likewise, the correlation matrix shows the correlations between items. The total item correlation allows to analyze the degree of contribution of each item to the total.

(F2-2) Confirmatory factor analysis (CFA): CFA is a statistical technique that aims to reduce dimensions based on correlations between items. The items are assessed from a probabilistic standpoint by developing the total variance, which suggests six dimensions. On the other hand, to apply the CFA, it was confirmed that the determinant of the correlation matrix is below 0.05. Kaiser–Meyer–Olkin (KMO) and Bartlett's tests (see Appendix B) were also performed, and the KMO measure was determined to be

larger than 0.05. Likewise, it was determined that there were sphericity and significance as the *p* value was smaller than 0.05 (see Appendix C). Finally, all elements of the rotated principal component matrix were determined. In the rotated principal component matrix (see Appendix D and Appendix E), the following dimensions were found.

(F3-1) Reliability: According to [23], this implies recognition that a part of the variance of the results generated in a measurement is true variance, for which Cronbach's alpha is used. Values of this coefficient higher than 0.8 indicate a good consistency [28]. The 28-item instrument piloted with 39 workers from different financial institutions generated a Cronbach's alpha of 0.902 (Table 3). The proposed instrument after iterations, item deletions, and feedback from experts and users generated a 21-item questionnaire (see Appendix F) whose Cronbach's alpha was 0.931 (Table 3).

Table 4. Reliability statistics.

Cronbach's alpha	N of elements
0.902	28
0.931	21

(F4-1) Stability: According to [23], to perform an external assessment of the instrument, it is important to be able to run the instrument on the same assessment group, i.e., perform frequent repetitions of measurement [20]. On the other hand, the results of external validity are applicable to certain contexts and are generalizable according to the performed sampling [29].

(F5-1) Criterion: According to [23], this measures the external validity of the created instrument and consists of identification of a criterion that enables to determine whether the results of the instrument are correct. In addition, concordance between the created instrument and gold standard instrument is sought. However, gold standard instrument for measurement of the quality of IT FPS service does not exist. Therefore, the result is expressed in predictive validity; i.e., the criterion is set in future [29].

(F6-1) Performance: According to [23], the objective is to optimize the instrument by reducing the error upon value judgment for decision making.

5 Results

In this study, the discussion of the results comprises description, analysis, interpretation, comparison, and observation [23]. We discuss the results of the FPS IT service quality measurement for each of its proposed dimensions (Fig. 1).

This creation process was based on the instrument validation research design. Therefore, in this research, it is justified that the IT service quality construct was partially defined for the FPS. In this regard, these definitions and dimensions already reviewed for mature models such as ServQual, ServPerf, and ES-Qual did not completely cover the construct to be investigated. Therefore, there is a need to approach

the population and conduct unstructured interviews that allow finding characteristics to enrich the concept. In addition, according to [9], in this study, experts and judges independently performed assessments of the proposed instruments and provided feedback in this iterative process, in which the relevance, coherence, sufficiency, and clarity of the items were assessed. Finally, construct validation was performed by establishing dimensions and confirmatory factor analysis.

Cronbach's alpha was applied to test the reliability and homogeneity of this measurement instrument. As mentioned in [30], this statistical method verifies the internal consistency of the items and their behaviors. On the other hand, in [9], it is suggested that reliability is the degree to which an instrument produces consistent and coherent results. It is stated that Cronbach's α is 0.931, which shows excellent validity and reliability of the created instrument.

The FPS IT service quality measurement instrument was designed with 21 questions (see Appendix E), and a five-level Likert scale was considered (Table 4). This instrument was applied to 52 users of a financial institution. The results of each assessed dimension are presented below.

Table 5. Results obtained for the FPS service quality dimension.

Dimension	Item	N	Average
Responsive	P7, P5, P8, and P6	52	66.54%
Reliability	P3, P4, P1, and P2	52	74.90%
Security	P11, P12, P9, and P10	52	66.83%
Tangibility	P15, P13, and P14	52	71.41%
Empathy	P17, P18, and P16	52	71.28%
Compliance	P20, P21, and P19	52	65.13%

- **Responsiveness:** This refers to the organization's ability to provide a fast and timely service to a user [31]. Likewise, it is important to ensure service availability due to the criticality and expectation of immediacy of the service. According to [32], the processing of structured information positively impacts the performance of IT incident management in the IT service network. In addition, this may affect the quality of the provided service. The results of this research were applied to the user population, where a level of 66.54% (Table 4) was observed for the perception of responsiveness in this financial institution. The review of the results for each item shows that the lowest item is the institution's ability to notify when a transaction dispute has a final status, which causes a larger dissatisfaction among service users. Correspondingly, in [33], it is reported that critical services, including FPS, maintained an operational excellence of 99.67%, owing to the process improvement and availability measurement. However, according to these results, this low responsiveness affects the perception of the online service.
- **Reliability:** The value proposition of the FPS service is to allow clients to move their funds between various financial institutions every day of the week, 24 h a day, 365 days a year. Based on the results of the measurement, it can be interpreted that the reliability has been well valued by users in all assessed items, with a value of 74.90% (Table 4). The availability of the service in all digital channels is positively valued. The ACH states that the use of FPS continues to increase,

growing by 73.6%, from 61.4 to 106.7 million transactions. Notably, the unavailability of information technologies generates an immediate interruption of payment services; i.e., the transaction is canceled and interrupted [12]. Unavailability is one of the most critical factors that may affect the quality of the FPS service.

- **Security:** It is important to highlight the criticality of the information contained in an FPS, the customer's personal data as well as financial behaviors and payment credentials that are highly coveted by cybercriminals. In [2], security is valued over immediacy. However, in this measurement, customers are not being informed about the risks or protection activities applied by the organization. Therefore, a percentage of 66.83% is observed (Table 4), which indicates how the members of the organization perceive the levels of security applied to the service; perhaps this will be a topic to assess to implement controls and training for collaborators. The least appreciated item in the measuring instrument is the warning of fraudulent operations.

- **Empathy:** In ISO/IEC 20000-1:2018, it is defined as the ability to provide a service that meets the needs and expectations of users. It results in a value of 71.28% (Table 4), which also shows that it is the most valued dimension. Thus, the service delivers the solution that the user requires. In this regard, it is important to delve deeper into empathy as it is a dimension strongly related to service quality that allows the organization to understand the customer's pain [5]. According to [33], considering the customer first is a value of the financial institution, to empathize and understand their needs to deliver quality services.

- **Tangibility:** It refers to the quality and functionality of the equipment and materials used to provide the IT service [31]. This dimension has a score of 71.41% (Table 4). These entities are backed by large holding companies and have an infrastructure in line with demand. A proper capacity management can improve these elements, which are highly valued by users.

- **Compliance:** This dimension, regulatory and legal, refers to the organization's ability to comply with laws, regulations, and policies established by the relevant authorities, as well as to protect the organization's interests in relation to compliance with these standards [34]. It has a low value of 65.13% (Table 4) either because of misinformation or because they consider that the FPS IT service does not comply with the minimum quality agreements proposed by the regulators. However, the competent authorities make visits to the ACH and financial institutions to ensure compliance with current regulations. In addition, there is a risk factor established by regulatory aspects that may generate an operational error in the management of IT services [5], which generates a decrease in the quality of the IT service. Finally, in [30], it is suggested that prompt payment systems should be balanced with a careful management in favor of a rapid compliance.

This measurement has allowed to efficiently and effectively identify the actions and strategies to improve each dimension of IT service quality, positively satisfying the needs of the internal and external users. In addition, the measurement of service quality is a strategy for the competitiveness of organizations, allowing the organization to identify opportunities for improvement [31].

Responsiveness, security, and compliance are dimensions that represent the largest pain in financial services [19]. This is supported by the results of the measurement

instrument implemented in this research (Table 4). The responsiveness was 66.54%, the security was 66.83%, and the compliance was 65.13%, the last dimension, the most underrated. However, in this research, the compliance dimension was added, where it is recommended to review the management practices that help reinforce regulatory compliance to avoid falling into noncompliance and transgressions. On the other hand, an empirical evidence shows that the dimensions of empathy and reliability are relevant dimensions to improve service quality as they strongly contribute to customer satisfaction [13].

Likewise, risk prevention is useful to preserve the consumer's confidence in the service [2]. In other words, customers are attracted to fast and secure systems. In this regard, the dimension that is highly considered by users is security. In other words, it is important that technology is an essential part of the progress and fulfillment of the financial industry's objectives. The FPS service in the Peruvian financial ecosystem is not entirely efficient. On the other hand, it is important to make the end customer's communication about the functionality of the system transparent; i.e., the implemented systems must be easily accessible, trivially usable, and highly reliable [32]. In very important cases, such as bank-to-bank fund transfers, no precautions can be spared. Therefore, data must be protected, as well as the privacy of customers who perform transactions using the channels of financial institutions. In addition, the user must be kept informed about the traceability of transactions.

6   Conclusion

The development of the logical measurement instrument was based on the instrument validation research design defined in [9]. For the implementation of this service quality measurement instrument, content validity, construct validity, and reliability of the instrument were employed in a rigorous and iterative manner. The perception of IT service quality of the FPS service was assessed through the six dimensions comprising the construct: reliability, responsiveness, security, tangibility, empathy, and compliance.

This research provides results for each of its dimensions and establishes improvement opportunities for the organization. The need for communication of regulatory issues, as well as raising awareness of the importance of notifying customers regarding the status of operations and risks incurred by them is identified. In this regard, the actors that are a part of the value stream of the FPS in a financial institution were identified for convenience, and the 21-item logical measurement instrument was applied. The results covered all dimensions identified for IT service quality contextualized in the FPS service. This also enabled to recognize in which dimensions there are opportunities for improvement, such as the dimensions of responsiveness, security, and compliance.

Finally, the measurement of the quality of FPS services improves the competitive capabilities of the organization and financial ecosystem by having a snapshot of service perception from the users' perspective. This enables senior management to make better informed decisions in support of the organization's strategic objectives. In summary, the implementation of some best practices aligned to the dimensions of IT service

quality contributes to the identification of improvement points in the perception of IT service quality by the internal user of financial institutions.

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Appendix [URL](URL)

Appendix A. 30-Item Instrument questionnaire
Appendix B. Dimensions in the rotated component matrix
Appendix C. Results of the KMO and Bartlett tests
Appendix D. KMO and Bartlett's test analysis
Appendix E. Dimensions in the principal component matrix
Appendix F. 21-Item Instrument questionnaire