

Ensuring the service quality at a university construction technology laboratory in Brazil

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Abstract

Service quality in a construction technology laboratory can result in an improvement in construction companies' competitiveness. This research aims to evaluate the service quality provided by a construction technology laboratory, specifically in the segment of performing testing through the rupturing of concrete samples. For this research, a survey was conducted using a structured questionnaire that was created based on a literature review regarding the surveying of laboratory customers at a university in the south of Brazil. Our research was both exploratory and quantitative, and the data were analyzed by applying multivariate data analysis. The conclusions of this study show that the dimensions of quality services are: communication, reliability, responsiveness, credibility, and tangibility. These five dimensions together provide a high explained variance standard of 79.75%. Having a suitable number of attendants available to serve customers and presenting agility in the construction laboratory is one of the managerial research contributions. Moreover, through information availability, this research generates greater traceability that can be used both by customers and by institutional management. Constantly and thoroughly monitoring the customer service cycle is another relevant factor that can improve the quality of the services provided.

KEYWORDS

Brazilian construction industry, construction technology laboratory, customer satisfaction, rupturing concrete samples, service quality

1 | INTRODUCTION

In today's competitive world, the monitoring and improvement of service quality to ensure the delivery of high service quality is the key to success in the service industry and to developing efficiency and volume in business (Anderson & Zeithaml, 1984; Babakus & Boller, 1992; Garvin, 1983; Meesala & Paul, 2018). High service quality is also associated with success against competitors (Bateson & Hoffman, 2011; Lazzari, 2009). Improving service quality is one of the relevant factors that has an impact on consumer satisfaction (Meesala & Paul, 2018; Oliver, 1980, 2010).

For Grönroos (2004), the service quality level is directly related to a possible source of a company's competitive advantage. Thus, a service company differentiates itself by its recognition of and

attendance to its customers' needs and desires, and by doing so, the company can present a competitive advantage over its competitors (Albrecht & Bradford, 1992; Lazzari, 2009; Zeithaml, 1988).

Some universities make their laboratories available to the community. Developing research and teaching is among the labs' main purposes, and working with companies outside the university itself allows the laboratories to bring the universities closer to market needs and allows these institutions to provide support through technical services and technical consulting services (Lazzari, 2009). For Lazzari (2009), the construction technology laboratory performs testing of construction materials, and it generates partnerships with builders, concrete factories, ceramic producers, and other construction industry companies (Lazzari, 2009).

For a university to engage in teaching and service delivery to the community in a research environment requires an understanding of quality management from the customer's point of view. This is a key factor in ensuring customer satisfaction based on the value customers assign to the level of quality that they experience (Fornell, 1991, November; Grönroos, 1998; Lazzari, 2009; Oliver, 1980, 2010). Thus, the main aim of this research is to evaluate customers' perception of the service quality that they receive from a university construction technology laboratory, specifically by providing services in the materials testing segment of rupturing concrete samples.

As specific objectives, this study aims to:

1. Adapt the custom scale from Lazzari (2009) to the context of the study.
2. Evaluate the perceived quality related to the services provided to customers of rupturing concrete samples testing through the attributes and dimensions of the custom scale adapted to this study.
3. Compare theoretically the scale developed by Lazzari (2009) with the scales developed by Gianesi and Corrêa (1994), Johnston, Graham, and Shulver (2012), and Parasuraman, Zeithaml, and Berry (1985).
4. Identify gaps in the delivery of quality service directly to companies that make use of the services provided by university construction technology labs in order to maximize their customers' satisfaction.
5. Propose improvements that university construction technology labs can make to enhance their perceived service quality.

The rest of the paper is organized as follows: First, the extant literature review is performed to contextualize customer service quality. The second section explores the research method applied to examine customer needs. This research also exposes the setting, the objectives, the steps, techniques, and procedures adopted. The third section includes the profile of respondents and a listing of the attributes that were measured. In the fourth section, the major research findings are discussed. The fifth section includes the conclusions; discussion of research limitations and future research directions are highlighted.

2 | LITERATURE REVIEW

2.1 | Service quality

Service quality has been widely discussed by researchers, scholars, and business managers (Cronin & Taylor, 1992; Grönroos, 1990; Johnston, 1995; Lazzari, 2009; Liljander & Strandvik, 1995; Lobato, 2016; Olorunniwo, Hsu, & Udo, 2006; Svensson, 2006a, 2006b; Yasin, Correia, & Lisboa, 2004; Zeithaml, Berry, & Parasuraman, 1993). The initial conceptual model or scale developed by Parasuraman et al. (1985) was intended to provide an understanding of the expectations of customers versus their perceptions of the quality of the service that was provided to them. For Zeithaml et al. (1993), service quality is defined as the difference between the customers' perceptions and their expectations. A company's or other service provider's perceived performance is

measured through a comparison between the customers' expectations and their perceptions of the quality of the service that they received (Zeithaml et al., 1993). Furthermore, as services are custom processes, everything that occurs throughout the service cycle can influence the perception of its quality (Grönroos, 1998; Lobato, 2016). Thus, the perception of service quality is formed by the integrated performance of all of the steps involved in the service as evaluated by the customers (Lobato, 2016).

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Service quality is understood as a multidimensional construct by different authors. For Parasuraman, Zeithaml, and Berry (1988), the Service Quality Model, or SERVQUAL Model, seeks to capture and measure perceptions of the elements of service quality along a scale of dimensions or factors describing service providers:

- Reliability.
- Assurance.
- Empathy.
- Tangibility.
- Responsiveness.

Gianesi and Corrêa (1994) classified service quality into nine factors, composed of:

- Availability of access.
- Atmosphere of the service provider's location.
- Competence.
- Consistency.
- Credibility and security.
- Cost.
- Flexibility.
- Tangibles.
- Speed.

Johnston, Graham, and Shulver (2012) analyzed the SERVQUAL model and proposed 18 factors to represent service quality. These factors include:

- Access.
- Attention.
- Assistance.
- Competence.
- Commitment.
- Communication.
- Reliability.
- Comfort.
- Courtesy.
- Care.
- Availability.
- Aesthetics.
- Flexibility.
- Functionality.
- Cleanliness.
- Attractiveness.
- Responsiveness.
- Security.

Research developed by Lazzari (2009), identified seven factors that represent service quality in laboratories:

- Delivery time.
- Customer service.
- Results presentation.
- Service safety.
- Communication with customers.
- Price of service.
- Technical aspects.

For Parasuraman et al. (1988), the dimensions of service quality and what they mean are:

- Reliability, which is the ability to deliver reliable, accurate, and consistent service.
- Assurance, which is related to the competence and courtesy of the employees in transmitting confidence, security, and credibility.
- Empathy, which is the attention paid and individualized communication to customers.
- Tangibles, which are linked directly to the physical facilities, the employees' appearance, and the condition of the equipment.
- Responsiveness, which is related to the willingness to assist the customer in service provision (Parasuraman et al., 1988).

For Ganesi and Corrêa (1994), service quality includes ease of access as it relates to the customer's ease of contacting the company. Customer service and atmosphere of the service provider's facility are linked to the customer's feelings during the service. Competence is related to the service team's skill and knowledge in performing a given task. Consistency is related to expectations based on previous experiences, which is one of the reasons why a customer returns to a service provider for additional services. Credibility and security when purchasing a service can cause a decrease in the perception of possible risks. Cost is related to the value that the customer invests in the service. Flexibility is associated with the service providers' ability to adapt and offer customized products or services. Tangibles include the appearance of the physical space. Finally, service speed is related to how rapidly the service provider can perform the service (Ganesi & Corrêa, 1994). The table in **Exhibit 1** presents comparisons among the dimensions found by this study's authors in what other researchers say constitute service quality.

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2.2 | Customer satisfaction

Service quality is a multidimensional concept composed of variables that have an impact on customer satisfaction (Meesala & Paul, 2018; Saunders, 2008). Service quality has emerged as an important determinant of consumer satisfaction (Lang, 2011; Meesala & Paul, 2018). Other researchers also agree with the idea that quality is a crucial element for consumer satisfaction (Gremler, Gwinner, & Brown, 2001; Meesala & Paul, 2018; Radwin, 2000). When organizations focus on providing quality service, they can generate consumer satisfaction (Kumar, Smart, Maddern, & Maull, 2008; Meesala & Paul, 2018). Moreover, consumer satisfaction is the main factor driving corporate performance, as service providers exceed customers' expectations. Finally, customer satisfaction is a state-of-mind in customers after they have obtained a particular service, and it represents how much the consumer likes or dislikes certain services after the experience (Meesala & Paul, 2018; Woodside, Frey, & Daly, 1989).

Customer satisfaction is the response to the perceived discrepancy between a customer's expectations and the service performance they receive (Meesala & Paul, 2018; Parasuraman et al., 1985; Tse & Wilton, 1988). It is the difference between the expected and the perceived quality that determines the customer's perception of the service that has been provided (Oliver, 1980, 2010). Consumer satisfaction can be viewed as a guide to help service providers improve their performance, help them with continuous monitoring, and empower future decisions (Meesala & Paul, 2018; Zairi, 2000). Customer satisfaction leads to customer loyalty, recommendations, and repurchase

EXHIBIT 1 Summary of service quality dimensions

Parasuraman et al. (1985)	Gianesi and C�rrea (1994)	Lazzari (2009)	Johnston, Graham, and Shulver (2012)
Tangibility (physical facilities and appearance)	Tangibility		Cleanliness and attractiveness Comfort Aesthetics Functionality Cleanliness and attractiveness
Reliability (reliable, accurate, and consistent)	Consistency	Results presentation (clarity of information, certification)	Commitment Reliability Integrity
Responsiveness (ability to help customers promptly)	Customer service speed Flexibility	Deadline (punctuality, early communication)	Responsiveness Flexibility Attention and assistance Care (Attention) Availability Flexibility
Access, communication, and customer understanding	Access, customer service, and atmosphere	Customer communication (efficiency) Customer service hours	Access, communication
Competence courtesy Credibility safety Guarantee	Credibility and safety Competence cost	Security with the service Technical aspects Services price	Safety Competence Courtesy

Source: Developed by the authors.

intention (Meesala & Paul, 2018; Wilson, Zeithaml, Bitner, & Gremler, 2017).

3 | RESEARCH METHODOLOGY

3.1 | Construction technology laboratory

Located in the South of Brazil, the construction technology laboratory, which is the subject of this research, sought to fill a gap of existing demand in the university's coverage area. This laboratory provides services in technological building materials testing. In addition to being a place of learning and researching, the laboratory has also created partnerships with construction companies, concrete producers, ceramic producers, and other companies linked to the construction sector, with the purpose of providing quality control for construction materials. Nowadays, this laboratory attends to the needs of 105 customers and companies involved with the civil construction sector.

3.2 | Techniques and research procedures

The research conducted by the authors of this paper was composed of two steps. In the first step, qualitative research of an exploratory nature was conducted to allow the researchers to explore literature on service quality to examine the criteria that have been used in describing and measuring service quality and to obtain a sufficient understanding to continue with the research project (Denzin & Lincoln, 2011; Hennink, Hutter, & Bailey, 2011). For Hennink et al. (2011), exploratory research increases a researcher's familiarity with the study object, clarifying the concepts, and allowing the generation of hypotheses for later empirical investigation. In the second step, a

quantitative research model was developed of a descriptive nature, with the objective of quantifying the data by applying statistical methods. The descriptive research presents well-defined and structured objectives that are used in solving problems (Remler & Van Ryzin, 2010).

The exploratory phase is grounded in theoretical references and the descriptive research was operationalized by means of a survey, that is, research based on a structured questionnaire and applied to a representative sample of a given target population with the intention of obtaining specific information from the respondents' perspectives (Fowler, 2009; Remler & Van Ryzin, 2010). This study included a pretest to assess the validity and reliability of the respondents' survey; four customers were given the pretest. They were asked to report any difficulties they encountered in the survey, such as ambiguous questions or terms. Feedback and information from the pretest were used to develop a final survey questionnaire, which was composed of 38 questions related to the attributes associated with service quality and 9 items that provided a customer's profile, totaling 47 questions.

To create our data collection tool, which was intended to provide a scale of responses, we used a Likert scale of seven points, allowing responses with extremes varying from "1 - Totally Disagree," to "7 - Totally Agree" (Bearden, Netemeyer, & Haws, 2011; Netemeyer, Bearden, & Sharma, 2003). It is worth mentioning that scales that we used were adapted from previous studies, with utilization of validated scales. Once the research questionnaire was written and structured, content validation, which is also known as face validation, was carried out (Kinnear & Taylor, 1996; Malhotra, Nunan, & Birks, 2017), during which the data collection tool was submitted to a group of experts. Data collection for this research took place by the self-filling method using the web-based questionnaire survey in Google docs® (Fowler,

2009). The online questionnaires were sent by e-mail. Also, the authors made themselves available, so in cases of doubt, the respondents could call the university construction technology lab to ensure accurate completion of the questionnaires. However, no calls were made to request that respondents complete the questionnaires.

This questionnaire was structured in three parts: the service quality perception (38 questions), the respondent profile characterization (9 questions), and space for comments and suggestions. For database construction and statistical analysis, the software PASW® Statistics 20.0 was used. The data were tabulated, and the questionnaire was verified for consistency, and questionnaires with more than 10% “no answer” to questions were eliminated. In addition, when responses to attributes presented indices under 10%, the mean answer was adopted (Hair et al., 2010; Malhotra et al., 2017; Remler & Van Ryzin, 2010).

To facilitate interpretation of the factors, the Oblimin rotation was applied with Kaiser Normalization (Hair et al., 2010). The Bartlett Sphericity Test and the sample adequacy measure, Kaiser–Meyer–Olkin (KMO), which guarantees the existence of sufficient correlations in the statistical data to validate the application of Factor Analysis, were both used to verify whether the data were adequate for the utilization of Factor Analysis. The Bartlett Sphericity Test verifies whether each variable correlates perfectly with itself, but does not correlate with other variables. The KMO test is an index that compares the observed correlation value with the partial correlation values. KMO values under 0.5 indicate that the correlation between the pairs of attributes cannot be explained by other attributes, and that factor analysis is not indicated (Johnson & Wichern, 2007; Mulaik, 2010).

The study scale's reliability was analyzed using the Cronbach's Alpha (Hair et al., 2010). The Cronbach's Alpha test seeks to verify the internal consistency of the data. Hair et al. (2010) and Malhotra et al. (2017) suggest that an acceptable value be equal or superior to 0.7.

4 | RESEARCH DEVELOPMENT – CUSTOMERS' PROFILE AND ATTRIBUTES MEASUREMENT

4.1 | Customers' profile

The portfolio of customers attended by this laboratory totals a population of 105 companies. All of them received a questionnaire to fill out sent by e-mail, however, only 38 customers returned the completed questionnaire. Of this total, 15 (39.5%) were construction workers, 13 (34.2%) were technical managers, and 10 (26.3%) were owners of construction companies or nontechnical managers. In regard to gender, 27 (71.1%) were male and 11 (29.8%) were female. Most of the respondents were between 26 and 50 years in age (52.6%). Respondents who were less than 25 years old represented 36.8% of the sample, and those who were more than 50 years in age represented 10.5%. The majority of the respondents were university graduates (36.8%), and 27 of the surveyed customers (71.1%) said that they had been in the same function for more than 1 year and less than 5 years, as shown in the table in Exhibit 2.

EXHIBIT 2 Respondent characteristics

Variable	Frequency	Percentage (%)
<i>Gender</i>		
Male	27	71.1
Female	11	29.8
<i>Age</i>		
Below 25 years old	14	36.8
Between 26 and 50 years old	20	52.6
Above 50 years old	4	10.5
<i>Education degree</i>		
Complete high school	5	13.0
Incomplete higher education	14	38.0
Complete higher education	14	38.0
Incomplete postgraduate	1	3.0
Complete postgraduate	4	8.0
<i>What is your position in the firm?</i>		
Construction workers	15	39.5
Technical manager	13	34.2
Owners of construction companies, nontechnical managers	10	26.3
<i>How long have you been in this position in the firm?</i>		
Less than a year	6	15.0
Between 1 and 5 years	27	72.0
Between 5 and 10 years	3	8.0
Between 10 and 15 years	2	5.0

Source: Results from data analysis.

4.2 | Attributes measurement

Aiming to identify the intrinsic attributes responsible for the perception of customer service quality, Exploratory Factor Analyses were carried out. These analyses identified specific attributes that provided the best explanation within each of the factors or dimensions. To strip away extraneous data, attributes with factor loadings under 0.5 were removed (Hair et al., 2010; Malhotra et al., 2017; Mulaik, 2010). In the final factor extraction, five factors or dimensions emerged that explained a total variance of 79.753%. The results are shown in the table in Exhibit 3, which demonstrates that both the factor loadings and the communalities values are higher than 0.5. Also, these attributes were gathered for each factor identified. The scale was adapted from the research of Lazzari (2009). In the tables in Exhibits 3 and 4, it is possible to check the attributes retained within the dimensions. Moreover, these factors were redefined based on the table in Exhibit 1. Thus, the retained factors or dimensions are according to the dimensions proposed by Parasuraman et al. (1985):

- Communication (CM).
- Reliability (RL).
- Responsiveness (RP).
- Credibility (CD).
- Tangibility (TG).

EXHIBIT 3 Results of factor extraction

	Attributes related to quality	1	2	3	4	5	Communalities
RP1	Agility in telephone service				−0.578		0.716
CM1	Meeting the specific needs of the company		0.511				0.751
RL1	Customer service post-testing	0.792					0.786
RL2	Attitude to communicate to the company in case of problem in meeting the deadline	0.693					0.791
CM2	Clarity in the discrimination of the tests in the invoice		0.879				0.825
RP2	Commitment of the technical staff with the customer				−0.811		0.816
RL5	Explanations regarding the performance of the test (s) with technical scientific background	0.665					0.813
RL3	Cordiality in customer services	0.597					0.832
TG1	Location of the laboratory			−0.860			0.817
RP3	Laboratory credibility (Construction Technology Laboratory)				−0.784		0.837
CD1	Performance of the test according to established standards					0.752	0.756
RL4	Ethics in procedures	0.538					0.783
RL6	Supply of information about the previous test results	0.886					0.859
TG2	Guidance as the concrete samples			−0.814			0.794
TG3	Deadline of results			−0.921			0.886
RP4	Price of trials and tests				−0.774		0.667
CM3	Technical team qualification		0.601				0.750
CD2	Technical solutions proposed by the laboratory staff, when requested					0.882	0.877
		8.458	2.134	1.584	1.175	1.003	Percentage of accumulated variance
		46.991	11.858	8.800	6.530	5.574	79.753

Source: Results from data analysis.

Note. KMO: 0.956; degrees of freedom (DF): 153; sig.: 0.000.

Thus, of the 37 attributes that were evaluated, only 18 were retained as relevant to the research findings. To facilitate an understanding of these research findings, Exhibit 4 relates both the dimensions responsible for the quality of service perceived by customers and their respective attributes.

The internal data consistency analysis was realized for each of the five identified dimensions. The relative values from Cronbach's Alpha were considered satisfactory for all factors, as they exceeded the minimum value, 0.7, as recommended by the literature (Hair et al., 2010). Also, these 5 dimensions were represented by a total of 18 attributes, and there is a higher percentage of attributes in the dimension Reliability (Dimension 1) and Communication (Dimension 2) than is the case with the other dimensions.

5 | DATA ANALYSIS AND RESULTS

The dimension, *Reliability*, showed the highest number of retained attributes, explaining 46.991% of the variance of the total sample.

The dimension, *Communication*, explained 11.858% of the variance. The table in **Exhibit 5** presents a comparison between the scale adapted by Lazzari (2009) and the theoretical approaches by Gianesi & Corrêa (1994), Johnston (1995), and Parasuraman et al. (1988). Thus, it is possible to conclude that there is adherence and alignment among the studies developed by the authors mentioned in Exhibit 5. As an example, the first attribute found in the table in Exhibit 5, "agility in telephone service" (Lazzari, 2009), is related to the speed of customer service (Gianesi & Corrêa, 1994), and responsiveness (Johnston et al., 2012; Parasuraman et al., 1988).

6 | CONCLUSION

Based on the main aim of this study, five central factors or dimensions that represent service quality in a construction technology laboratory were identified out of the initial eight factors based on research developed by Lazzari (2009). After data refinement, the five factors that could explain perceptions of service quality regarding materials testing

EXHIBIT 4 Quality's attributes for construction technology laboratory

Factors	Attributes	Cronbach's Alpha
Responsiveness (RP)	RP1—Agility in telephone service RP2—Commitment of the technical staff with the customer RP3—Laboratory credibility (Construction Technology Laboratory) RP4—Price of trials and tests	0.859
Communication (CM)	CM1—Meeting the specific needs of the company CM2—Clarity in the discrimination of the tests in the invoice CM3—Technical team qualification	0.739
Reliability (RL)	RL1—Customer service post-testing RL2—Attitude to communicate the company in case of problem in meeting the deadline RL3—Cordiality in customer services RL4—Ethics in procedures RL5—Explanations regarding the performance of the test (s) with technical scientific background RL6—Supply of information about the previous test results	0.846
Tangibility (TG)	TG1—Location of the laboratory TG2—Guidance as the concrete samples TG3—Deadline of results	0.873
Credibility (CD)	CD1—Performance of the test according to established standards CD2—Technical solutions proposed by the laboratory staff, when requested	0.777

Source: Results from data analysis.

involving rupturing concrete samples were identified. These five factors, which presented a high standard of explained variance of 79.75%, were responsiveness, communication, reliability, tangibility, and credibility.

Thus, the perception by customers of service quality regarding rupturing concrete samples is explained by 79.753% of these five factors. Of this total, 46.991% of the explained variance is represented by the *Reliability* (RL) factor. Reliability is the factor that best explains perceived service quality in the environment under study. Therefore, reliability is represented by the variables or attributes, including after-sales service, meeting deadlines, and business ethics. These findings are consistent with the ideas of Parasuraman et al. (1994) that showed that service courtesy is associated with the intangibility of service provision. This means that courtesy and competence from the university lab can be associated with ethics in procedures, cordiality in customer services, and accurate and consistent service.

In regard to managerial implications, it is essential for a construction technology laboratory to fulfill its promises. Labs should also show interest in solving problems and in keeping commitments. Thus, the monitoring of customer service is suggested to increase the reliability, precision, and consistency of the service, as well as customer satisfaction related to the service provided by the laboratory.

The second factor that best explains service quality is *Communication* (CM). Related to the total of 79.753% of service quality's overall explained variance, 11.858% is represented by the communication factor. The attitude conveyed in communication, empathy for the customer, the efficiency and transparency of the information that is conveyed, and correct instructions regarding the concrete samples are variables that measure communication. These findings are related to the theoretical basis that places communication, ease of access, and understanding of customer needs and desires as variables that improve the lab's service quality performance. The communication factor from the university lab also includes performing the correct procedures and the correct execution of the instructions to the customer. The university lab must have knowledge of the product and the service. Also, conveying consistent instructions related to all the process, can result in an improved delivery of good service.

In regard to the managerial implications related to communication, it is suggested that service delivery routines be customized and characterized with service planning that is specific to the customer. Furthermore, the tracking of the product or service processes ensures that explicit and understandable data and information is delivered to the customer and captured for internal institutional analysis. Moreover, making information available in a consistent way can bring the service provider closer to the customer, which, in turn, can contribute to increased customer satisfaction and subsequent intentions by the customer to repurchase services, thus promoting customer loyalty.

The third factor that best explains service quality is *Tangibility* (TG). Based on the total service quality's explained variance of 79.753%, 8.800% is represented by the tangibility factor. Tangibility is formed by attributes that refer to the laboratory's location, instructions for collecting rupturing concrete samples, sample collection, and meeting deadlines for the delivery of results. Thus, it is possible to perceive that the tangibility factor represented by the laboratory's location is related to its agility and/or responsiveness in regard to the delivery and collection of samples, so that the final results are delivered in a timely manner without the loss of quality.

The fourth factor that best explains service quality is *Responsiveness* (RP). 6.530% of service quality's explained variance is represented by responsiveness. Responsiveness is associated with customer service agility, and whether the laboratory staff is readily available and able to solve a customer's problems regarding the service that is provided. It is possible to associate responsiveness with the theoretical reference that speed and punctuality of delivery, with minimal lost time or waiting time, can contribute to improving the customer's perception of service quality (Johnston et al., 2012). Comparing these research findings with the theoretical models, the variables were found to be associated with the speed and flexibility of customer service as stated in the research developed by Ganesi and Corrêa (1994). For Johnston et al. (2012), responsiveness is associated with flexibility and availability. For Parasuraman et al. (1988), responsiveness is related to a willingness to assist the customer.

As for the managerial implications related to the responsiveness factor, it is possible to emphasize the need to have available an adequate number of employees staffing the laboratory to ensure the

EXHIBIT 5 Theoretical comparison among researchers' models

Factor (Dimension)	Attributes (From Lazzari, 2009)	Theoretical Comparison		
		Gianesi and Corrêa (1994)	Johnston et al. (2012)	Parasuraman, Zeithaml, and Berry (1988) (SERVQUAL)
Responsiveness	Agility in telephone service	Customer Service Speed	Responsiveness	Responsiveness
	Commitment of the technical staff with the customer	Customer Service/ Atmosphere	Competence	Trust
	Laboratory credibility (Construction Technology Laboratory)	Credibility/ Safety	Integrity	Credibility; Safety
Communication	Price of trials and tests	Cost	Safety	Guarantee
	Meeting the specific needs of the company	Flexibility	Flexibility	Empathy
	Clarity in the discrimination of the tests in the invoice	Access	Integrity	Trust
Reliability	Technical team qualification	Competence	Competence	Competence
	Customer service post-testing	Consistency	Attentiveness/ Helpfulness	Reliability
	Attitude to communicate the company in case of problem in meeting the deadline	Speed in customer service	Attentiveness/ Helpfulness	Responsiveness
	Cordiality in customer services	Customer Service/ Atmosphere	Cordiality	Trust
	Ethics in procedures	Consistency	Integrity	Trustworthy
	Explanations regarding the performance of the test (s) with technical scientific background	Consistency	Support/ Assistance	Responsiveness
Tangibility	Supply of information about the previous test results	Customer Service/ Atmosphere	Responsiveness	Responsiveness
	Location of the laboratory	Tangibility	Tangibility	Tangibility
	Guidance as the concrete samples	Competence	Attentiveness/ Helpfulness	Trust
	Deadline of results	Speed in customer service	Responsiveness	Responsiveness
Credibility	Performance of the test according to established standards	Competence/ safety	Competence/ Safety	Credibility/ Safety
	Technical solutions proposed by the laboratory staff, when requested	Competence	Competence	Competence

Source: Results from data analysis.

timely performance of work, along with the ability to solve subcontractor problems, prioritize possible consumer complaints, and improve the customer service system by using a virtual communication platform to supplement the existing telephone service. These actions can improve the relationship between the institution's laboratory and its customers. Furthermore, increased training and qualification for the team that provides customer service is essential to the delivery of excellent service quality. As the test of the rupturing concrete samples involves different "actors," meaning the university lab, construction workers, technical managers, owners of construction companies, nontechnical managers, and the like. Therefore, it is necessary to prepare all involved players to reduce errors throughout the production process of rupturing concrete samples.

The fifth and final factor is *Credibility* (CD). Related to the total of 79.753% of service quality's explained variance, credibility represented 5.574%. In this research, credibility was perceived in the variables grouping that refers to conducting tests according to the

established standards, and to the technical solutions proposed by laboratory employees when such advice was requested. Thus, proposing technical solutions can be linked with the idea of courtesy, security, and assurance presented by Parasuraman et al. (1985). As for managerial implications, companies should act in ways that convey security, assurance, courtesy, and credibility. These factors can improve the perceptions of service quality related to the technical aspects that are provided and through service pricing that is appropriate within the market in which the laboratory is located.

6.1 | Study limitations and further research

Even with the contributions and advances identified in this research, some limitations can be perceived. Initially, the sample size may have interfered in the study results. However, the results were found to be satisfactory and with adequate theoretical basis to support such a sample size. Understanding the SERVQUAL scale longitudinally is a

suggestion for future studies; in other words, it is necessary to verify the customers' perceptions of service quality over the following period of time: before, during, and after the provision of the laboratory's services. What is the total customer perception of customer service longitudinally, related to the arc of the service provided by the laboratory?

Beyond that, replicating this research by analyzing customer service perceptions related to other laboratory services, and to other types of laboratories, may contribute to validating the factors identified in this study (responsiveness, communication, reliability, credibility, and tangibility). This replication will contribute to verify the divergences existing in relation to the customer's expectations and perceptions, and the customers' characteristics, such as gender, individual income (salary), and the like. Future research may verify customer satisfaction with the service of rupturing concrete samples related to customer retention and loyalty. Apart from that, understanding service quality related to the laboratory's financial performance may also contribute to better positioning within the service provider market.

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