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The Influence of Innovation and Service Quality on Customer Satisfaction

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Abstract

This research aims to determine the suitability of the influence of innovation and service quality on customer satisfaction at Perumda Air Minum Makassar City. Data collection uses primary data obtained from questionnaires using saturated random sampling, its validity and reliability have been tested, and classical assumptions in the form of Normality, Multicollinearity and Heteroscedasticity have also been tested. The data analysis method uses descriptive analysis techniques, coefficient of determination analysis (R2), multiple regression analysis, partial testing (t test) and simutant test (f test). The results of this research show that the Innovation variable has a positive and significant effect on customer satisfaction at Perumda Air Minum Makassar City. The service quality variable does not influence customer satisfaction at Perumda Air Minum Makassar City. And the innovation and service quality variables simultaneously have a positive and significant effect on customer satisfaction at Perumda Air Minum Makassar City.

Introduction

Makassar City Regional Public Company (Perumda) Drinking Water is one of the companies owned by the Makassar City Government, which is engaged in distributing clean water to the general public of Makassar City. Perumda Air Minum is a BUMD which is supervised and monitored by the Executive and Legislative parties. Along with the growth and development of the population in Makassar City from time to time, this also has an impact on the need for Clean Water facilities and infrastructure in adequate quantity and quality, considering that Clean Water is a basic need that is very essential for the continuity of human life both from the health aspect. as well as as an aspect of driving economic growth.

Symptoms of increasing demand for clean water are expected to continue to increase along with population growth, cultural levels and technological advances (Mishra et al., 2021), so that the provision of clean water and customer satisfaction management has become the main focus (strategic sector) which is very urgent to be addressed because until now not all people enjoy the service. adequate clean water (Connor, 2015). If measured from real demand, the level of clean water services is increasing over time, this can be seen from the current trend in people's lives which are becoming more urbanized (Zhang et al., 2023; Lüdtke et al., 2021). This condition has led to an increase in demand for clean water services and more appropriate services have also become demands of the community.

Therefore, water resources must be protected so that they can continue to be useful for life and living (Mishra et al., 2021; Grönwall & Danert, 2020). Service is closely related to innovation which is a product or further development is an action that combines all new interactions from creating and managing offers, preferably through previously accessible interactions (Adypurnawati & Hariani, 2019; Peñalba-Aguirrezabalaga et al., 2022). Service innovation can

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be described as a form of service or service process that is based on the use of technology and methodical techniques.

Innovations or breakthroughs that have been carried out by Perumda Air Minum Kota Makassar which have been technically implemented to make it easier for customers to make payment transactions and innovations in equalizing and increasing water pressure in certain areas (Mujahid et al., 2021). Payment innovations that previously could only make offline payments can now make online transactions via banks, mbanking and other e-commerce (Fitriana et al., 2023). And the innovation of equalizing and increasing pressure, the Makassar City Drinking Water Company has innovated by installing inline pumps in the North and East areas of the City.

Apart from that, the innovation related to service quality that has been implemented by Perumda Air Minum Kota Makassar is that complaints which were previously based offline have now become online based such as via hotline, WA and social media, making it easier for customers to report their complaints to Perumda Air Minum Kota Makassar. Apart from that, the response from Perumda Air Minum Kota Makassar quickly responded to complaints or complaints from customers in less than 1 hour by forming a Quick Response Team which coordinated directly with the Regional Office. Now new customer service complaints in this sector are seen as new services or service improvements to customer satisfaction (Murni et al., 2024; Awadhi et al., 2021).

The Makassar City Drinking Water Perumda service that has been provided to customers is also an important issue, so research needs to be done on customer satisfaction by evaluating the performance of the Makassar City Drinking Water Perumda service to customers. Customer satisfaction is a priority for drinking water services that must be provided by the Makassar City Drinking Water Company to expand the reach of drinking water services, especially for communities where water distribution is still difficult. Where we know that service quality is the expected level of perfection and control over that perfection to meet customer needs and desires (Tjiptono, 2017).

Even though the Makassar City Drinking Water Company has innovated and improved the quality of its services, the phenomenon that occurs in the field is that there are still many communities or certain areas that have only a small supply of water or are even in the "No Water" (TDA) category (Datla, 2023). The population of Makassar City according to data from the Central Statistics Agency in 2023 is 1,436,636 people, and the number of Active Customers of the Makassar City Drinking Water Company in 2023 is 181,203 SL (Subscription Connections) or only 12.61%.

So further innovation is needed or what society currently needs, in order to increase service coverage and support the supply of clean water in various areas evenly, especially in Makassar City. Where we know that Makassar City is now becoming a Metropolitan City with the dynamics of increase and development in the number and activities of the population, the level of need for the population of Makassar City for clean water also continues to increase and continues to increase and in order to fulfill clean water for the residents of Makassar City. Perumda Drinking Water can be said to operate in the field of Clean Water provider services. Because services are activities or actions carried out for consumers/customers and with consumers/customers, they usually include a series of steps, activities and activities. The combination of all these steps or activities constitutes a process or service experience that is evaluated by consumers/customers, which can be good, bad, or just ordinary.

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Methods

The study used cross-sectional survey research method to assesses the impact of innovation and service quality on customer satisfaction of Perumda Air Minum Makassar City. This decision taken based on the positivist paradigm, which means that the social reality can be measured and quantified. This method was suitable for only exploratory analysis and for conducting research questions that were based on theories and hypotheses drawn from previous literature. The conceptual assumption of this study was anchored on the Service Dominant Logic (SDL) and the Innovation Diffusion Theory (IDT). SDL assumed that value was a joint creation of the interactions between service providers and customers, and that service quality had a direct bearing on satisfaction. Specifically, IDT postulated the following antecedent variables of innovations perceived benefits in the form of benefits of use which are perceived by users, compatibility in that innovations should match with the existing practices of the adopters. In doing so, the proposed the utilization of the seven mentioned theories of service delivery and perceived service quality to understand the impact of innovation in an overall customer satisfaction in the context of urban water utility.

Research Hypotheses

Based on the theoretical framework, the study tested the following hypotheses:Based on the theoretical framework, the study tested the following hypotheses:

H1: Innovation of Perumda Air Minum Makassar City enhanced customer satisfaction.

H2: Perumda Air Minum Makassar City has high customer satisfaction due to high service quality.

H3: This research also showed that combination of innovation and service quality has a positive and significant influence towards the perceived customer satisfaction in Perumda Air Minum Makassar City.

In this study, multiple regression analysis was used to examine the hypotheses to establish the significance of the independent variables namely innovation and service quality to the dependent variable, which is customer satisfaction.

Population and Sampling Strategy

The sample of this study encompassed all the active drinkers of Perumda Air Minum Makassar City up to the time covered by this study. Since the study targeted a potentially huge and heterogeneous sample group, the strategy that was used was saturation sampling. Saturated sampling also known as census sampling was the process of including all the members of the population in the sample. However, owing to pragmatic exigencies, the survey covered only a limited 75 customers, albeit making sure that the selections made were truly random and in effect a microcosm of customers. Criteria used to select participants were intended to provide for the inclusion of customers with different characteristics, residing in different geographical areas of Makassar City, having different socio economic status, and with different degrees of exposure to Perusahaan Daerah Air Minum Makassar services. Thus, this approach made it possible to present the finding so that they could apply to the rest of the customers.

Research Instrument

The research used a carefully constructed structured questionnaire as the major research instrument developed to capture the three key constructs of the research innovation, service quality and customer satisfaction. Consequently, the development of this instrument was driven

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by a rigorous approach, from item generation to item refinement that involved, inter alia, a comprehensive bibliographic research. The items for the innovation construct were adopted from Measures of Perceived Innovation, which is a part of the innovation diffusion theory (IDT) and widely used to assess the level of perceived innovation in services. To reflect on this arrays of innovation, these items were selected in a way to capture multi faceted aspects with respect to customer perceptions in the Perumda Air Minum Makassar City.

When measuring the service quality construct, the questionnaire items were thus derived from the SERVQUAL model, which has been developed to measure the perceived gap between the service quality as expected by the consumers and the service quality as perceived by the consumers. This model evaluates service quality across five key dimensions: tangibles are known as the physical components of the service, while reliability is the capacity to perform the services estimated and accurately, responsiveness is the readiness of the employees to assist customers and offer timely service, assurance is the familiarities of the service personnel and the ability to inspire confidence amongst customers and empathy is also the ability to treat customers individually and show concern for their needs. These dimensions were deemed necessary for providing a broad, comprehensive view on evaluating the quality of services in the Perumda Air Minum Makassar City.

In order to increase the content validity of the questionnaire the questions formulated in the first set of items were subjected to the opinion of the panel of experts who are drawn from the fields of service management and innovation. This expert panel reviewed whether all items provided adequate measure of the constructs under study and recongnized the context of the study. Users' comments allowed streamlining of several items and making them clearer and more pertinent. It made sure that while completing the questionnaire it poses theoretical relevance, and at the same time is culturally suitable for the study sample.

Data Collection Procedure

For this study, data was collected over a four week period as a way of ensuring that the information collected from the study population was detailed and systematic. This time was deemed adequate in order to ensure that the respondents would have enough time to fill in the questionnaire and also to ensure that the research team would have enough time to organise the data collection undertaking. The procedure was designed in a Most efficient and effective way to have higher response rates and reliable data collected. Prior to the commencement of data collection, ethical clearances were sought from the relevant institutional review board in order to ensure that the study was conducted in strict conformity with the laid down ethical considerations. The subjects of the study were told the purpose of the research their participation was completely voluntary and, the results of their answers would be kept anonymous. Written consent was sought from all the participants before data was collected from them, alongside an explanation to them that the data collected from them would only be used for research purposes and that their identity could not be divulged throughout the research process.

The questionnaire was administered through online and face to face administration procedures so as to capture a diverse population. Concerning the online distribution, participants with access to the Internet was required to complete a questionnaire through an online survey. This method was chosen because of the effectiveness and the possibility to share the information within a short time with a large number of people who are sufficiently used to using digital platforms. These precaution were taken to ensure that this questionnaire got to all segments of the population, this questionnaire is face and easy to understand and fill.

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Concerning the remaining customers, who could probably not fill an online survey, face to face distribution was done. The questionnaire was also self administered, but the research assistants were able to administer it face to face with respondents at different service centers of Perumda Air Minum Makassar City. It was particularly helpful for reaching out to a fairly different population who are not quite as active in the digital space or who prefer face to face communication. The research assistants were instructed to read through and explain each of the questions to the respondents in order to guarantee that the questions were understood and answered in the manner in which they were intended to be answered. This method also created a way where we could respond to any questions or issues the participants might have developed upon completing the questionnaire.

To mitigate the influence of non response bias a follow up strategy was adopted. For cases of online externals, e-mail and text message follow up was done to remind them to complete the online questionnaire if they have not done so. In the cases where the respondents were contacted directly, it was possible to follow them up in order to get some of them to complete the questionnaires hence increasing their response rates. This consistent contact had to be made in order to guarantee that the sample achieved a correct representation of the whole population and the collected data were exhaustive.

Data Analysis Strategy

Data analysis for this study was done systematically to ensure validity and reliability of the results in the following sequenced manner. The first step of Dis stands for data description which encompassed the use of measures of central tendency, measures of dispersion and measures of frequency. These descriptive statistics were used first to describe the demographic profile of respondents, and second to give an initial impression of the distribution and centrality of the main variables of interest, namely innovation, service quality and customer satisfaction.

Subsequently to the descriptive analysis, the reliability and validity of the measurement scales were also examined. The reliability of each created scale was evaluated using Cronbach's Alpha; the standard set was 0zielona. 70 being used to define acceptable reliability level. This test made it possible to establish that the items in each scale were valid, that is, were measuring the same thing in a consistency. Reliability was assessed besides conduct validity, which was, in turn, checked using exploratory factor analysis. This technique was used to check the validity of the items which were used in the study and loaded appropriately on their correct factors in terms of innovation, service quality, and customer satisfaction. This was done with the aid of EFA which aided to establish the dimensionality of the constructs and given assurance that, the scales used were indeed valid measure on the intended variables.

After this, the study checked for multicollinearity among the independent variables, which is the condition where the variables are too much related. This was done with a view of determining the Variance Inflation Factor (VIF) and tolerance statistics. When multiple independent variables in a model are correlated, multicollinearity can increase the variance of the coefficient estimates thereby threatening the stability of the model a reason why it has to be detected and dealt with. Also, the study checked for heteroscedasticity, that is, equal variance of the residuals of the regression model. Breusch-Pagan test was adopted for the purpose of checking heteroscedasticity. Heteroscedasticity is also a source of inefficiency and produces inaccurate tests and coefficients, and therefore, its existence must be addressed.

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Result and Discussion

The results of data collection carried out on 75 customers of Perumda Air Minum Kota Makassar who were used as respondents obtained the characteristics of respondents based on gender, age and education , including:

By Gender

The characteristics of respondents based on gender can be seen in the table below:

Table 1. Characteristics of Respondents Based on Gender

		Frequencies	Percent	Valid Percent	Cumulative Percent
Valid	Man	32	42.7	42.7	42.7
	Woman	43	57.3	57.3	100.0
	Total	**75**	**100.0**	**100.0**	

Data obtained through spread questionnaire show that proportion biggest from respondents is manifold sex Woman as many as 43 people or 57.3% and men as many as 32 people or 42.7% of the total 75 customers or 100%.

Characteristics Respondent Based on Age

The characteristics of respondents based on age can be seen in the table below:

Table 2. Characteristics of Respondents Based on Age

		Frequencies	Percent	Valid Percent	Cumulative Percent
Valid	20-25	3	4.0	4.0	4.0
	26-30	15	20.0	20.0	24.0
	31-35	22	29.3	29.3	53.3
	36-40	18	24.0	24.0	77.3
	41-45	8	10.7	10.7	88.0
	46-50	9	12.0	12.0	100.0
	Total	**75**	**100.0**	**100.0**	

Data obtained through spread questionnaire show that respondents according to age show age highest are aged 31-35 years as many as 22 people or 29.3%, aged 20-25 years as many as 3 people or 4%, aged 26-30 years as many as 15 people or 20%, aged 36-40 years as many as 18 people or 24% and aged 41-45 years as many as 8 people or 10.7% and aged 46-50 years as many as 9 people or 12%.

Based on Education

The characteristics of respondents based on gender can be seen in the table below:

Table 3. Characteristics of Respondents Based on Education

		Frequencies	Percent	Valid Percent	Cumulative Percent
Valid	Elementary School	15	20.0	20.0	20.0
	Junior High School	14	18.7	18.7	38.7
	Senior High School	22	29.3	29.3	68.0
	Bachelor	17	22.7	22.7	90.7
	Master	7	9.3	9.3	100.0
	Total	**75**	**100.0**	**100.0**	

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Data obtained through distributing questionnaires shows that the largest proportion of respondents had a high school education of 22 people or 29.3%, 15 people had an elementary school education or 20%, 14 people had a junior high school education or 18.7%, 17 people had a bachelor's degree or 22.7% and 7 people had a master's degree or 9.3% of the total 75 people or 100%.

Data Analysis Method

Results of Descriptive Statistical Analysis

Descriptive variable categories describe respondents' responses regarding Innovation, Service Quality and Customer Satisfaction. This descriptive statistical analysis includes the average value (*mean*), standard deviation, maximum value and minimum value. The following are the results of descriptive statistical analysis as follows:

Table 4. Descriptive Statistical Analysis

Descriptive Statistics					
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
X1.1	75	4.00	5.00	4.7600	,42996
X1.2	75	4.00	5.00	4.7600	,42996
X1.3	75	3.00	5.00	4,4800	,52915
X1.4	75	3.00	5.00	4.5733	,52436
X1.5	75	2.00	5.00	4.8267	,47572
Total_X1	**75**	**20.00**	**25.00**	**23,4000**	**1.20808**
X2.1	75	1.00	2.00	1.7333	,44519
X2.2	75	1,00	3,00	1,9067	,66115
X2.3	75	1,00	3,00	1,8400	,69826
X2.4	75	1,00	5,00	1,6933	,71610
X2.5	75	1,00	3,00	1,7600	,63331
Total_X2	75	6,00	15,00	8,9333	2,13297
Y1	75	3,00	5,00	4,4000	,59275
Y2	75	4,00	5,00	4,4933	,50332
Y3	75	4,00	5,00	4,5733	,49792
Y4	75	3,00	5,00	4,2133	,50117
Y5	75	4,00	5,00	4,5067	,50332
Total_Y	**75**	**19,00**	**25,00**	**22,1867**	**1.24871**
Valid N (Listwise)	75				

Based on the provided table, it can be inferred that the descriptive statistics for the Innovation variable, with a sample size of 75 respondents, indicate a minimum value of 2, a maximum value of 5, an average value of 4.68, and a standard deviation of 0.24. The descriptive statistics for the Service Quality variable, based on a sample size of 75 respondents, are as follows: the lowest value is 1, the highest value is 5, the average value is 1.78, and the standard deviation is 0.42. The descriptive statistics for the Customer Satisfaction variable, based on a sample size of 75 respondents, are as follows: the lowest value is 3, the highest value is 5, the average value is 4.43, and the standard deviation is 0.24.

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Validity test

The data in this study was assessed for validity using statistical techniques, namely by calculating the correlation between each question and the overallscore using the product moment Pearson correlation method. The data is considered genuine if the computed r value, obtained from the Corrected Item Total Correlation, is greater than the critical r value from the r table at a significance level of 0.05 (5%). The data's validity was assessed using the Pearson Correlation method. The validity test results for each variable are shown below:

Table 5. Innovation Validity Test Results (X1)

Instrument Study	r count	r table	Information
Innovation	0.747	0, 224	Valid
Innovation	0.669	0, 224	Valid
Innovation	0.662	0, 224	Valid
Innovation	0.793	0, 224	Valid
Innovation	0.622	0, 224	Valid

Test result validity show that all items in variable Innovation tested in study state that each instrument statement considered valid because Corrected Item *Total Correlation* value > *from r table* at a significance of 0.05 (5%).

Table 6. Service Quality Validity Test Results (X2)

Instrument Study	r count	r table	Information
Quality Service	0.709	0, 224	Valid
Quality Service	0.714	0, 224	Valid
Quality Service	0.827	0, 224	Valid
Quality Service	0.809	0, 224	Valid
Quality Service	0.718	0, 224	Valid

Test result validity show that all items in variable Quality Service tested in study state that each instrument statement considered valid because Corrected Item *Total Correlation* value > *from r table* at a significance of 0.05 (5%).

Table 7. Validity Test Results of Customer Satisfaction (Y)

Instrument Study	r count	r table	Information
Satisfaction Customer	0.773	0, 224	Valid
Satisfaction Customer	0.704	0, 224	Valid
Satisfaction Customer	0.678	0, 224	Valid
Satisfaction Customer	0.673	0, 224	Valid
Satisfaction Customer	0,699	0, 224	Valid

Test result validity show that all items in variable Satisfaction Customer tested in study state that each instrument statement considered valid because Corrected Item *Total Correlation* value > *from r table* at a significance of 0.05 (5%).

Reliability Test

Reliability testing may be comprehended by focusing on the fundamental notion of the concept, which is consistency. Researchers may assess research instruments using many views and approaches. However, the key issue for determining data dependability is the degree of consistency in the obtained data. Reliability measurement employs a quantitative indicator known as a coefficient. Reliability may be assessed using three methods: stability coefficient,

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equivalence coefficient, and internal consistency reliability. Reliability testing is a quantitative method used to assess the consistency and accuracy of a questionnaire, which serves as an indication of a certain variable. A questionnaire is considered trustworthy if the responses provided by the participants are consistent and unchanged throughout a period of time. A research instrument is considered dependable if the reliability coefficient, determined using the Cronbach Alpha (α) statistical test, is more than 0.60.

Table 8. Reliability Test Results

Variable	Cronbach's Alpha	Limits of Reliability	Ket
Innovation	0,764	0.60	Reliable
Quality Service	0,662	0.60	Reliable
Satisfaction Customer	0,690	0.60	Reliable

The table above shows that Cronbach's value The alpha of all variables is greater than 0.60, so it can be concluded that the instrument from the questionnaire used to explain the Innovation and Service Quality variables is declared reliable or trustworthy as a measuring tool for the Customer Satisfaction variable.

Normality test

Normality test completed to determine if residual values are regularly distributed or not. Conducting a test to see whether the data is within the scope of the research. This may be accomplished via two methods: using analytical graphics and conducting statistical tests. A histogram graph and a Probability Plot graph may be used for graphic analysis to see the normal distribution. Additionally, the one sample Kolmogorov-Smirnov test may be used to do statistical testing. This test is intended to obtain more comprehensive data as to whether a regression equation that will be employed passes normality. A regression equation is considered to satisfy the normality assumption if the p-value of the Kolmogorov Smirnov test is higher than 0.05. The results of the normality test indicate that the data follows a normal distribution. This is shown by a significance value greater than 0.05.

Table 9. Normality Test Results

		Unstandardized Residual	VAR00001	VAR00002
N		75	75	75
Normal Parameters[a,b]	Mean	,0000000	22,2533	8,9333
	Std. Deviation	1,19877917	1,61156	2,13297
Most Extreme Differences	Absolute	,072	,212	,149
	Positive	,050	,135	,149
	Negative	-,072	-,212	-,085
Test Statistic		,072	,212	,149
Asymp. Sig. (2-tailed)		,200[c,d]	,000[c]	,000[c]

From the table above, it can be seen that the significance of the Kolmogorov Smirnov value is above the 5% confidence level, namely 0.2, this shows that the data is normally distributed.

Multicollinearity Test

The purpose of the multicollinearity test is to determine whether there is a strong correlation between the independent variables in a multiple linear regression model. Multicollinearity refers to the presence of a linear connection between two or more independent variables in a

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regression model. The presence of multicollinearity may be assessed by examining the Variance Inflation Factor (VIF) and tolerance values. Multicollinearity does not arise if the Variance Inflation Factor (VIF) number is less than 10 and the tolerance value is more than 0.10.

Table 10. Multicollinearity Test Results

Coefficients [a]			
Model		**Collinearity Statistics**	
		Tolerance	**VIF**
1	Innovation X1	,993	1,007
	Quality X2	,993	1,007
a. Dependent Variable: VAR00003			

Based on results testing above, because VIF value for all variable own mark more small than 10 and the tolerance value is more big of 0.10, then can concluded No there is symptom multicollinearity between variable independent.

Heteroscedasticity Test

The heteroscedasticity test is conducted to determine if there is unequal variance in the residuals of a regression model across different observations. Homoscedasticity refers to the condition where the variance and residuals remain constant across different observations, whereas heteroscedasticity refers to the presence of differences in variance and residuals.

Heteroscedasticity is a desirable characteristic of a good regression model. When making conclusions about the heteroscedasticity test, specifically, if the significance value is over 0.05, the conclusion is that heteroscedasticity is not present. If the p-value is less than 0.05, it may be concluded that heteroscedasticity is present.

Table 11. Heteroscedasticity Test Results

Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std. Error**	**Beta**		
1	(Constant)	1,028	1,208		,851	,397
	X1	,002	,051	,006	,048	,962
	X2	-,012	,038	-,038	-,318	,751
a. Dependent Variable: RES2						

Based on the table above, it shows that the significance values obtained for the Innovation and Service Quality variables are 0.962 and 0.751, so it can be concluded that there are no variables that contain heteroscedasticity because the significance value is > 0.05.

Multiple Regression Analysis

This method is used to test the influence of the independent variable on the dependent. The test results are displayed as follows:

Table 12. Multiple Regression Analysis

Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std. Error**	**Beta**		
1	(Constant)	27,152	2,096		12,955	,000

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	X1	,218	,088	,281	2,474	,016
	X2	-,014	,066	-,023	-,205	,838
a. Dependent Variable: Y						

Based on the data in the table above, it can be seen the regression coefficient value of Innovation and Service Quality on the Customer Satisfaction variable respectively 0.218 (X 1) and -0.014 (X 2) with a constant value of 26.099 . Thus, the following regression equation is formed:

The regression equation above can be explained as follows:

Y = 27,152+0,218X1+-0,014X2+e

According to the above equation, when the constant value is set to 27.152 (a = 27.152), the independent variable (Innovation and Service Quality) will be zero (0), resulting in the dependent variable Customer Satisfaction being equal to 27.152. The coefficient of innovation (b1) has a value of 0.218, indicating a positive relationship. This implies that a 1% rise in Innovation will result in a 27.152 increase in the Customer Satisfaction measure, providing all other variables remain unchanged. The coefficient of cash planning accuracy (b2) is -0.014, indicating a negative value. For each 1% reduction in Service Quality, the Customer Satisfaction variable will fall by 27.152 providing all other variables remain constant.

Partial Test Results (T Test)

The t test was carried out to see how far the influence of one independent variable individually was in explaining variations in the dependent variable tested at the 0.05 significance level. The t test results are shown in the table below:

Table 13. Partial Test Results (T Test)

Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**Q**	**Sig.**
		B	**Std. Error**	**Beta**		
1	(Constant)	27,152	2,096		12,955	,000
	X1	,218	,088	,281	2,474	,016
	X2	-,014	,066	-,023	-,205	,838

The t-test measures the extent to which an independent variable has a partial or individual effect on the dependent variable. The data above indicates that the regression model coefficient remains constant at 27.152. It also reveals a positive t-value of 12.955 and a significance level of 0.000. A constant value of 27.152 indicates that while the independent variable is unchanged, the average Customer Satisfaction variable is also 27.152.

The t-test results for the Inovas variable indicate a computed t-value of 2.474, with a significance level of 0.016. This indicates that the significance level is less than 5% or 0.05 (0.05 > 0.016) and the estimated t-value is higher than the critical t-value from the t-table (2.474 > 1.665). Therefore, it can be inferred that innovation has a positive and substantial impact on customer satisfaction.

The t-test findings for the Service Quality variable indicate a computed t-value of -0.205, with a significance level of 0.838. This indicates that the significance level is more than 5% or 0.05 (0.05 < 0.838) and the estimated t-value is less than the critical t-value (-0.205 < 1.665). Therefore, it can be inferred that Service Quality does not have any impact on the variable of Customer Satisfaction.

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Coefficient of Determination Test Results (R2 Test)

Based on the results of the coefficient of determination test, it can be seen in the table below:

Table 14. Determination Coefficient Test Results (R2 Test)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,780 [a]	,638	,653	1.81532
a. Predictors: (Constant), X2, X1				
b. Dependent Variable: Y				

According to the provided data, the R value is 0.780. Based on the correlation interpretation rules, this result falls into the high or strong correlation category since it is within the range of 0.50 to 0.80. These findings indicate that the factors of Innovation and Service Quality have a significant impact on Customer Satisfaction. Based on the above data, it can be determined that the R 2 value is 0.780. This indicates that 78.0% of the Customer Satisfaction variable is impacted by the Innovation and Service Quality variables. The remaining 20.0% is determined by other factors that have not been investigated in this study.

Simultaneous Test Results (F Test)

The model test in this research was used to test whether the model prepared by the researcher was acceptable. The model test results can be seen in the table below:

Table 15. Simultaneous Test Results (F Test)

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	9,043	2	4,522	4,061	,003[b]
	Residual	106,343	72	1,477		
	Total	**115,387**	**74**			
a. Dependent Variable: Y						
b. Predictors: (Constant), X2, X1						

From the table above, the Fcount results are greater than Ftable (4.061 > 2.727) and the significance level is 5% or 0.05 smaller than the significance results of the simultaneous test (0.003 < 0.05). With these results, the Innovation and Service Quality variables simultaneously have a positive and significant effect on Customer Satisfaction.

Interpretation of Research Results

Technology Driven Innovation Imperative to Improving Customer Satisfaction

The conclusions of this study also stress the importance of innovation in enhancing customers' satisfaction in Perumda Air Minum Makassar City. Innovation Theory postulates that when customers feel that an organisation is using new and improved practices, they are likely to be satisfied with the service received (Ogunmokun et al., 2021; Jamshidi & Kazemi, 2020) this is consistent with the finding linking customer satisfaction ($\beta = 0.218$, $p < 0.05$) with innovation. This outcome is not only a verification of theoretical predictions but also an indication of the increasing use of innovation as a management tool in the PU sector which generally lags behind the private sector's use of innovation.

At the center of this kind of relationship are the concrete innovations that were introduced and adopted by Perumda Air Minum Makassar City including the online payments option and the formation of the Quick Response Team. They are not evolutionary improvements in the service provider customer relationship model, they are revolutionary. Frameworks such as streamlining in-person payments, and reaction to service concerns have tackled history pains

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showing that any time solutions have made customer experience a more convenient and even more value added endeavor (Mujahid et al., 2021; Jameaba, 2024).

This finding is supported by the existing literature on service innovation as it established that innovations of customer closeness are likely to increase customer satisfaction since they solve people's problems directly (Adypurnawati & Hariani, 2019; Alzoubi et al., 2022). But it also raises questions about what innovation in the delivery of services might mean more broadly. Although innovations can create a great value for the customer it is also important to understand that they add new challenges that have to be face. For example, Pacey & Bray (2021) indicate that over-relies on digital technologies to improve efficiency to increase a digital divide so that clients who are not tech savvy end up losing their bearings or eventually become out of place in the operations.

According to the study, it is possible to argue that Perumda Air Minum Makassar City has managed to overcome the named problems while putting into practice innovations that will help to improve the overall picture of the customers' experience while at the same time not setting up new barriers on this way (Talwar et al., 2020). But this success story should make one wonder about what sort of conditions might underlie the negative consequences of innovation. for instance, progression research could evaluate situations that innovational changes are seen by customers as undesirable or done in a wrong way that only leaves them frustrated. Awareness of these conditions is important for formulating a less general approach toward innovation management, especially within entities such as public utilities which have a high service delivery accountability (Brummel, 2022; Nuhu et al., 2020; Sofyani et al., 2020).

Furthermore, it is important to point out the specific application of the role of innovation in public utilities and it poses certain important questions over the development of the services in this segment. According to Connor (2015) and Zhang et al. (2023), the growing trend in urbanization plus the quest for efficient delivery of public services puts a lot of pressure on utilities to come up with innovations regularly. Hence, innovation does not mean only increasing services' quality it means changing the model of services delivery to respond to the new customer's needs and demands. This view accords with the general drive for digitization across organizations, in which the creation of innovation is viewed as a way of gaining a competitive edge and customer patronage.

Paradox in Customers' Perceived Service Quality

Perhaps, one of the most interesting lessons derived from this research is the lack of direct correlation between the antecedents of service quality and the level of customers' satisfaction in the Perumda Air Minum Makassar City. This result refutes the orthodoxy that service quality is the main driver of customer satisfaction, and is well-founded in the literature (Tjiptono, 2017). The existence of such a contradiction raises the question about possible attributes of service quality that may or may not be effective for usage in the context of public utilities.

Service quality might therefore be suggesting a paradox, and the answer to this could be found in the aspects of service quality that the SERVQUAL model used in this study sought to measure: tangibles, reliability, responsiveness, assurance and empathy (Kharub et al., 2021; Anas, 2024). That is why, in a public utility, especially in an industry as vital as water supply, customers might judge the service differentially focusing on some aspects as compared to others. For example, reliable and available service might be more important to the customer than variables such as care, or the appearance of service outlets (Mishra et al., 2021). Perhaps this shift in customer priorities might had explained why the conventional service quality factors that were used did not determine satisfaction in this research.

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However, there seem to be considerable overshadowing effects exerted by innovation that appear to have contributed to this result. Perumda Air Minum Makassar City may have changed the expectations by introducing some innovativeness that make these reflect more of a salience than an actual service quality in the view of customers. This study agrees with Awadhi et al (2021) who postulate that in settings where innovation is present, the customers may regard innovation as the fourth dimension of service quality. This shift could mean that customer have become accustomed to expecting a level of traditional service quality and are more likely to notice and respond positively to innovativeness than before (Lee et al., 2022; Truong et al., 2020).

As highlighted earlier, the generalization of the findings means that further investigation is required to understand dynamics of service quality of public utility organisations in the current and emerging contexts (Medberg & Grönroos, 2020). In particular, it would be useful to follow up this study under the null hypothesis that Perumda Air Minum Makassar City is not unique in terms of its service quality non-significance and/or that customer expectation shift is not particular to it either. Also, knowledge could be extended on analysing how various dimensions of service quality moderate innovation and customer satisfaction (Chaithanapat et al., 2022). Such studies would add to the existing knowledge base regarding the customer satisfaction in public utilities to improve customer satisfaction with the service delivery in this sector.

The Interaction between the Technological and the Quality of Service

Even though service quality by its own did not prove to be a significant factor for either innovators or non-innovators, the additive composite of innovation and service quality turned out to be significant concerning customer satisfaction level. The value that arises from accomplishing this work is that it concludes that innovation can be significant to satisfaction, however when it is backed by high service quality, it works more effectively (Novitasari et al., 2022). Altogether these factors jointly accounted for a considerable amount of variance in customers' satisfaction, higher than seventy five percent, and this underscore the idea that the factors are not necessarily independent of each other as they in fact interrelate.

This match between innovation and service quality is a key integration that is in consonant with the work done elsewhere that postulated satisfaction as a complex construct that is a function of multiple factors (Fatima & Elbanna, 2023). For example, while innovation is about presenting new and efficient ways of engaging these services, it is the service quality that guarantees that the new developments are well implemented. Hence, it stands for the proposition that no matter how highly technical or sophisticated a service innovation is, it cannot yield the requisite benefits if it rests on a weak frame of service quality.

Indeed, it means that it is possible to use the factor that has been identified as the moderating or mediating variable in the relationship between service quality and customer satisfaction. Innovation may increase the potential service quality to elevate the efficiency level of service delivery and to increase the multiplier effect of high service quality (Adypurnawati & Hariani, 2019). On the other hand, the customers might increase the perceived values of high-quality services when these services are delivered through the new methods indicating an interaction effect of these variables (Nguyen et al., 2021; Rahardja et al., 2021).

The consequent of such synergy is very significant to public utilities like Perumda Air Minum Makassar City. This implies that rather than regarding innovation as a substitute for service quality it was most suitable to consider it as an accompaniment of service quality (Rubalcaba, 2022). In light of this, instead of directly calling for devotion to a single customer service pillar as some scholars have suggested, public utilities should approach customer service with a

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systematic concept that involves the ongoing enhancement of services as well as the concept of innovation that places a customer at the center (Aarons et al., 2011). Using this approach, the changes result in improvement of the overall client experience while, at the same time, making sure that change is anchored on solid service delivery thereby, making them better when implemented in the long run.

The next studies could extend this analysis of innovation's positive effect on service quality by comparing or analyzing different kinds of innovations and by studying service quality's various dimensions in the context of a range of public services organizations. For instance research could examine the moderating role that technological supports like those of service platforms have on relationships between more established service quality variables like reliability and responsiveness, on customer satisfaction (Ruiz-Alba et al., 2022; Nguyen & Malik, 2022). They would be useful in advancing knowledge of appropriate approaches for improving the provision of services by public utilities irrespective of the growing competition and complex technological systems.

The present research provides real valuable information concerning the interactions between innovation, service quality, and customer satisfaction in an environment of a public utility organization (Mohammad Salameh et al., 2018; Ali AlShehail et al., 2022). The results thus refute orthodoxy thinking that developing and maintaining high service quality is the optimal way for achieving high levels or customer satisfaction and call for a new focus on innovation as a key determinant of satisfaction. However, the study also emphasizes the need to take a closer look at the relationship between innovation and service quality pointing the fact that they are most beneficial when delivered in conjunction with a proper service delivery model (Tajeddini et al., 2022; Al-Gasawneh et al., 2022).

Reflecting on the findings of the study among the public utilities, it is possible to point to the optimization of the processes in these organizations requires combining innovation and a focus on the quality of services provided. It also serves the noble purpose of improving customer satisfaction as well as the over-all sustainability of the delivery of particular services within the competitive and rapidly, technologically transforming industry. Further research in this field continues, to derive further and more precise models of the customer satisfaction that is going to reflect the new role that has been given to the innovation in the provision of public services.

Conclusion

The study established that the impact of innovation on customer satisfaction is very high most probably because most customers believe that new methods of service delivery are preferable to the old ones. These innovations have been helpful in dealing with major issues that customers have and, therefore, increases the level of satisfaction. This was an indication that it was imperative for public utilities to strive to continue to innovate in a bid to retain significance and market share ad adapt to the growing customer expectations that are pegged on available technological and service improvements. Service quality did not performed out as an independent factor that explains customers' satisfaction in this study. This has implication that in an environment where innovation is recognised, it may be possible for the traditional dimensions of service quality to be considered less important by customers. This does not mean that service quality is unimportant; it means that service quality may now be defined as pickets rather than bar, or as meeting expectations rather than surpassing them. When service quality is homogeneous hence trustworthy, customers are likely to pay attention to how the innovations contribute to the experience they accrue from the services offered. The analysis of these two aspects disclosed synchronizing reciprocation since innovation and service quality determine the level of customers' satisfaction. This synergy reveals the reason why it has become

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fashionable for public utilities to fuse innovation with the fundamentals of service delivery. These elements should not be treated as matters of separate concern, but rather should be an ongoing process of developing a systems approach wherein innovation is always aimed at improving service delivery characteristics rather than merely replacing them.

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