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Web system for treasury control in service and sanitation management boards

Sistema web para el control de tesorería en juntas administradoras de servicio y saneamiento

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ABSTRACT

Treasury control in service and sanitation management boards is an essential process to ensure the proper management of financial resources in rural communities. The objective of the study was to implement a web-based system to optimize treasury control in an administrative board of a Peruvian village center. The research had a quantitative approach, applied and pre-experimental design. A sample of 20 participants evaluated the system in terms of effectiveness, reliability, usability and efficiency. The results indicated that, prior to implementation, 85% had a neutral perception of the effectiveness of the cash control system and 90% had a neutral perception of satisfaction. After implementation, 100% of the participants reported a positive perception. The Student's t-test showed a significant improvement, with a p-value of 0.000, confirming the impact of the system on financial management. It is concluded that the use of the web system optimized treasury control, improved transparency and reduced administrative errors, suggesting its application in other similar entities.

Keywords: financial management; automation; digital administration; accounting software; accounting software

RESUMEN

El control de tesorería en las juntas administradoras de servicio y saneamiento es un proceso esencial para garantizar la adecuada gestión de recursos financieros en comunidades rurales. El objetivo del estudio fue implementar un sistema web para optimizar el control de tesorería en una junta administradora de un centro poblado peruano. La investigación tuvo un enfoque cuantitativo, de tipo aplicado y diseño pre-experimental. Se trabajó con una muestra de 20 participantes, quienes evaluaron el sistema en términos de eficacia, confiabilidad, usabilidad y eficiencia. Los resultados indicaron que, antes de la implementación, el 85% tenía una percepción neutral sobre la eficacia del control de tesorería y el 90% sobre la satisfacción. Tras la implementación, el 100% de los participantes reportó una percepción positiva. La prueba T de Student evidenció una mejora significativa, con un p-valor de 0,000, confirmando el impacto del sistema en la gestión financiera. Se concluye que el uso del sistema web optimizó el control de tesorería, mejoró la transparencia y redujo errores administrativos, sugiriendo su aplicación en otras entidades similares.

Palabras clave: gestión financiera; automatización; administración digital; software contable

1. INTRODUCTION

Treasury control is considered to be the set of policies, norms and technical procedures aimed at regulating administrative operations carried out in public or private entities, which, according to Arteta Olvea (2019), its deficiency could affect the management and regulation of financial management, to such an extent of being detrimental by not having liquidity to maintain the balance of the accounts collected by the treasury.

According to Grajales Gaviria & Castellanos Polo (2018), the most frequent frauds in public entities occur in the treasury department due to the inadequate structuring of institutional processes and technological infrastructure; these cause weaknesses in the control mechanisms, conceiving risks such as theft, economic losses and organizational image losses. On the other hand, Garza Sánchez et al. (2017) refer that devoting additional efforts to the accounting operation can skew the sustainability of the transparency of payment and expense control activities, thus generating risks or crises in fund management and failures in collections.

Montenegro Pozo (2018) acknowledges that the inconveniences that arise in the treasury control process are basically due to the fact that the movements are recorded manually, which leads to poor monitoring of paid and unpaid pensions, which leads to incorrect supply and budget planning. In addition, Flórez Villadiego & Martínez Velásquez (2018) reflect that there are complications in identifying the rate of delinquency of pension debts, reflecting the fullness of the problem that involves the income deficit to meet obligations and social activities.

Regarding the Service and Sanitation Administrative Boards, also known as JASS, according to Verdesoto Velástegui et al. (2018), they are necessary for sustainable development in rural communities or in social-geopolitical growth; however, these organizations lack state support, showing low training for the management of administrative processes, with this the lack of planning and order of records of income and expenses made by the services.

Thus, after conducting an on-site interview with the administrative staff in charge of the treasury at the JASS in the Bello Horizonte population center, located in the district of La Banda de Shilcayo, San Martín region, Peru; the deficient financial control process in cash was identified as a result of the lack of knowledge of treasury management and the disorganization of the documents generated by payments and expenses. In addition, it was recognized that treasurers have low training in skills in the use of information and communication technologies, leading to a lack of knowledge of the digitalization of administrative processes for treasury control; In addition, since the staff makes the records manually, overloaded work is generated (García Zambrano et al., 2019; Hossain & Rahman, 2022).

On the other hand, Huamán Varas & Huayanca Quispe (2017) identified that the payment and expense registration processes are prepared on notebook sheets or paper cards, conceiving on recurrent occasions the loss of the same, which together, leads to the absence of management and investments with the collected funds and the poor control of the people who present late payments for the services. Added to this, is the low awareness for the use of technological tools, which generates the use of own criteria to manage the administrative documents, highlighting in this way the insufficient tools for the treasury control process (Rosales Borbor et al., 2017).

All this has repercussions, according to Navarro Silva et al. (2017), on the deficiency in the provision of information on investments and financial projections for the improvement of services in the town. In addition, they infer that poor conservation and internal control of the issued receipts generate the loss of misplaced documents. In general, these consequences lead to the loss of money collected (misappropriation of funds) in the services of the JASS in the town of Bello Horizonte.

Given this situation, the present investigation aimed to determine the influence of the use of a web system on treasury control at JASS Bello Horizonte; to do so, the specific objectives were to identify the current

state of treasury control; design and implement a web system for treasury control and measure the influence of the use of the web system on treasury control.

2. MATERIALS AND METHODS

2.1. Research design

The hypothetical-deductive method was chosen, since a phenomenon (treasury control) was observed in order to create a hypothesis that can explain said phenomenon and at the same time deduce elementary conclusions based on the manipulation of a web system. On the other hand, the study was of an applied type because it was proposed to solve a concrete and determinable problem; of a quantitative approach because it was sequential and probative, of a rigorous order, in which the variables were measured and analyzed through statistical methods and conclusions were formulated according to the hypothesis. Regarding the scope, it was explanatory since the causes of the phenomenon were determined to explain the influence of a web system on treasury control, in order to generate a sense of understanding by establishing relationships (Hernández Sampieri et al., 2014) . Likewise, an experimental design was considered, of a pre-experimental type, since a single sample was evaluated in two times, before and after the implementation of a web system.

2.2. Unit of analysis

The population consisted of JASS staff who perform the treasury control function and are involved in the administrative process, which totaled 20 individuals. Because the population was finite and known, the sample was 100% of the population. This corresponds to a non-probabilistic convenience sampling. Additionally, 20 records of the time required to record payments, expenses, balances and identification of late payments (indicators) were taken into account; to measure the influence of the web system on the traditional (manual) method of treasury control.

2.3. Data collection instruments

The survey technique and direct observation were used, with their respective questionnaire instruments and data registration forms, which were validated by expert judgment. For the independent variable (web system), 4 indicators were measured: functionality, reliability, usability and efficiency. For the dependent variable, the indicators of payment and expense registration time, report generation time, balance sheet accuracy, time to identify late payments, administrative performance, service time, service reliability and service satisfaction were measured.

2.4. Data analysis

The collected data were tabulated in Excel 2019 spreadsheets to facilitate their organization, and then processed using the SPSS version 26 package to prepare tables and figures through frequency analysis. To perform the inferential statistical analysis in order to respond to the research hypothesis, the assumption of data normality was verified using the Shapiro-Wilk test for samples of less than 50 elements, as a normal and non-normal distribution was presented, the T-Student and Mann-Whitney U statistical tests were applied.

2.5. Software development

The software development was carried out using the agile Extreme Programming (XP) methodology, which allowed for close collaboration between developers and end users (Guerrero Hernández et al., 2024; Pinedo et al., 2023). During the planning phase, interviews were conducted to collect the functional requirements (Table 1), which covered user management, resident and property records, cash management, and report generation. A modular architecture was designed that includes four main components: Owners and

Properties, Cash, Administration, and Reports. The system design prioritized simplicity and usability, which facilitated its implementation and subsequent adoption.

Table 1. Functional requirements

Nº	Requirements
1	Support login via user authentication
2	Creating, viewing, editing and deleting resident records
3	Creating, viewing, editing and deleting property records
4	Automatic generation of fees for service charges
5	Support for opening and closing cash register operations
6	Viewing cash transactions
7	Record of cash income and expenses
8	Cancellation of cash movements
9	Monitoring accounts in financial institutions
10	Creating, viewing, editing and deleting branches
11	Viewing services
12	Editing service prices
13	Creating, viewing, editing and deleting boxes
14	Creating, viewing, editing and deleting vouchers
15	Creating, viewing, editing and deleting banking entities
16	Creating, viewing, editing and deleting employees
17	Creating, viewing, editing and deleting user profiles
18	Viewing and editing user profile permissions and access
19	Creating, viewing, editing and deleting users
20	Generation of reports of residents and properties
21	Generation of movement reports

In technological terms, the system was developed using the Laravel 8 framework, based on PHP, and was structured following the Model-View-Controller (MVC) design pattern. The business logic was implemented using Eloquent ORM, which facilitated the interaction with the MySQL database (Appendix 1), used as the information storage engine. For the user interface, a Single Page Application (SPA) model was adopted, guaranteeing a fluid and dynamic experience for users. The system was deployed on a server with a Linux operating system, running an Apache web server and PHP version 7.4.

The software development included functionalities such as user authentication, role-based access control, generation of reports in PDF and Excel formats, and cash register operations with opening, closing and cancelling movements. The user interface was designed in an intuitive manner, allowing efficient management of records and facilitating decision-making through information panels. In addition, the implementation of validations in the frontend and backend guaranteed the integrity and security of the data, minimizing errors and improving the reliability of the system. Finally, to evaluate the perception of users regarding the web system, a survey was applied, based on the ISO 9126 standard – Product quality.

3. RESULTS AND DISCUSSION

3.1. Interfaces of the implemented software

The first screen shows the login interface of the "JASS Bello Horizonte" system (Figure 1). It featured a clean and modern design with a blue gradient background and a system access form. In this form, users were required to enter their credentials, such as username and password, and had the option to check "Remember me" to facilitate future access. In addition, it included a prominent "Login" button, which allowed for easy and quick access to the system.

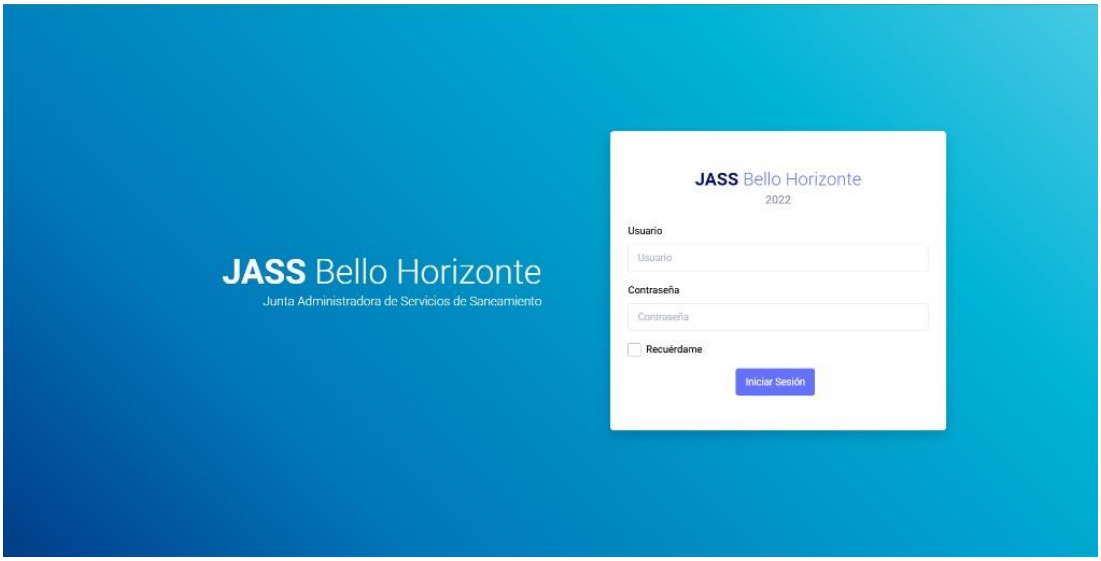

Figure 1. Login screen

The second screen shows the system's dashboard (Figure 2). In this interface, data on the status of managed services was presented, including the number of active and suspended services and payment distributions in a pie chart. Important metrics, such as revenue generated, were also displayed, allowing administrators to monitor the financial and operational status of JASS in real time. The design was minimalist and organized, with a navigation sidebar that facilitated access to other sections of the system.

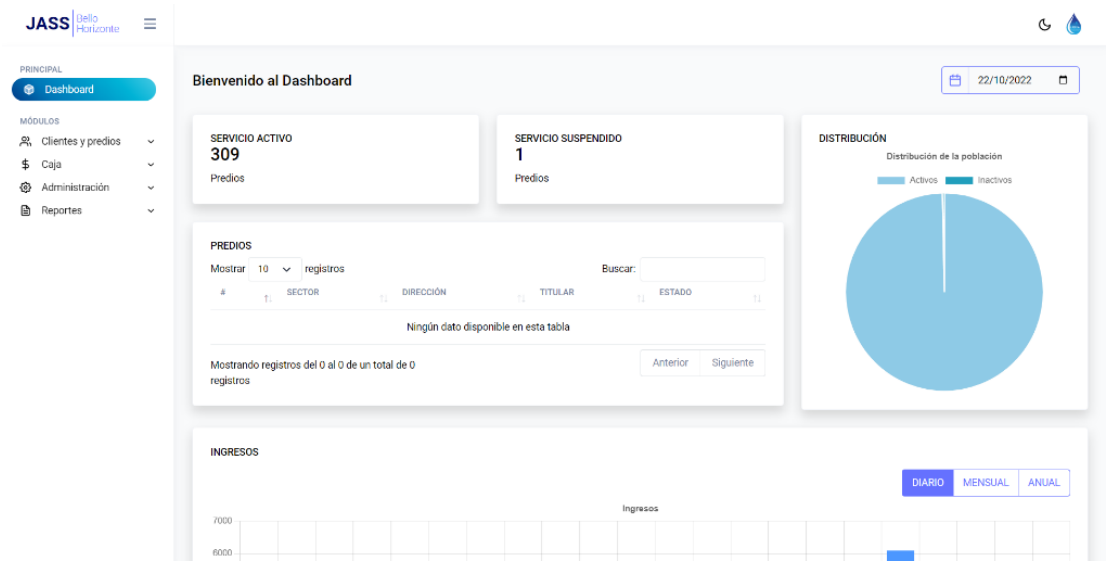

Figure 2. Dashboard screen

The third screen corresponds to the payment management interface (Figure 3). In this view, administrators were able to record and modify user payments, entering information such as amount, date, and service details. A pop-up window was observed with a form that allowed entering payment data and different action options, such as saving, canceling, or recording a new payment. The interface was clear and facilitated the efficient management of collections within the system, ensuring orderly administration of resources.

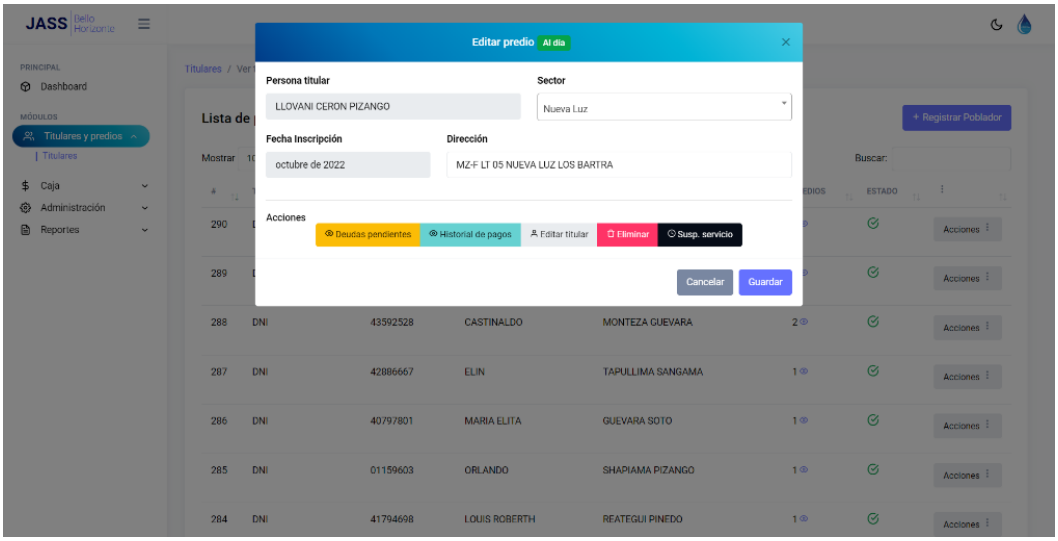

Figure 3. Payment management module screen

The system is currently in use by JASS staff. Source code and further evidence of operation can be obtained from the corresponding author upon request.

3.2. Comparison between pre and posttest

The analysis of the effectiveness of treasury control before and after the implementation of the system shows a significant improvement (Table 2). In the pretest phase, 15% of the participants stated that they "strongly disagree" with the effectiveness of the system, while 85% were neutral ("neither agree nor disagree"). There were no responses in the "strongly agree" category. However, in the posttest, 100% of the participants rated the effectiveness of the system as "strongly agree", which indicates that the implementation considerably improved the perception of the efficiency of treasury control.

Table 2. Effectiveness and satisfaction of treasury control (pre and post-test)

Assessment	Effectiveness				Satisfaction			
	Pretest		Posttest		Pretest		Posttest	
	F	%	F	%	F	%	F	%
Totally disagree	3	15%	-	-	2	10%	-	-
Neither agree nor disagree	17	85%	-	-	18	90%	-	-
I totally agree	-	-	20	100%	-	-	20	100%
Total	20	100%	20	100%	20	100%	20	100%

In terms of satisfaction, the results also reflect a positive evolution. In the pre-test, 10% of respondents stated that they were "Strongly Disagree", while 90% remained neutral. After the implementation of the system, in the post-test, the perception changed, as 100% of participants rated their satisfaction as "Strongly Agree". These results suggest that the new system optimized treasury management, improving both efficiency and user experience.

Thus, based on the results in Table 1, the main reasons that generate levels of dissatisfaction when assessing the efficiency of treasury control are related to what was mentioned by Grajales Gaviria & Castellanos Polo (2018), who state that the origin of the deficiency is mainly due to the fact that there was no adequate structuring of the organizational processes, which generated inadequate treasury control. And according to what was established by Montenegro Pozo (2018), said deficiency was caused by the execution of conventional and manual administrative processes, which cause delays in the functions performed by the treasury service, impacting the satisfaction of the board members.

On the other hand, based on the low performance identified in terms of satisfaction with the control of the treasury area, we agree with what was mentioned by Garza Sánchez et al. (2017) who specify that the

operational weaknesses in the processes where the economic flow is constant make the administrative activities have a greater probability of risk of generating an error, this having repercussions on the poor management of the collected amounts, and also causing distrust among users. In this sense , Castrillón Monsalve (2018) points out that technological tools have allowed to better articulate the processes in financial matters, unifying administrative, accounting and treasury activities, which allows greater integrity when developing operations and transparency of the executed movements, becoming an optimal solution for the identified problems.

3.3. Hypothesis testing

In order to respond to the general objective of the research, the hypothesis testing protocol was carried out. To do this, first the distribution of the data was found, which, according to the Shapiro-Wilk test for samples less than 50, resulted in a normal distribution since the p-value, both for the pre-test (0.088) and the post-test (0.356), was greater than 0.05.

Statistical analysis using the Student T test for related samples (Table 3) allowed us to evaluate the influence of the web system on the treasury control of JASS. The null hypothesis (H_0) stated that the use of the web system did not have a significant influence, while the alternative hypothesis (H_1) established that it did have a significant impact. With a significance level of 5% (0.05), the result obtained showed a p-value of 0.000, indicating that H_0 is rejected and H_1 is accepted, confirming that the web system had a significant impact on treasury control.

Table 3. Student's T test

	Paired differences					t	gl	Next (bilateral)
	Average	Std. Deviation	Std. Average Error	95% confidence				
				Lower	Superior			
Pretest - Posttest	-25.000	7.887	1.764	-28.691	-21.309	-14.175	19	0.000

The difference in means between the pretest and posttest was -25.000, with a standard deviation of 7,887 and a 95% confidence interval (-28.691, -21.309). This finding suggests that the implementation of the system significantly improved efficiency in financial management, optimizing access to information and facilitating administrative decision-making, results that coincide with previous studies such as that of Phan & Tran (2022), who highlight that web systems allow greater organization and control in the management of financial resources.

Additionally, the data from the records of the time in seconds that it took to record a payment, expense, balance and identification of a late payment in the treasury control process before and after the implementation of the web system were processed, obtaining, according to Table 4, mean differences. Likewise, regarding the distribution of the data, a non-normal distribution (Sig.>0.05) was obtained for all indicators according to Shapiro-Wilk for samples less than 20.

Table 4. Descriptive statistics (mean and standard deviation)

Indicators	**Treasury control**									
	Traditional					**Web system**				
	N	Min	Max	Average	Standard deviation	N	Min	Max	Average	Standard deviation
Payment record	20	133	211	176.40	19.245	20	21	47	29.00	6.593
Expense record	20	215	345	281.40	42.530	20	45	72	54.00	6.224
Report (balance)	20	14225	28512	20083.15	4455.892	20	3	6	4.90	0.852
Identification of delinquency	20	10800	22351	16221.25	3274.369	20	2	4	2.60	0.681
N valid (by list)	**20**					**20**				

Therefore, according to the distribution values, the Mann Whitney U test was applied to compare two independent sample averages, where, according to Table 5, statistically significant differences were obtained between traditional treasury control and using the web system, for the registration of payment, expense, reporting and identification of delinquency (p-value < 0.05).

Table 5. Mann-Whitney U statistical test

Test statistics [to]				
	Payment record	**Expense record**	**Report (balance)**	**Identification of delinquency**
Mann-Whitney U	0.000	0.000	0.000	0.000
Wilcoxon W	210.000	210.000	210.000	210.000
Z	-5.414	-5.414	-5.451	-5.475
Asymptotic Sig. (bilateral)	0.000	0.000	0.000	0.000
Exact significance [2*(sig. unilateral)]	.000 [b]	.000 [b]	.000 [b]	.000 [b]

a. Grouping variable: Treasury control
b. Not corrected for ties.

In this way, the acceptance of the hypothesis and general objective of the study is reinforced, by stating that the use of a web system significantly influences treasury control in the JASS of Bello Horizonte, measured through the optimization of time to record a payment, expense, report and identification of late payments.

3.4. Software quality

It is important to highlight that progressive training in the use of the web system was developed for the 20 individuals selected as a study sample, who were involved in treasury control at JASS Bello Horizonte. In this framework, the participants answered a survey of 11 indicators to measure the quality of the product of the developed web system, whose perceptions reflected a high positive perception of the system's functionality. According to the participants' evaluation, 53% agreed and 47% strongly agreed with the functionality of the web system, indicating that it met the functional and security requirements for treasury management. In terms of reliability, 50% of the participants indicated that they strongly agreed or agreed that the system executed its processes optimally, minimizing errors and facilitating the recovery of data and information.

In terms of usability, 50% of respondents agreed or strongly agreed with the ease of use of the system, highlighting its simplicity in terms of understanding, learning and operation. Similarly, the efficiency of the system was rated favorably, with 50% of participants stating that processes were efficient, response time was optimal and the system remained available at all times. These findings demonstrate that the system not only optimized treasury control, but also ensured an intuitive and effective user experience.

In summary, the implementation of the web system under the XP methodology was functional, reliable, usable and efficient, meeting the requirements of end users (Makhnevich, 2023). These results agree with the study by Quipuscoa Castro (2016), who emphasizes the importance of a good internal control system in organizations to improve efficiency and productivity. Likewise, Pico Gutiérrez & Núñez Neira (2018), Ranatarisza et al. (2022) and Noviani & Muda (2022) support the need to incorporate management software in accounting and financial areas, highlighting its importance as computer support to channel projects and optimize operational activities.

CONCLUSIONS

This study highlighted the need to strengthen treasury control at JASS Bello Horizonte through the implementation of a technological solution. The initial evaluation reflected a neutral perception of the effectiveness and satisfaction of treasury control, which justified the design and implementation of a web-based system based on the XP agile methodology. After its implementation, the results showed a significant

improvement, as 100% of respondents stated that they were very satisfied with the effectiveness and functionality of the system. In addition, the Student T test confirmed that the technological solution had a significant positive impact, allowing for better management of income and expenses, greater security in operations, and optimization of service time.

From a practical perspective, this study highlights the importance of digitizing administrative processes in community sectors to improve operational efficiency. Continuing use of the system will ensure more transparent and secure management, and its adoption by other administrative boards would contribute to the modernization of financial control in similar communities. Likewise, the integration of new modules such as online payments and a transparency portal will expand the system's capabilities, optimizing resource management. Finally, it is recommended that future research explore the long-term impact of this type of technology and continue developing digital solutions that reduce the technological gap in the field of community services management.

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest related to the development of the study.

AUTHORSHIP CONTRIBUTION

Conceptualization: Sánchez-Pérez, R. E. and Alva-Arévalo, A. Methodology: Rengifo-Amasifen, R., Terán-Chávez, N. M., and Martell-Alfaro, K. Software: Sánchez-Pérez, R. E. and Alva-Arévalo, A. Validation: Rengifo-Amasifen, R. Formal analysis: Terán-Chávez, N. M. and Martell-Alfaro, K. Research: All authors. Visualization: Alva-Arévalo, A. and Rengifo-Amasifen, R. Project management: Sánchez-Pérez, R. E. Writing - Original draft: All authors. Writing - Proofreading and editing: Sánchez-Pérez, R. E. and Alva-Arévalo, A.

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Anexo 1. Entity-relationship model of the database