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Process management to improve effectiveness in the Environmental Sub-Management of a municipality, Moche, 2025

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Abstract. The research "Management by processes to improve effectiveness in the Environmental Sub-Management of the District Municipality of Moche, 2025" applied management by processes to optimize the activities of the area Environmental, linked to Sustainable Development Goal No. 12, addressing deficiencies in waste management. **Objective:** Implement management by processes to improve effectiveness operational aspects of management Municipal environmental study. **Methodology:** Study applied with focus quantitative and design pre-experimental. It was used observation direct observation and document review to diagnose the waste collection and valorization process Solids. **Results:** The process presented initially an effectiveness of 79.05 % Lack of standardization. After the intervention, activities were reduced, achieving an effectiveness of 99.25%. **Conclusion/Contributions:** Management by processes improved the efficiency and quality of service Municipal environmental management. **Keywords:** Process management, effectiveness, activities, improvement.

Gestión por procesos para mejorar la efectividad en la Subgerencia Ambiental de una municipalidad, Moche, 2025

Resumen. La investigación "Gestión por procesos para mejorar la efectividad en la Subgerencia Ambiental de la Municipalidad Distrital de Moche, 2025" aplicó la gestión por procesos para optimizar las actividades del área ambiental, vinculada al Objetivo de Desarrollo Sostenible N.º 12, frente a deficiencias en la gestión de residuos. **Objetivo:** Implementar la gestión por procesos para mejorar la efectividad operativa en el manejo ambiental municipal. **Metodología:** Estudio aplicado con enfoque cuantitativo y diseño preexperimental. Se utilizó observación directa y revisión documental para diagnosticar el proceso de recolección y valorización de residuos sólidos. **Resultados:** El proceso presentó inicialmente una efectividad de 79.05% por falta de estandarización. Tras la intervención, redujeron actividades, lográndose una efectividad de 99.25%. **Conclusión/Aportes:** La gestión por procesos mejoró la eficiencia y calidad del servicio ambiental municipal. **Palabras clave:** Gestión por procesos, efectividad, actividades, mejora.

Gestão de processos para melhorar a eficácia na subgestão ambiental de um município, Moche, 2025

Resumo. A pesquisa "Gestão por processos para melhorar a efetividade na Subgerência Ambiental da Prefeitura Distrital de Moche, 2025" aplicou a gestão por processos para otimizar as atividades da área ambiental, vinculada ao Objetivo de Desenvolvimento Sustentável nº 12, diante de deficiências na gestão de resíduos. **Objetivo:** Implementar a gestão por processos para melhorar a efetividade operacional na gestão ambiental municipal. **Metodologia:** Estudo aplicado com abordagem quantitativa e desenho pré-experimental. Utilizaram-se observação direta e análise documental para diagnosticar o processo de coleta e valorização de resíduos sólidos. **Resultados:** Inicialmente, o processo apresentou uma eficácia de 79,05% devido à falta de padronização. Após a intervenção, as atividades foram reduzidas, atingindo uma eficácia de 99,25%. **Conclusão/Contribuições:** A gestão de processos melhorou a eficiência e a qualidade do serviço ambiental municipal. **Palavras-chave:** Gestão de processos, eficácia, atividades, melhoria.

Gestion des processus pour améliorer l'efficacité de la sous-gestion environnementale d'une municipalité, Moche, 2025

Résumé. La recherche intitulée « Gestion par processus pour améliorer l'efficacité de la Sous-direction Environnementale de la Municipalité de Moche, 2025 » a appliqué la gestion par processus afin d'optimiser les activités du secteur environnemental, en lien avec l'Objectif de Développement Durable n° 12, face aux insuffisances de la gestion des déchets. **Objectif:** Mettre en œuvre la gestion par processus afin d'améliorer l'efficacité opérationnelle de la gestion environnementale municipale. **Méthodologie:** Étude appliquée à approche quantitative avec un plan préexpérimental. L'observation directe et l'analyse documentaire ont permis de diagnostiquer le processus de collecte et de valorisation des déchets solides. **Résultats:** Le processus a initialement affiché une efficacité de 79,05 % en raison d'un manque de standardisation. Après l'intervention, les activités ont été réduites, permettant d'atteindre une efficacité de 99,25 %. **Conclusion/Cotisations:** La gestion des processus a amélioré l'efficience et la qualité du service municipal de l'environnement. **Mots-clés:** Gestion des processus, efficacité, activités, amélioration.

1. Introduction

Traditional management in many organizations, especially in growing and medium-sized companies, is often characterized by considerable improvisation, which can sometimes be extreme or even risky. In the current context, process management (PM) has taken on a fundamental role in enabling public organizations to respond effectively and efficiently to citizens' needs. Globally (Ovejero, 2025), labor interventions were generally related to problems such as disorganization, poorly executed processes, or insufficient controls, which affected both customer service and inventory management. These difficulties stemmed from a lack of order in processes, communication problems, and a tense work environment, exacerbated by internal cultural conflicts. In Peru, the lack of process management is a structural problem that significantly affects the effectiveness and transparency of public entities. According to the Comptroller General of the Republic, in 2022, public contracts exceeding S/ 18.58 billion were awarded without following formal processes, representing 32% of total government procurement spending. This situation jeopardizes transparency and fair competition, and creates fertile ground for corruption and the inefficient use of public resources. (Comptroller General of the Republic, 2023)

At the local level, specifically in the La Libertad region, problems related to weak process management are also evident. The Regional Public Management Index for the fourth quarter of 2022 revealed that local governments in this region show serious limitations in the timely execution of projects, taking almost twice as long as agreed, and in some cases up to five times longer. This situation directly impacts the quality of services provided to residents (Private Council for Competitiveness, 2023).

Furthermore, De la Cruz & Morales (2024) applied process management to increase the effectiveness of the company under study. The results showed that effectiveness rose from 52% to 78%, efficiency increased from 70% to 103%, and efficacy rose from 74% to 76%. In the order management process, there was also a reduction in processing time, which was minimized by 51%, and in sales, there was also a reduction in processing time of 14%.

Given this detailed problem, one of the main issues identified at the study site is the lack of basic internal organizational tools, such as process maps, flowcharts, or procedure maps. The lack of clarity regarding what tasks to perform, in what order, who is responsible, or how one activity connects to another, generates confusion, duplicates efforts, and sometimes leaves tasks incomplete due to the absence of clear guidance.

Furthermore, an evaluation of the efficacy, efficiency, and effectiveness of the "collection and segregation of inorganic solid waste" process during the first six weeks of 2025 revealed the following results: in week 1, efficacy was 82.9%, efficiency 93.88%, and effectiveness 77.82%. In week 2, efficacy was 81.12%, efficiency 92.5%, and effectiveness 75.03%. Similarly, in week 3, efficacy reached 89.38%, efficiency 93.26%, and effectiveness 83.35%. Finally, in week 4, efficacy was 82.58%, efficiency 94.37%, and effectiveness 77.93%. In week 5, the efficacy was 86.14%, the efficiency 94.73%, and the effectiveness 81.60%. Finally, in week 6, the efficacy was 84.54%, the efficiency 93%, and the effectiveness 78.62%, demonstrating areas for improvement.

Clearly, it can be easily detected that the effectiveness of the year 2025 is not as expected. Taking this into account, the need arose to investigate: To what extent does process management improve the effectiveness in the environmental sub-management of a district municipality, Moche, 2025 ?

The study was theoretically justified, as process management has become a key tool for optimizing the functioning of organizations, allowing them to organize and streamline activities across different areas. In the public sector, where problems of disorganization, duplication of tasks, and unnecessary delays are common, this approach helps establish clear procedures and defined roles, directly impacting the effectiveness of services.

This research adopted a quantitative approach because it seeks to objectively and precisely measure various indicators related to effectiveness, such as time, resource utilization, and goal

achievement. The study's scope was explanatory, as it focuses on determining the impact of implementing Management by Performance (MxP) on operational effectiveness in the study area. The design employed was pre-experimental, as it worked with a single control group, in which the results were evaluated before and after the aforementioned intervention. Data collection instruments included observation guides, review of operational records, and document analysis.

As a practical justification, the study area encompasses activities fundamental to public health and the well-being of the population, such as selective waste collection, environmental education, basic sanitation, and the promotion of healthy practices. However, many of these tasks were performed empirically or with little standardization, leading to delays, waste of materials, non-compliance with activities, staff overload, and difficulties in measuring results. Implementing process management allows for the organization of these functions, the definition of responsibilities, the establishment of indicators, and better utilization of available resources. This not only improves internal effectiveness but also translates into a more agile and higher-quality service for the public. Furthermore, it allows for a clear visualization of what is being done well and what can be improved, facilitating the determination of appropriate decisions based on concrete data and results.

For this reason, the following objectives were set. General objective: To implement process management in the environmental sub-management of a district municipality, Moche, 2025. In addition, to achieve this objective with the expected results, four specific objectives were set: To carry out a current diagnosis of the operational processes in the sub-management, to identify the main problems that affect effectiveness, to design and apply process management, and finally, to carry out an effectiveness analysis.

This aims to test the following hypothesis: Process management improves efficiency in the environmental sub-management of a district municipality, Moche, 2025.

2. Methodology

The research is applied in nature. According to Stewart (2025), applied research focuses on analysis aimed at solving practical problems. Applying this type of research involves finding solutions to various challenges faced by the entity under study. Furthermore, a quantitative approach was chosen. According to Ortega (2021), quantitative research is a structured tactic for compiling and analyzing data extracted from various sources. This is done using statistical and mathematical instruments to quantify the problem being investigated. The research also employs a pre-experimental design. According to Galarza (2021), in this sub-design of experimental research, the independent variable is treated with a single experimental group, in which the intervention chosen by the researcher is implemented. The dependent variable, on the other hand, must be measured on two occasions, known as pre- and post-tests. Finally, the scope is explanatory, as evidenced by the testimonies of (George & Merkus, 2022). This type of scope explains why and how a specific phenomenon occurs and visualizes future events.

In this research, the population consists of the processes identified in the Organizational and Functional Regulations (ROF) of the Environmental Management Sub-Directorate of the entity under study, which are carried out on a weekly basis. This process is the selective collection and recovery of inorganic solid waste. It was not necessary to calculate the sample size due to the size of the population.

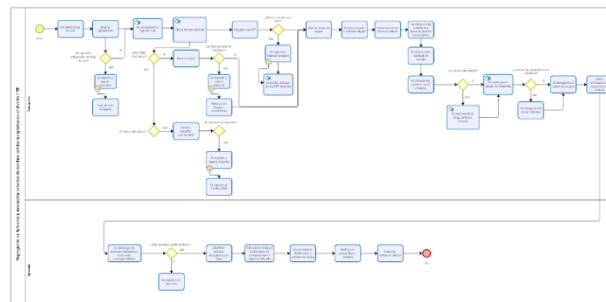
The techniques and instruments used were as follows: First, for the situational diagnosis of the company, direct observation was conducted, allowing the researcher to witness the development of activities and operational processes in real time within the natural work environment. This technique was fundamental for identifying daily dynamics, workflows, coordination between departments, and potential inefficiencies. An observation guide, a structured instrument containing predefined criteria and indicators, was used for its application. These criteria and indicators guided the systematic recording of information during field visits. A technical documentary review was also conducted, consisting of the analysis of official documents such

as internal manuals, control forms, process records, activity reports, and administrative files. This technique allowed for the identification of the degree of formalization and standardization of existing procedures. A documentary observation guide, designed to evaluate the relevance, clarity, currency, and applicability of the reviewed documents in relation to the study's objectives, was used as the instrument. Finally, the operational activity timing technique was applied, focused on accurately measuring the time required to perform specific tasks within the evaluated processes. This technique will allow for the identification of critical activities, downtime, and potential bottlenecks in the operational chain. The associated tool will be a time-tracking sheet for each activity, where measured intervals, responsible parties, and observed execution conditions will be recorded. Finally, the operational activity compliance verification technique will be used to measure the level of execution of activities scheduled for each process. The tool used will be an effectiveness indicator sheet, designed to compile data on completed activities within a managed process. The validity of the instruments used was established through expert judgment.

3. Results

To understand what are the processes that the sub-management executes The environmental technique used was “ observation ” , through the instrument “Observation Guide” , where the Organizational Regulation of Functions (ROF) was analyzed , where the Deputy Manager environmental offered certain information , which was analyzed to corroborate Yeah It coincided with the Operational Plan Institutional (POI) of the study area , which was delivered by the field specialist , who to his time helped in the identification of processes existing ones and which ones no longer existed , giving as evidence that work with five processes operational , of which this The work focused on the process of “ Segregation at the source and collection selective waste solids in the district .”

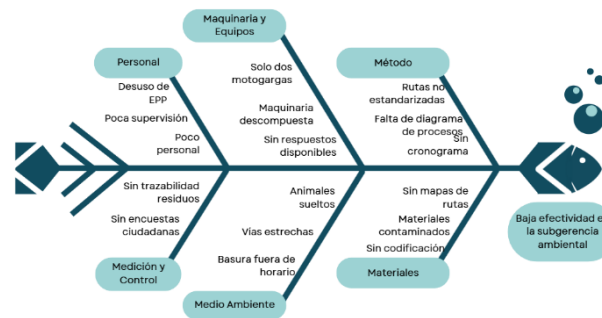
Figure 1: Observation Guide



For the process focused on waste inorganic , it has three phases (collection and transport ; reception and segregation ; operation and valorization), in the first phase , the operators Those in charge of carrying out the process , mostly “two operators ” , receive the route sheet corresponding to the day that touch collect , because every day of the week They have zones/ urbanizations different , later the two operators they perform the same time the vehicle checklist and use of corresponding PPE , in order to ensure mobility used be in condition mechanical and fuel checks, as well as verifying that all those who do the work Count on the security necessary , these The results are placed on a sheet physical copy to then transfer it to digital format . Before leaving , the driver signs the vehicle 's exit form , where specifies Date and time of departure , consequently the route begins towards the first The starting point for the urbanization is the "Luz Marina Neyra de Fernández" coliseum , where the study entity is also located . Once Upon arrival at the first collection zone , an operator gets out and proceeds to remove the waste Inorganic waste is collected from the containers / homes in the area while the driver waits . The waste is placed inside . Inorganic materials are loaded into the vehicle , the load is rearranged before moving to the next point, and the steps are repeated as many times as necessary. that be

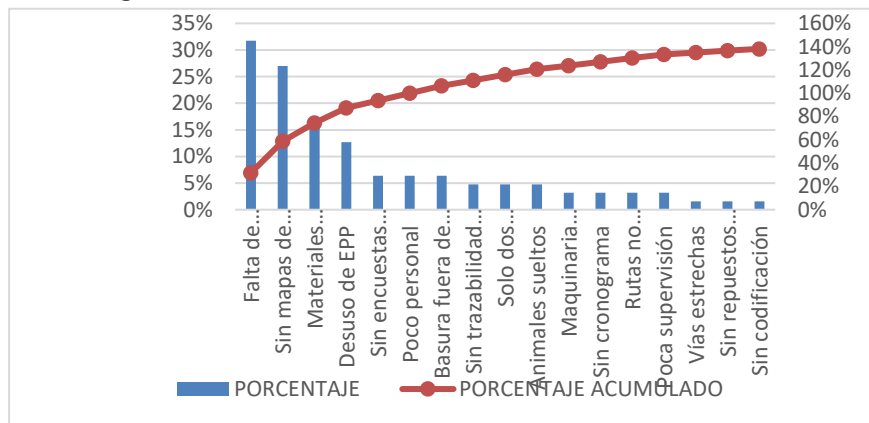
necessary in order to complete All day . Once collected Waste is transported to all housing developments . inorganics to the collection center “ garage ” “ old woman ,” here's the operator sign the waste reception authorization , waste that are downloaded in the area marked for her segregation and classification by type , finally the weighing “ tare and detare ” is carried out . Once The processes were rigorously evaluated in order to assess the current state of the " Source Segregation and Collection " process . selective waste solids inorganics in the district “ of the study entity and understand What are the problems? further representative that To identify factors affecting effectiveness , the " Ishikawa Diagram " was used , where the nonconformities were placed . according to the following Aspects : Method, materials , machinery and equipment , personnel, environment , culminating by Measurement and control. In this graphs are displayed Problems such as: Non - standardized routes , lack of process diagram , machinery decomposed among others .

Figure 2: Ishikawa diagram



Having made known the problems observed that affect the effectiveness in the sub-management For environmental analysis , the “ Pareto Diagram ” was used to quantify the level of impact forehead to this problem . Knowing the 80/20 ratio , once done saying The diagram resulted in that 80% of the problems They stem from a lack of process diagrams , route maps , and materials . contaminated and disused PPE . results allow understand What are the causes ? that They will have higher priority when it comes to improving effectiveness .

Figure 3: Pareto Diagram



Likewise, the effectiveness of the pre - test was calculated , referring to all the information provided by the Environmental Sub-management of the last 6 weeks of the months of May and June of 2025 .

Table 1: Pre-Test Productivity Calculation

Effectiveness Analysis Matrix					
Week	Route Efficiency	Effectiveness of Activities	Effectiveness (R+A)/2	Efficiency	Effectiveness (Effectiveness * Efficiency)
Week 1	90.6%	75.2%	82.9%	93.88%	77.82%
Week 2	90.25%	72%	81.12%	92.5%	75.03%
Week 3	86.36%	82.4%	89.38%	93.26%	83.35%
Week 4	87.54%	77.6%	82.58%	94.37%	77.93%
Week 5	87.48%	84.8%	86.14%	94.73%	81.60%
Week 6	87.48%	81.6%	84.54%	93%	78.62%
Average	88.28%	78.93%	84.44%	93.6%	79.05%

As can be seen in the matrix, the results obtained in the effectiveness measurement focused on compliance with collection routes is 88.28%. Similarly, the efficiency associated with measuring compliance with activities in the waste collection and valorization process The percentage of inorganic materials is 78.93%, so the overall process efficiency is 84.44%. Furthermore, efficiency side based on measurement times to complete the process The aforementioned percentage is 93.6%, which could to be considered in good Under these conditions, however, the effectiveness, which is the product of efficacy and efficiency, yielded a value of 79.05%, demonstrating that can optimize to achieve better results.

Design and application of Process Management BRAINSTORMING

Through the use of “brainstorming”, During the observation of the operators, the activities were observed that they carried out the process tedious, 14 problems in total found.

The Ishikawa Diagram was used to classify these problems.

Figure 4: Brainstorming Scheme

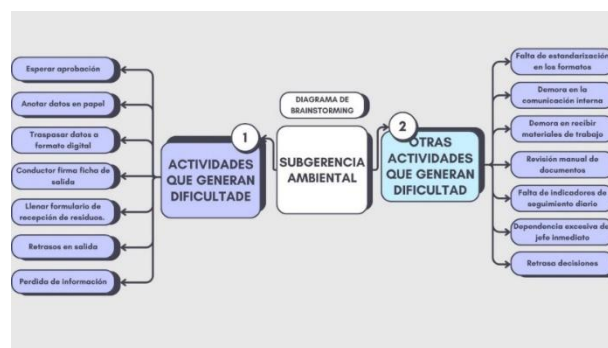
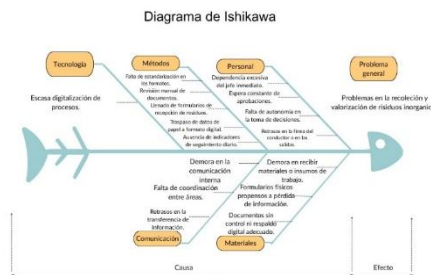


Figure 5: Ishikawa diagram





Subsequently, the Pareto diagram was created, where it was observed that 80% of the problems are caused due to the following activities: Constant waiting for approvals, delays in signing off on vehicle release, forms physical unnecessary, transfer data physical to digital, filling out waste reception form solids and delay in receiving materials.

Activities that were deleted according to the following justifications, "wait roadmap request approval", position that Previously, the collection route was given to them on a printed sheet, and this generated time unnecessary since it was already available that wait for this machine unoccupied printer and assistant administrative position that Now the routes and activities to be carried out are delivered in folders with plastic sleeves; this ensures the durability of the object and that it is not being damaged. requesting in each moment a copy.

Other activities that have been removed include "writing down data on paper" and subsequently "transfer data in digital format", as observed These activities are repetitive, and because the area implemented a maintenance system unaware of the study, it was decided by eliminate these two activities. Similarly, the activity "signing" The "exit slip" was removed to streamline the process, as it was considered an activity unnecessary, since the responsibility already exists validated in the previous steps.

Finally, the activity "fill" The "waste receipt form" was removed to streamline the process since receipt confirmation can now be done electronically. do it verbally and more direct, eliminating bureaucracy unnecessary without affecting control

Effectiveness Analysis

Once implemented all phases of management by processes in the sub-management Environmental, a comparison was made of how effective it was before applying are Improvements. Before this, the before and after effectiveness was measured, demonstrating step by step, both for the effectiveness of collection routes, the effectiveness of collection and recovery activities, and the efficiency of the waste collection and recovery process. inorganics.

Table 2: Analysis of effectiveness before applying the improvements.

Effectiveness Analysis Matrix			
Week	Effectiveness (pre)	Effectiveness (post)	Percentage of improvement
S1	77.82%	98.5%	20.68%
S2	75.03%	98.06%	23.03%
S3	83.35%	98.94%	15.59%
S4	77.93%	98.68%	20.75%
S5	81.60%	100.95%	19.35%
S6	78.62%	100.37%	21.75%
Average	79.05%	99.25%	20.2%

How can observe in the matrix, of six samples measures by each week, the effectiveness performed a notorious increase Well, the effectiveness before implementing Management by processes was 79.05%, and once applied GxP, this It increased to 99.25%, showing an improvement of 20.2%.

As can be seen in the table above, the water container production process was reduced to 22 activities, where. To test the research hypothesis "Process Management Improves the Effectiveness of the Environmental Sub-Management," the normality of the data was first verified using the Shapiro-Wilk test. The results showed a significance value of 0.769 for the pre-test and 0.436 for the post-test, both greater than 0.05. This suggests that the data are



normally distributed and allows for the parametric test, in this case, the paired-samples t-test. Furthermore, the significance level found was $<.001$.

Comparing the pre-test and post-test results revealed a significant increase in the scores. The pre-test mean was 79.06 with a standard deviation of 2.71, while the post-test mean reached 99.25 with a standard deviation of 1.04. Therefore, the average difference between the two analyses was 20.19, confirming an improvement after the implementation of process management.

On the other hand part, the hypotheses raised in the development of this investigation were:
H0: Process management does not improve effectiveness in the environmental sub-management of a district municipality, Moche, 2025.

H1: Process management Improves the effectiveness of the environmental sub-management of a district municipality, Moche, 2025.

Therefore, H1 is accepted and H0 is rejected.

4. Discussion

The first objective involves a current diagnosis of the operational processes of the Environmental Sub-Management, as this helps to visualize the main activities related to the collection and recovery of inorganic solid waste. To achieve this, the "observation" technique and the "observation guide" instrument were used. According to Campos & Lule (2012), observation is one of the simplest ways to create reliable visual records, facilitating the analysis and accurate explanation of phenomena. This instrument aims to document the regulatory and operational aspects of the phenomenon being observed, detailing key data such as: process name, basic description, personnel involved, resources used, identified stages, problems identified, and other observations. In this case, the focus is on the Organizational and Functional Regulations (ROF) and the Institutional Operational Plan (POI). As a result, the study process and how and when it is carried out were made known. Identifying that of the five operational processes, the "collection and valorization of inorganic solid waste" process is used as the subject of study because collection occurs daily, although different areas are collected each day of the week. This is comparable to the research of Moreno Centeno (2020), who conducted a study of the vehicle technical inspection method, identifying the steps of the procedure. Methodologically, it can be inferred and reflected that a prior evaluation was carried out. This relates to the present research because it demonstrates the importance of identifying the process or area to be investigated from scratch. Furthermore, from a theoretical perspective, Kortas (2023) asserts that processes must be analyzed and described in their actual state before beginning redesign, thus ensuring that the improvements applied are linked to realities and not assumptions. This contribution demonstrates that honestly evaluating the current state is essential to achieving real improvements and ensuring reliability. On the other hand, the Presidency of the Council of Ministers (2021) points out that identifying an organization's processes begins when the work team recognizes the products the institution must deliver and who they are intended for, all through internal regulations or rules. This contribution serves to corroborate the importance of the Organizational and Functional Regulations (ROF) and the Institutional Operational Plan (POI), manuals that allow observation of whether the organization or area is aligned with the final product and client—in this case, public services and citizens—as well as verifying consistency between planned and executed activities. For the second objective, determining the problems that affect the effectiveness of the sub-management is necessary to take appropriate measures to address the problem, in order to solve and optimize it. This is where the purpose of Management by Performance (GxP) comes in, as it allows each of these actions to be carried out in an orderly and reliable manner. Obtaining these results is possible thanks to the Ishikawa and Pareto diagrams, which revealed that 80% of the problems stem from the lack of a process diagram, route maps, contaminated materials, and improper use of personal protective equipment (PPE). The "Effectiveness Indicator Sheet" is used for this purpose. According to Robles (2008), the organization is obligated to provide the necessary training for its personnel

and, in turn, measure the effectiveness of the improvements implemented, following a pre- and post-measurement approach. This sheet collects data for each day of the week based on the completion of activities and the areas to be collected from the process. Similarly, the "Activity Time Record Sheet" is used. According to Kagan (2025), time records rigorously inspect activities and their duration to gain insight into the phenomenon being studied. This instrument collects data for each day of the week, based on the time spent completing each activity. The results for this objective, demonstrating the state of effectiveness and efficiency measured in the first six weeks observed before the implementation of GxP, are 84.44% and 93.6% respectively, yielding an effectiveness of 79.05%, showing room for improvement. This is due to non-standardized processes, empirical work, lack of communication, and insufficient supervision. This relates to the research of Romero Sánchez (2024), who mentions that before implementing his GxP, 93% of the Sub-Management's files were processed, a value similar to the pre-implementation effectiveness obtained (90.45%). Furthermore, the delay rate was 31%, a much lower value than that obtained in the time-based efficiency section. According to Martins (2025), efficiency, in short, is completing objectives optimally—that is, doing so faster, using fewer resources, and essentially achieving more with less. On the other hand, George et al. (2022) define effectiveness as the ability to complete objectives appropriately. It involves achieving the expected results in relation to the proposed goals. Finally, the same author defines efficacy as the actual impact of an action, linking the stated objectives with the results obtained. Furthermore, he mentions that it goes beyond efficacy because it not only measures goal achievement but also the benefits and consequences it generates for the population. Regarding the results obtained, it can be deduced that before implementing process management, the efficacy and efficiency were 84.44% and 93.6%, respectively, and the effectiveness was 79.05%, meaning that the proposed goals and timelines were not being met, resulting in ineffective service to the population. This only confirms that the lack of defined roles and a visual representation of the tasks to be performed confuses workers, preventing them from working efficiently. Regarding the third objective, designing and implementing Process Management (PM) after addressing the problems is a priority, since the empirical approach used has only hindered optimal execution, causing delays and a lack of completion of tasks. Therefore, the implementation of Process Management in the Environmental Sub-Management allowed for the standardization of the activities in the collection and recovery process of inorganic solid waste, beginning with process diagramming, in order to systematically visualize the activities performed by the operators. Similarly, mapping collection zones allows for visualizing the points where workers collect on different days. This allows workers to have a better understanding of their daily tasks and avoid skipping any activities. However, due to the constant complaints and repetitive tasks observed, the process flowchart needs optimization. Brainstorming was used to gather all the suggestions and complaints expressed by the operators, leading to the identification of the most critical ones using the Ishikawa and Pareto diagrams. This resulted in the elimination of 5 of the 25 previously identified activities, thus reducing those that did not add value to the process. This translates into better organization, increased efficiency, and a reduction in unproductive time. Thanks to the training provided to the operators, this improvement is reflected in effectiveness and efficiency rates of 99.2% and 100.05%, respectively, achieving an overall effectiveness of 99.25%. This relates to what Carrasco (2025) mentions: process management helps organizations model, analyze, design, implement, monitor, and continuously improve their processes from start to finish, fostering a culture of effectiveness. This aligns with the present research, as it allows the Environmental Sub-Management to design, implement, and monitor its processes from beginning to end. The creation and optimization of process diagrams helped solve the problems addressed in objective two. Similarly, sharing the diagrams with operational staff, along with continuous control and improvement, are aspects related to what Vinodh et al. (2021) stated. Likewise, Alarcón et al. (2023) state that applying Process Management (PM) encourages active employee participation, clarifies responsibilities, and promotes transparency in the entity's operations. It also minimizes time and costs in the process stage, resulting in the

efficient use of resources. The theory observed in this research is that the GxP design was shared with each employee through training sessions, addressing uncertainties and fostering honesty. This resulted in effectiveness and efficiency of 99.2% and 100.05%, respectively, yielding an overall effectiveness of 99.25%. To achieve the final objective, an effectiveness analysis was conducted to compare the observed improvement with that of other researchers. This comparison aimed to better understand the viability of GxP in improving effectiveness across various organizations. The "Pre-Post" methodology was used, which, according to Pomeranz (2011, paras. 36-37), is an evaluation of differences, measuring the change in the measured value relative to the group's initial state. The effectiveness and efficiency obtained before implementing GxP were 84.44% and 93.6%, respectively, resulting in an overall effectiveness of 79.05%. Similarly, once process management was implemented, the effectiveness and efficiency reached 99.2% and 100.05%, respectively, resulting in an overall effectiveness of 99.25%, an increase of 20.2%, demonstrating the viability of the research. This is related to the thesis by De la Cruz & Morales (2024), in which pre-improvement results showed effectiveness and efficiency of 74% and 70%, respectively. Subsequently, after implementing their process management, their effectiveness and efficiency increased to 76% and 103%, respectively, culminating in an overall effectiveness of 78%, an increase of 26%, demonstrating similarity in this research and its viability.

5. Conclusions

A current diagnostic assessment of the environmental sub-management's operational processes was conducted using direct observation with an observation guide, reviewing the Organizational and Functional Regulations (ROF) and the Institutional Operational Plan (POI). Data was analyzed using a descriptive method, allowing for the observation of processes performed at least weekly. The collection and recovery of inorganic solid waste was identified as the focus of study, as it is carried out daily and measured weekly. Therefore, it was concluded that conducting this diagnostic assessment allowed for a more focused analysis of the most frequently used process. To identify the main problems affecting the effectiveness of the environmental sub-management, techniques such as observation and brainstorming were used, employing an observation guide and a brainstorming sheet. These results were analyzed quantitatively and qualitatively, respectively, which helped to highlight operational deficiencies and the lack of process standardization compared to the approach used before the implementation of Management by Process (MxP). Problems that, thanks to the Ishikawa diagram and Parteo analysis, were shown to stem from the lack of a process diagram, uncharted routes, contaminated materials, and underutilization of PPE, were identified. Quantifying these issues, the effectiveness and efficiency measured in the first six weeks, prior to the implementation of Process Management (PM), were 84.44% and 93.6%, respectively, resulting in an overall effectiveness of 79.05%, indicating room for improvement. The PM design was based on prior research through a literature review, which facilitated an understanding of the various theories surrounding PM and how it enhances effectiveness. Consequently, designing and implementing Process Management in the Environmental Sub-Management is feasible. Therefore, the flowchart was redesigned for optimization, resulting in the elimination of five activities that did not add value and caused delays, reducing the number of activities from 25 to 20, thus creating a more agile and understandable process for the workers. In addition, the collection routes were mapped, as the previous system only provided a textual list of the neighborhoods and streets to be collected, without any references. In conclusion, the GxP (Governance-Based Planning) system simplified and ultimately standardized the processes. These improvements were presented to senior management and operators for implementation, resulting in an efficiency and effectiveness of 99.2% and 100.05%, respectively, for a total effectiveness of 99.25%. The effectiveness achieved was analyzed using various techniques, such as time studies, activity and route evaluation, time tracking sheets, activity effectiveness sheets, and collection route effectiveness sheets. The data was analyzed by examining the measured samples, with six

samples taken before and six samples taken after the GxP implementation , each sample representing one week of operation. The results showed an improvement in effectiveness, with a pre- GxP effectiveness of 79.05% increasing to 99.25% after implementation, representing a 20.2% increase. In conclusion, implementing Process Management in the Environmental Sub-Management was extremely beneficial to the area, as it standardized processes and implemented indicators such as efficacy, efficiency, and effectiveness. Furthermore, it provided a better environment and improved understanding of the work performed daily by the operators.

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