v. 5, n. 6, 2025

Scientific Journal of Applied Social and Clinical Science

INNOVATION FOR SUSTAINABLE WATER MANAGEMENT. CASE STUDY, GUANAJUATO CITY POTABLE WATER AND SEWERAGE SYSTEM

Pedro L. López-de-Alba
PhD in Innovation, Virtual University of the State of Guanajuato (UVEG), Mexico

Francisco J. Villareal-Segoviano
PhD in Innovation, Virtual University of the State of Guanajuato (UVEG), Mexico

Rocio Guadalupe Morales Romero
Engineering Division, University of Guanajuato (UG)

José Pablo Nuño de la Parra
Division of Natural and Exact Sciences, University of Guanajuato (UG)

Paula C. Isiordia-Lachica
PhD in Innovation, Virtual University of the State of Guanajuato (UVEG), Mexico
Division of Life Sciences, University of Guanajuato (UG)

Ricardo Alberto Rodríguez Carvajal
PhD in Innovation, Virtual University of the State of Guanajuato (UVEG), Mexico
Division of Natural and Exact Sciences, University of Guanajuato (UG)

Acceptance date: 24/03/2025

Abstract: Purpose: This study aims to analyze and enhance the innovation process within the potable water and sewerage system of Guanajuato City, focusing on improving efficiency and sustainability. The research identifies key operational challenges and explores solutions to foster a water-conscious culture and optimize resource consumption. **Design/Methodology/Approach:** A mixed-method research approach was employed, integrating both documentary and field research. The study utilized qualitative tools such as the CANVAS model, empathy mapping, and SWOT analysis to diagnose organizational challenges. Open innovation workshops were conducted with various stakeholders, including municipal authorities, civil society, and experts, leading to the generation of over 300 ideas to address water sustainability concerns. The study followed a three-phase methodology: contextualization-research-comprehension, definition-idea generation, and development-materialization. **Findings:** The research identified two critical challenges: the need for a strong water culture and improved consumption efficiency. The participatory approach facilitated the generation of innovative solutions, resulting in the development of awareness campaigns and strategic projects. A key initiative, "Awareness for the Care and Better Use of Water," successfully engaged municipal employees and policymakers in sustainable water practices, demonstrating a positive shift in attitudes and behaviors. **Conclusion:** The study highlights that sustainable water management requires more than infrastructure improvements it demands behavioral change and community involvement. The findings emphasize that innovation-driven solutions, when supported by citizen engagement and institutional commitment, can significantly enhance water conservation efforts. **Practical Implications:** The research provides a replicable model for municipalities and policymakers to integrate innovation into water management strategies. By fostering a culture of responsible water use and implementing structured awareness campaigns, similar approaches can be adopted in other regions facing water sustainability challenges. The study underscores the importance of collaboration between public institutions, civil society, and experts in shaping effective water management policies.
Keywords: innovation process, water culture, challenge identification, idea generation

INTRODUCTION

According to Pineda (2002), the potable water service in Mexico has gone through different administrative stages throughout its history. The first, known as the centralist era (1948-1983), was marked by the concentration of urban potable water systems under the Secretariat of Hydraulic Resources (SRH), an agency of the federal government.

In 1983, with the reform of Article 115 of the Mexican Constitution, the second stage known as municipalization began. Afterwards, municipalities became responsible for the provision of potable water services.

The third stage began in 1989, with the creation of the National Water Commission (CNA), which promoted the formation of autonomous operating agencies managed as companies, in response to the operational deficiencies of the previous period.

In Guanajuato State, on February 29, 1968, Decree No. 362 was published, which led to the Law for the Supply of Potable Water and Sewerage in Rural Areas of the State of Guanajuato. This law created the State Board of Potable Water and Sewerage, a decentralized public agency with legal personality and its own assets, with headquarters in Guanajuato capital city.

With the proclamation of this law, the federal boards, excepting for that of Leon, as well as the Municipal Committees and Operation Managers, ceased to exist, and their

assets were transferred to the State Board. In the 1980's, a new reform of Article 115 of the Constitution strengthened municipal participation in the administration of potable water and sewerage, consolidating the transfer of these systems to the municipalities.

Despite efforts to establish efficient operating agencies, the current model has not always achieved its original objectives, such as satisfying water needs and resolving conflicts about water.

On February 25, 1992, the City Council of Guanajuato Capital approved the creation of the Municipal System of Potable Water and Sewerage of Guanajuato (SIMAPAG), a decentralized public agency. Months later, SIMAPAG's first regulations were published in the Official Gazette No. 66, and later updated in 2001, remaining effective up to present. The Water Law for Guanajuato State (2000) regulates the operation of decentralized public agencies, such as SIMAPAG.

In 2012, Guanajuato city faced a water supply crisis, which led to an intermittent cut of the service for approximately six months, with supply cycles of 36 hours of normal service followed by 36 hours without water, affecting various zones of the city. This type of rationing had not been seen since the 1980's.

Furthermore, to water scarcity, the System faces internal and external challenges in two key areas: material and human. In the material aspect, there has been a significant increase in the overdue portfolio, a decrease in billing and fluctuations in annual revenues. Moreover, there has been an increase in operating expenses and an increase in the number of employees.

In terms of service, it is necessary to expand the coverage of water intakes and drainage discharges, replace old sewer system and improve coordination between this agency and the municipal planning and urban development agencies. It is also necessary to implement preventive and corrective maintenance programs.

In the human area, conflicts among personnel and lack of training have been identified, as well as a work environment that requires improvement to optimize performance. Likewise, general management turnover (six directors in the last 15 years) has generated instability in the administration.

The objective of this work is to propose an innovative process to improve the competitiveness of the System itself, through the identification of challenges, idea generation, the development of projects that address these challenges and the validation of the results, thus closing the innovation cycle.

METHODOLOGY

This work is developed through a historical and descriptive research, focused on the analysis of the current reality. Person-to-person participation studies and exploratory studies are used. According to the criteria proposed by Zorrilla (cited in Grajales, 2000), this is applied research, since its focus on the application, use and practical consequences of the knowledge acquired. One of the main objectives of this applied research is to present a proposal to improve the operation of the Municipal Potable Water and Sewerage System of Guanajuato.

The research follows a mixed approach, combining both documentary and field research. Activities include the review of various documentary sources, such as magazines, newspapers, books and journals. As for field research, the phenomena studied are approached in their real context and at the corresponding time, with a descriptive and exploratory approach, since areas not previously studied or described are investigated.

The research is of a vertical or transversal type, since it is carried out within a defined period of time. As a methodological strategy, the case study is used to approach the qualitative part. According to Creswell (2012), the

case study is especially useful for a deepen comprehension of organizational problems and is suitable for analyzing complex and dynamic phenomena in their real context.

The methodology for implementing innovation consists of three main phases: contextualization-research-comprehension, definition- idea generation and development-materialization.

Contextualization-research-comprehension. In this phase, tools such as the business model CANVAS and the empathy map, based on Osterwalder's methodology (2010), were used, as well as a SWOT analysis. Interviews and meetings were held with groups of up to 10 people, including managers, System staff, members of civil society and experts. The objective is to build an integral view of the current situation and the challenges that could improve the operation of the organization.

The business model canvas makes it possible to visualize the nine blocks that constitute the organizational structure, integrating the co-creation with parts who know different aspects of the business. This exercise results in a detailed X-ray of the organization.

The Empathy Map allows understanding the customer or user's perspective, focusing on six key aspects (what they see, hear, think, feel, say and do). This tool helps to identify the real needs and expectations of users, which facilitates the restructuring of organizational policies.

Finally, the SWOT analysis compares the external environment (threats and opportunities) and the internal environment (strengths and weaknesses) of the organization. These analyses were performed in sectorial groups and afterwards consolidated to obtain an integral diagnosis of the organization.

Definition- idea generation: In this second phase, open innovation workshops were held, gathering experts and relevant stakeholders to generate solutions to the challenges identified in the previous phase. The open innovation paradigm, as described by Chesbrough (2006), allowed for both internal and external collaboration in the development of ideas. The brainstorming technique was used to generate proposals intended to solve the challenges prioritized by the System's authorities.

Development-materialization: In this last phase, the ideas generated are transformed into concrete projects and intervention actions in the quoted System. A portfolio of specific projects is formed; each designed to approach the challenges selected in the previous phases. These activities were done both at the System's own facilities and at the Guanajuato Municipality.

RESULTS

In the first phase of the innovation process, the contextualization-research-comprehension of the organization was done, which allowed acquiring a profound knowledge of the organization. During this stage, various tools were applied to analyze its current situation.

The CANVAS or business model canvas was applied to a group of 60 participants distributed among the working tables. The results of this tool are presented in Table 1, which identifies key areas of opportunity to improve the organization. These include improving the value proposition perceived by clients, as well as the need to increase the organization's competitiveness and profitability.

Throughout this analysis, several important challenges began to appear for the agency under study. Among these challenges are the need to generate a water culture among the population, implement a program to reduce leaks and increase the volumes of water available, among others.

The Empathy Map generated from the responses obtained in the six working groups shown in Figure 1. Among the main problems identified by the participants were the lack of service coverage, poor diffusion of the agen-

<table>
<tr>
<td>STRATEGIC PARTNERS
- National Water Commission.
- Water Commission of Guanajuato State.
- Chambers of commerce.
- Municipal presidencies.
- Input suppliers.</td>
<td>KEY ACTIVITIES
- Drainage system maintenance.
- Maintenance of the distribution and conduction net.
- Potabilization.
- Supply sources.

KEY RESOURCES
- Sludge sales.
- Water sales.
- Regularization of subdivisions (payment of services).
- Sanitation.</td>
<td>VALUE PROPOSAL
- Water supplier.
- Drainage supplier.
- Sanitation supplier.
- Potabilization.
- Water service.
- Wastewater treatment.
- Attention to low-income neighborhoods.
- Provider of the vital liquid.
- Provides life and health.</td>
<td>CUSTOMER RELATIONSHIP
- Personnel.
- Brochures.
- Radio.
- Web.
- Press.
-Orders

CHANNEL
- Potable water pipes.
- Treated water pipes.
- Pipelines.
- Drainage.
- Household intakes.</td>
<td>CUSTOMER SECTOR
- Homes.
- Hotels.
- Restaurants.
- Schools.
- Universities.
- Municipal government.
- Judiciary.
- State government.
- Business.
- Companies.</td>
</tr>
<tr>
<td colspan="3">COSTS
- Personnel.
- Leakage.
- Potabilization.
- Pumping.
- Extraction.
- Administration.
- Project engineering.
- External studies.</td>
<td colspan="3">INCOME
- Water sales.
- Sanitation.
- Drainage.
- New connections.
- Rights for subdivisions.
- Refund of payment of rights.
- VAT refund.</td>
</tr>
</table>

Table 1. Business model of the Municipal System of Potable Water and Sewerage of Guanajuato (SIMAPAG).

Source: Self made, based on Osterwalder 2010.

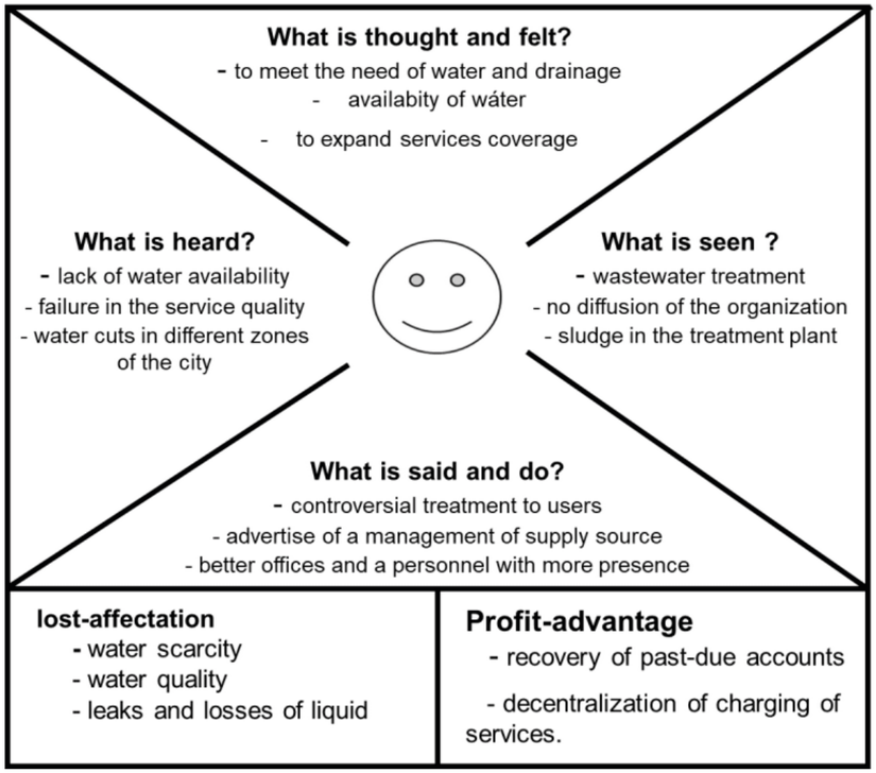

Figure 1. Empathy map of the Guanajuato Potable Water and Sewerage System. Self made based on Osterwalder 2010.

cy's programs and actions, and water cuts in various areas of the city, especially during the hot season. A critical point identified was that, although the public recognizes the existence of the wastewater treatment plant, it does not adequately value its importance or the benefits brought to society.

Afterwards, three meetings were held with heterogeneous groups to complete the SWOT analysis. The resulting matrix presented in Table 2, which summarizes the main internal and external factors affecting the organization.

Once the results of the three tools used to contextualize the organization in question had been analyzed, the Board of Directors and the director were brought together to present the challenges identified. These challenges, which reflect the key areas for improvement, include distribution coverage, financial resources, water quality, water culture, system securitization, design of a new business model, leakage reduction, consumption efficiency, water availability and improvement in system efficiency.

By prioritizing the challenges, the Board of Directors considered factors such as implementation time, costs and available technologies. Following this analysis, two main challenges were select: water culture and consumption efficiency. In this paper, the results obtained in relation to the Water Culture challenge are presented.

To approach this challenge, innovation roundtables were organized. More than 150 people from different sectors of society were invited, of which 117 participated. The roundtables were held in different locations, including the facilities of the organization itself and Guanajuato Municipality.

The tool used in this exercise was brainstorming. In order to motivate the participants, they were given an introduction on what "Water Culture" is, remarking the importance of preserving and using this resource responsibly under a sustainable development scheme. Subsequently, they were invited to propose ideas to promote a true water culture in Guanajuato.

These roundtables came up with *317 ideas*, focused on raising public awareness of the value of water as a limited resource. Some of the most outstanding ideas were:

- *Awareness campaigns* on water use in homes, hotels, businesses and other institutions.
- *Incentives* for the reduction of water consumption, such as 30% waiver for those who reduce their consumption month by month.
- *Mass dissemination* of the importance of water through the media, social networks and comparisons between the city and rural communities.

These ideas were analyzed, classified and prioritized based on criteria of time, cost, ease of development and availability of technologies. The most viable proposals were selected and specific action plans were designed.

Among the final proposals, three projects stand out:

1. *Awareness-raising for the care and better use of water:* This project is aimed for the government and the agency itself and seeks to involve employees in raising awareness of the importance of water.
2. *Linking the agency with the citizen*: By disseminating information through newsletters, social networks and other media, it seeks to improve communication between the system and the population.
3. *Reduction of water consumption:* This project promotes the reuse of water in homes to reduce consumption and associated costs.

STRENGHTS	OPPORTUNITIES
· Exclusivity in the supply of services. · Work environment. · Reliable billing and service request system. · Two wastewater treatment plants (90% coverage). · Communication equipment. · In-house laboratory for water quality analysis. · Liquidity and profitability. · List of users.	· Recovery of accounts receivable. · Flow measurement at household outlets. · Reduction of electric energy consumption by pumping. · Reduction of current expenses. · Access to financial support programs. · Access to potable water is a matter of national and international security. · Efficiency policies for personnel.
WEAKNESSES	**THREATS**
· Rates policies. · Decrease in collection in recent years. · Generation of reliable and appropriate information. · Impossibility of obtaining water from irrigation dams. · Sale of treated water. · Sale of sewage sludge (fertilizers). · Public image. · Remuneration and incentives to workers.	· Legal framework. · Water availability. · Shortage of rainfall to fill surface supply sources (dams). · Falling groundwater of phreatic water (deeper and deeper wells). · Increasing production cost per m3 of water. · Increase in personnel. · Increase in overdue portfolio. · Hydraulic net at the limit of its useful life.

Table 2. SWOT analysis of the Guanajuato Potable Water and Sewerage System. Self made based on Rivas (2011).

In this work, we present Project 1**:** *Awareness for the Care and Better Use of Water*, which aimed to compromise users in the government sector and the System's own personnel. Workshops and training were held to promote a better understanding of the water cycle and its efficient handling, both at personal and organizational levels.

The impact of these activities was evaluated by quastionaries addressed to the 250 employees who participated in the project pilot. The responses revealed a positive change in the participant's attitude towards water care and a better understanding of the importance of its efficient use.

The next step will be to give these workshops to the public, with the objective of validating savings in water consumption and promoting the Water Culture throughout the population of Guanajuato.

CONCLUSIONS

The innovation process carried out in the Guanajuato Potable Water and Sewerage System made possible to identify and prioritize key challenges that the agency faces in its operation and relationship with citizens. The contextualization phase, using tools such as CANVAS and SWOT analysis, revealed areas of opportunity in aspects such as water distribution, infrastructure, water culture and consumption efficiency, among others. Through a collaborative approach, various sectors of society were involved to generate ideas and innovative solutions to respond to the needs identified.

One of the most relevant findings was the need to promote a Water Culture that recognizes this resource as limited and essential for life and development. By prioritizing this challenge, the agency's Board of Directors decided to involve society in the task of caring and using water responsibly, which became the central objective of the innovation roundtables.

The methodology used, through brainstorming, proved to be effective in generating a large number of proposals that were later classified, prioritized and transformed into specific projects. The 317 ideas that emerged from the worktables reflect the population's interest and creativity in water care, with proposals aimed at raising awareness and making consumption more efficient.

The results of this exercise led to the formulation of several projects, among which Project 1: Awareness for the Care and Better Use of Water was presented as an essential action. This project, aimed to government and agency employees, succeeded in raising awareness of the importance of this resource throughout training and workshops, establishing a model that could be replicated in the future to involve a bigger public.

Throughout the study, it was found that the success of initiatives focusing water care depends not only in the implementation of technologies or the improvement of infrastructure, but also in the transformation of society's habits and attitudes. The active participation of citizens is essential to ensure sustainable water management in the long term.

Finally, it's concluded that the promotion of Water Culture must continue to be a priority for the agency, together with the improvement of infrastructure and the adoption of innovative technologies. By continuing to develop educational and collaborative projects, it will be possible to move towards a more efficient and conscious handling of hydric resource in Guanajuato Capital city, promoting a rational use that will benefit both the environment and future generations.

REFERENCES

Chesbrough, H. W. (2006*). Open innovation: A new paradigm for understanding industrial innovation.* Oxford University Press.

Creswell, J. W. (2012). *Qualitative inquiry and research design: Choosing among five approaches.* Sage Publications.

Grajales, T. (2000). Tipos de investigación. Recuperado el 22 de marzo de 2012, de http://tgrajales.net/investipos.pdf

Osterwalder, A., & Pigneur, Y. (2010). *Business model generation*. John Wiley & Sons.

Pineda, N. (2002). *La política urbana de agua potable en México: Del centralismo y los subsidios a la municipalización, la autosuficiencia y la privatización.* Región y Sociedad, 14(24).

Rivas, L. T. (2011). *Dirección estratégica y procesos organizacionales: Nuevos modelos para el siglo XXI.* Instituto Politécnico Nacional.