Zero Waste School

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ABSTRACT: This paper presents an improvement proposal for schools in the city of Itapetininga/SP, regarding efficient waste management aimed at reducing waste. The data were obtained through a verification form, associated with digital transformation and social engagement, within the context of Smart Cities. It is based on the Sustainable Development Goals, the challenges of population growth, the concentration of people in urban centers, and the need for the intelligent use of available resources to enable a better quality of life for citizens. The paper initially presents a general context on Smart Cities, Zero Waste, Digital Transformation, and Sustainable Development. The methodology used was based on data collection through documentary research and a form completed by the public administration. The data analysis technique used was based on the SWOT tool. The improvement proposal is presented through the 5W2H technique. The research results showed opportunities for the development of actions aligned with the aspirations of the population and with the maximization of available resources, focusing on quality of life, with technology as a means, highlighting not only deficiencies and limitations, but also, and mainly, proposing paths for effective change management in waste management.

Keywords: Smart Cities. SDGs. Waste.

I. INTRODUCTION

Rapid population growth in urban centers, especially in the last century, has brought several problems and challenges to current cities that were not prepared for such a situation, according to Leal et al. (2019), particularly in infrastructure, despite technological advances. Given this situation, there has been an urgent need for new practices and approaches to deal with these problems, and important concepts have begun to gain prominence, such as Smart Cities (LEAL et al., 2019) and Zero Waste (INSTITUTO LIXO ZERO BRASIL, 2020).

Regarding the development of this work, the Zero Waste School theory was applied in the municipality of Itapetininga, in the interior of the State of São Paulo, a city in full growth, but with many difficulties, and consequently, with potential to be explored for the benefit of its citizens and resource optimization. Itapetininga is a city that has, as one of its particularities, its extensive territorial area of 1,790.20 km^2 (IBGE, 2010), generating challenges in properly training and managing waste and the opportunities linked to it, given its vast territory. Known as the "city of schools," with 142 educational institutions (ITAPETININGA, 2020), it also faces challenges in monitoring and improving each of them.

The main objective of this work was to model a form to support the school waste utilization plan, using technology, for Itapetininga, with goals and projects based on the Sustainable Development Goals proposed by the United Nations, and using Information and Communication Technology (ICT) as a fundamental tool to support the city's environmental axis for agile and reliable decision-making, starting with the school environment. The improvement proposal presented serves as a basis for guiding public school management strategies and actions.

II. METHODOLOGY

This chapter aims to demonstrate the methodological procedures of the type of research used, addressing the criteria for constructing the study universe, the data collection method, the way these data were processed, and, finally, the limitations of the chosen method.

2.1 RESEARCH CLASSIFICATION

This study can be characterized as an initial examination of the occurrence of a specific phenomenon within the reality of a given object or environment. To carry out this initial study, a qualitative, applied, and descriptive research approach was chosen, based on the "case study" technique, with primary data (interviews and data surveys) and secondary data (documentary sources).

2.2 DEFINITION AND DESCRIPTION OF THE STUDY OBJECT

The object of research in this study is the city of Itapetininga, located in the interior of the state of São Paulo, 170 kilometers from the capital. It is the third largest municipality in the state in territorial extension, with an estimated population of 165,526 inhabitants in 2020, according to IBGE data (2020). It has a GINI index of 0.490 in 2010 (IBGE, 2010) and a Municipal Human Development Index (MHDI) of 0.763, according to UNDP data (2010). Itapetininga was chosen because of its

regional importance, its growing development over the years, and the opportunities for change found there.

2.3 DATA COLLECTION

For this study, it was necessary to collect data from a wide variety of sources, taking into account the characteristics of the research conducted (qualitative and descriptive). In this stage of the survey, it was identified that the Department of Administration and Planning and the ICT area of the Municipality of Itapetininga could be possible providers of the information required for this work. Thus, the methodology to be used in this study and the tool for collecting data on the ICT situation within the Municipality of Itapetininga were presented to these areas through meetings: the Evaluative Model of Readiness of Information and Communication Technologies Applicable to City Management embedded in UrbeSys (WEISS, 2020). Through the averages of each domain, it is possible to identify the most fragile areas, with the greatest failures in the city and those that require special attention, as well as the most developed areas, with the greatest investments and the most robust structures. From this analysis, together with other data acquired from other sources, it is possible to work with strategic IT drivers.

2.4 DATA ANALYSIS TECHNIQUES

III. THEORETICAL FRAMEWORK

After data collection, analysis tools were used to clarify and better understand the city's situation and the directions the plan should follow. For this purpose, the SWOT matrix was used. The formulation of the SWOT matrix is carried out through a preliminary analysis of the study object and the context in which it is situated, considering four components, according to Oliveira (2004, p. 89, apud CRUZ et al., 2017, p. 145):
Strengths: internal variables that can be controlled by employees, helping to maintain a favorable internal environment for the organization's staff;
Weaknesses: internal variables that can be controlled, but which cause discomfort for the company, as they create uncomfortable situations in the organizational environment;
Opportunities: external variables to the organization that cannot be controlled, but if taken advantage of, can bring numerous benefits to employees;
Threats: external variables that can never be controlled by managers, as they depend on competition and always go against the company's mission, generating unfavorable environments (OLIVEIRA, 2004, p. 89, apud CRUZ et al., 2017, p. 145).

The use of this tool allowed the identification of strengths and weaknesses, threats and opportunities present in the city of Itapetininga and its region, considering both the internal and external environment, generating strategic directions.

2.5 COMMUNICATION OF RESULTS

With the collected data, the environmental analysis proceeds through the use of the SWOT analysis technique, identifying strengths and weaknesses, threats.

3.1 SUSTAINABLE DEVELOPMENT GOALS

In order to improve people's quality of life in the face of emerging challenges, the agenda "Transforming our World: The 2030 Agenda for Sustainable Development" establishes 17 Sustainable Development Goals. The principle of this agenda is that all countries adopt these goals in pursuit of a more socially just, economically equal, and environmentally sustainable world (UN, 2015). These goals guide the proposed plan in the school environment.

3.2 ZERO WASTE

According to studies by the Food and Agriculture Organization of the United Nations (FAO), one-third of all food produced in the world goes to waste, from harvesting and transportation to households, ultimately becoming synonymous with reduced sustainability. Marcos Buckeridge, director of the Institute of Biosciences at the University of São Paulo (USP), who coordinates USP's Global Cities Program, explains that the city functions as an ecosystem, something he dubbed an "urbsystem," not counting the water and energy spent processing discarded waste. The more recycling there is, the more sustainable the system will be, promoting sustainability and, consequently, development. He indicates that it is everyone's duty to demand better management from governments on the issue, and from politicians, to create efficient regulatory frameworks. For the scientist, there are different levels of sustainability, but if each person does their best, environmental impacts are already reduced. He argues that the solution lies in balancing management, regulation, and knowledge production, which can increase the degree of sustainability (DWIH-FAPESP, 2020).

The basic premise is source separation, a project to be disseminated in the community, directing waste in the best possible way and giving new meaning to the concept of waste as something that, if organized, can generate value and jobs, supporting families or social projects. The plan provides for a current diagnosis of waste generation, taking into account the school's characteristics, the sizing by waste streams, awareness-raising and ongoing environmental education, the current management model and its environmental liabilities, the current waste flow, the main stakeholders, the possibility of waste donation, the use of vacant land for planting and growing vegetables and for composting, encouraging organic collection.

Within the current legislation, the generation of waste, especially paper, should be minimized or properly directed to reuse or recycling, with concern for the final destination of waste (INSTITUTO LIXO ZERO BRASIL, 2021).

Based on Zero Waste, it is also important to treat organic waste in a more sustainable way and to value organic matter, which is today almost entirely discarded and buried in landfills, causing an environmental liability. Thus, the importance of composting in schools stands out, because about 41% of the waste that reaches landfills is organic, and there are already technologies that can produce cooking gas from organic waste (INSTITUTO LIXO ZERO BRASIL, 2021).

3.3 DIGITAL TRANSFORMATION

Much is said about the contribution of digital transformation to smarter and more sustainable cities; however, multiple technologies are of no use without coordination or the generation of information for better decision-making. According to Cunha et al. (2016), the stage of evolution of each city in relation to digital transformation differs according to its starting point and the demands of local citizenship, and can be divided into four phases:

- The first is the vertical phase, which connects technology to urban services.
- The second is horizontal, encompassing a cross-cutting service management platform.
- The third: various vertical services become interconnected and begin to operate on a management platform.
- And finally, the fourth, an intelligent phase, in which the city is managed in an integrated and real-time manner, and information and high-value-added services are offered to citizens and companies.

IV. RESULTS

4.1 SWOT ANALYSIS

The SWOT analysis conducted in this work highlighted:
Strengths:

- Planning budget approved by the municipality.

Weaknesses:

- no integrated waste information system.

Opportunities:

- Development of agreements with government programs.

Threats:

- Lack of qualified human resources on the subject.
- Based on the analysis, the project is recommended according to Table 1 – Improvement proposal, presented through the 5W2H technique.

V. FINAL CONSIDERATIONS

The first step in introducing digital solutions is to develop a digital culture, with strong learning and adaptation. Shared services can be a major differentiator within the institution, with digital labs shared with other organizations, reducing costs and increasing supply. Another important component to address is data, so that it produces information that generates value, together with innovation. Finally, it is necessary to define plans and goals for monitoring the performance of digital transformation actions so that they are not lost throughout the projects, as well as to support technical difficulties, the qualification of teachers, students, and staff, maintaining reputation through constant evaluations, data security, and ensuring the return on initiatives. Understanding that digital transformation is an endless continuous education process, that is, daily updating and continuous change management, and not merely the implementation of technology, but rather strategies for it to happen successfully (RABELO, 2018).

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