Enhancing project management in sanitation infrastructure: applying Scrum in the construction of a sewage pumping station

Melhoria da gestão de projetos em infraestrutura de saneamento: aplicação de Scrum na construção de uma estação de bombeamento de esgoto

DOI: 10.54021/seesv4n1-023

Recebimento dos originais: 15/11/2023
Aceitação para publicação: 18/12/2023

Bruno Vilas Boas de Castro
Master in Business Administration in Production Engineering
Institution: Universidade Estadual Paulista (UNESP)
Address: Av. Ariberto Pereira da Cunha, 333, Portal das Colinas, Guaratinguetá – SP, CEP: 12516-410
E-mail: brunovbcastro@hotmail.com

Cláudia Regina de Freitas
PhD in Collective Health
Institution: Faculdade Serra Dourada
Address: Estrada Chiquito de Aquino, Estr. Santa Lucrécia, 46, Lorena - SP, CEP: 12612-550
E-mail: psicocrfreitas@gmail.com

José Roberto Dale Luche
PhD in Production Engineering
Institution: Universidade Estadual Paulista (UNESP)
Address: Av. Ariberto Pereira da Cunha, 333, Portal das Colinas, Guaratinguetá – SP, CEP: 12516-410
E-mail: dale.luche@unesp.br

ABSTRACT
Over the years, increasing population growth and industrialization, coupled with inadequate urban planning, have led to rapid and disorganized city expansion. This expansion has resulted in significant social and environmental impacts. In this context, this paper presents a case study conducted at a basic sanitation company. The study aimed to monitor the impacts of implementing Scrum, an agile development methodology, in constructing a new Sewage Pumping Station (SPS) in Guaratinguetá, São Paulo State. The concepts, benefits, and challenges of applying this methodology to projects involving the collection and transport of untreated effluents were discussed. Notable improvements were identified with the use of Scrum in the construction of the SPS, which also complied with environmental laws and protected the ecosystem by reducing the discharge of untreated waste into the soil and water basins. The results indicated an increase in team productivity, with teams demonstrating motivation, commitment, and integration in task execution throughout the process.
RESUMO
Ao longo dos anos, o aumento do crescimento populacional e da industrialização, juntamente com o planejamento urbano inadequado, levaram a uma rápida e desorganizada expansão da cidade. Esta expansão resultou em impactos sociais e ambientais significativos. Neste contexto, este artigo apresenta um estudo de caso realizado em uma empresa de saneamento básico. O estudo teve como objetivo monitorar os impactos da implementação da scrum, uma metodologia ágil de desenvolvimento, na construção de uma nova estação de bombeamento de esgoto sanitário (SPS) em Guaratinguetá, no interior paulista. Foram discutidos os conceitos, os benefícios e os desafios da aplicação dessa metodologia em projetos que envolvem a coleta e o transporte de efluentes não tratados. Foram identificadas melhorias notáveis com o uso de Scrum na construção do SPS, que também cumpriu as leis ambientais e protegeu o ecossistema, reduzindo a descarga de resíduos não tratados nas bacias do solo e da água. Os resultados indicaram um aumento na produtividade da equipe, com equipes demonstrando motivação, comprometimento e integração na execução de tarefas ao longo do processo.

Palavras-chave: Scrum, saneamento básico, gerenciamento de projetos.

1 INTRODUCTION
Structural changes in cities have necessitated government action to ensure the efficacy of systems for collecting and treating sanitary sewage, distributing potable water, collecting solid waste, and managing urban drainage. In Brazil, the average rate of sewage collection is only 61.9% in urban areas. In Guaratinguetá – SP, where this research was conducted, 98% of generated sewage is collected (SNIS, 2019). Regarding sewage treatment, the national average is 78.5% for collected sewage, exceeding the average in the studied municipality, which is 29% (SNIS, 2019).

To protect water quality, the discharge of treated effluents must comply with the conditions, standards, and requirements set by CONAMA Resolution No. 430/2011 (AZZOLINO NETO, 2015). Cities must invest in infrastructure projects related to basic services, designed and executed with speed and flexibility (LOPES, 2017). For Guaratinguetá to comply with current legislation, investments in collector networks, main collectors, pressure lines, sewage pumping stations (SPSs), and sewage treatment plants (STPs) are necessary. To collect and transport domestic effluents and prevent raw discharges, contaminations, and disease proliferation in certain city areas, the implementation of a new SPS was essential.
Project planning involves identifying and listing specific objectives, resources, functions, deliverables, and tasks. Budget and time overruns are major problems in any construction project. Construction delays often occur due to communication failures among contractors, subcontractors, owners, and suppliers. Such issues are generally avoided using a transparent and efficient planning mechanism that clearly specifies the work and schedule. Delays in construction projects can be costly and sometimes result in significant losses for the involved parties (AHMAD, 2019).

In this context, the need for agile and assertive methods for project management led to the emergence of agile methods in the mid-90s. These methods aim to meet customer requirements dynamically and flexibly, allowing for quick changes and delivering high-quality products (SHARMA & KOTWAL, 2016). Serrador and Pinto (2015) emphasize that agile methods aim to minimize documentation and encourage frequent inspection and adaptation.

Among various agile methods or project methodologies, Scrum stands out for its focus on project management that reconciles monitoring activities and feedback through quick, daily meetings with the entire team. This approach aims to identify and correct any faults or impediments that may arise during the development process (RODRIGUES, et al, 2017).

The research questions that motivated this work were: How can the Scrum method contribute to the construction of the new SPS? What advantages can be gained by using an agile methodology in basic sanitation projects?

Thus, the goal of this work is to evaluate the contribution of applying the Scrum method in constructing a new SPS, aiming to analyze the benefits and impacts found with this methodology.

This study is action research of an applied nature with an exploratory objective, generating practical application knowledge directed at solving specific problems of local interest. It utilizes a qualitative approach to analyze the application of the iterative and incremental Scrum framework in constructing an SPS, aiming to increase project management efficiency and minimize the discharge of raw sewage into the soil and water basins. One of the authors assumed the role of scrum master in managing the SPS project.
The work is structured as follows: Section 2 presents the theoretical foundation, addressing concepts of basic sanitation and agile methodologies. Section 3 presents the problem, planning, SCRUM application, and execution of the works, including their results. Conclusions are drawn in Section 4.

2 DEVELOPMENT

2.1 BASIC SANITATION

Potable water is defined as water suitable for human consumption that poses no health risks and is an essential element for life. According to Barros et al. (1995), the water supply system is collectively operated and represents the set of civil works, materials, and equipment used from source capture to distribution for domestic, commercial, industrial, and other uses. The water supply system comprises the following units: source; capture; pumping; adduction (transport); treatment; storage (reservoirs); and distribution network.

Sanitary sewage or wastewater refers to effluents resulting from various water uses, such as domestic, commercial, industrial, public utility, and agricultural activities (CHAGAS, 2000).

According to Miguel et al. (2004), domestic sewage originates from residential and/or commercial properties, public institutions, or any building that contains a bathroom, kitchen, and laundry. These are characterized by containing human waste (feces and urine).

Industrial sewage comes from various processes conducted in businesses and must be treated separately from domestic effluents before being discharged into the public sewage network, adhering to the standards mandated by law (NBR, 1986).

The sanitary sewerage system comprises the following components: lateral; collection network; interceptor; sewage pumping station; outfall; sewage treatment plant; and receiving body, as shown in Figure 1.
Given the size and hydrographic network of municipalities, the sanitary sewage system is often divided into subsystems to collect and treat all effluents generated by the local population. With a system for collecting, transporting, and treating sanitary and industrial sewage in a municipality, it is possible to eliminate sources of contamination and pollution, conserve natural resources, and consequently reduce the costs associated with treating diseases (LEAL, 2008).

2.2 SEWAGE PUMPING STATIONS

Effluents are transported through sewage pipelines, functioning as open channels. Sewage collection networks are designed with gradients and velocities for continuous flow, with gravity being the dominant force in the sewage system (MACINTYRE, 1997).

With the extension of the pipelines and their gradients, there is a continuous decrease in the elevation of these pipelines, resulting in increased depth downstream. Such depth, beyond a certain point, becomes technically unfeasible due to the cost of implementing and maintaining the system (PEREIRA and SOARES, 2006).

In the lowest points of the sanitary basin, it becomes necessary to implement sewage pumping stations. These are responsible for capturing and transporting the exhausted effluents to an upstream point, where they then continue to function as open channels through the pipelines (NUVOLARI, 2011).

There are various types and models of sewage pumping stations. Typically, there is an upstream screening tank to filter coarse solid waste, aiming to prevent
damage to the pumps. The specifications of the pumps are defined based on the volume of collected effluents.

In most cases, sewage pumping stations comprise the following components: screening, surge tank, pressure line, motor-pump sets, generators, control valves, and electrical panel.

### 2.3 AGILE METHODOLOGIES IN PROJECT MANAGEMENT

Agile project management is a term increasingly used by companies in recent years, based on a set of principles, tools, and techniques to achieve better performance in cost, quality, and time (CONFORTO, REBENTISCH, and AMARAL, 2014).

According to Schwaber and Beedle (2002), agile methods have an adaptive nature, unlike traditional methods that seek to predict events that may occur during the project. The term Agile Project Management was popularized in 2001 with the aim of providing a new aspect in software development, based on agility and the ability to deliver new services and products in a short time (AMARAL et al., 2011).

#### 2.3.1 Agile Manifesto

The Agile Manifesto for software development emerged during a meeting in 2001, attended by seventeen software project professionals, with the purpose of moving away from traditional methods (HIGHSMITH, 2001).

During the meeting, the experts realized that there are better methods for developing software. Thus, they began to value more:

- ‘Individuals and interactions’ over ‘Processes and tools’;
- ‘Working software’ over ‘Comprehensive documentation’;
- ‘Customer collaboration’ over ‘Contract negotiation’;
- ‘Responding to change’ over ‘Following a plan’.

Van Nooijen, et al. (2011), report a positive experience of involving stakeholders in the project of an automatic controller for a sewage system through agile process management.

Over the past years, various methods considered agile have been created, but the Scrum method stands out compared to other agile methods (VERSIONONE, 2016).
2.3.2 Scrum

The Scrum method is a tool for developing complex projects in a way that allows for adaptations during the project.

According to Ribeiro and Ribeiro (2015), Scrum is based on three pillars:
- Transparency: the process must be visible to all. Transparency extends not only to the processes but also to the work environment and people;
- Inspection: anomalies and opportunities for improvement should be tracked in frequent inspections;
- Adaptation: adaptations should be made as soon as their need is identified in the inspections.

Scrum is based on a set of prioritized product features, forming a product backlog that is supported by the customer or product owner (GONÇALVES, 2018).

In a predefined interval of time (Sprint), usually lasting between two and four weeks, a planning meeting occurs where the product owner, along with the team, negotiates which tasks will be carried out during the next Sprint, called the Sprint Backlog. This cannot be altered or have tasks added during the Sprint, with changes allowed only in the Product Backlog to be implemented in a future Sprint.

Short daily meetings (Daily Scrum), lasting 10 to 15 minutes, are held to monitor the progress of activities and identify any impediments.

At the end of the Sprint, review meetings (Review Meeting) and Retrospective meetings (Retrospective Meeting) are held to learn and adapt for the next Sprints.

3 THE PROBLEM STUDIED

The municipality of Guaratinguetá is located in the Southeast region of Brazil, in the State of São Paulo, covering a territorial area of 752.636 km². Since 1971, the city has had a public municipal company initially responsible for the water supply and sanitary sewage systems.

In 2005, the municipal company anticipated the global concept of basic sanitation according to Federal Law No. 11.445, dated January 5, 2007, and took over the management of solid waste in the municipality.
In 2007, in accordance with the Federal Law that "establishes national guidelines for basic sanitation," the municipality developed the Basic Sanitation Plan for Sanitary Sewerage, which defined the guidelines for the universalization of the collection and treatment of sanitary sewage.

Guaratinguetá's sanitary sewerage system comprises 5 subsystems, with 2 located on the left bank of the Paraíba do Sul River and 3 on the right bank.

The goal is to increase the sewage treatment rate with the construction of a pumping station that will transport domestic effluent to one of the sewage treatment stations.

3.1 PLANNING

For this case, the Scrum method was applied, aiming for transparency in task execution, agility in problem resolution, adherence to deadlines, and cost reduction.

The Scrum team is divided into the Product Owner (PO), Scrum Master, and development team, who are responsible for completing activities defined in each Sprint. The team is represented by a sanitary engineer, two masons, and two laborers.

The sanitary engineer, responsible for approvals and land releases from environmental agencies and the municipality, participated in the development of the project for the construction of the SPS and was in charge of coordinating and/or guiding the activities of the masons and laborers.

The PO was represented by the Director of Sanitary Sewerage of the company, considering his knowledge in the field of sanitation and his decision-making power in the organization to facilitate the project's development.

Initially, the list of activities necessary for the execution of the SPS was prepared by the project team. Subsequently, the PO reviewed the list of activities.

Initially, 28 activities were listed for the project's execution. However, as the project evolved, new tasks emerged, with the PO being the only one with the power to make these changes.

The Scrum Master was responsible for ensuring that the project progressed as planned, removing obstacles, and participating in meetings. The Scrum Master was represented by the person responsible for monitoring and supervising the construction and services of the sanitary sewerage system in the city.
After defining the team’s activities, the Scrum Master conducted training with the entire team for a better understanding of this methodology. The PO outlined the activities necessary for the construction, potential interferences, necessary environmental licenses, and the model of the motor-pump set for the implementation of the SPS.

The project and the preliminary license for the construction were approved by environmental agencies, and the land was cleared by the municipality.

3.2 IMPLEMENTATION OF THE METHOD AND START OF CONSTRUCTION

Field surveys and markings were carried out using topographic equipment. The tank used for installing this pumping station is made of synthetic material, and the volume of the suction well must allow the pumps to operate under normal conditions and accommodate an additional emergency volume for the accumulation of incoming flows in case of a power outage. According to the local utility, the maximum expected period for a power outage, based on statistical data from this entity, is two hours.

The Product Backlog was defined by the project team and revised during the construction by the PO, according to the evolution and/or needs that arose. The final version of the Product Backlog is represented in Table 1.

Table 1 – Product Backlog

<table>
<thead>
<tr>
<th>PROJECT: SEWAGE PUMPING STATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRELIMINARY SERVICES</td>
</tr>
<tr>
<td>1.1 Site Inspection</td>
</tr>
<tr>
<td>1.2 Land Clearing - mowing with small shrubs and scraping</td>
</tr>
<tr>
<td>1.3 Temporary Water Installation</td>
</tr>
<tr>
<td>1.4 Continuous Barrier with Steel Plates</td>
</tr>
<tr>
<td>TECHNICAL SERVICES</td>
</tr>
<tr>
<td>2.1 Land Topography</td>
</tr>
<tr>
<td>2.2 Stake Marking</td>
</tr>
<tr>
<td>2.3 Soil Analysis</td>
</tr>
<tr>
<td>EARTH MOVEMENT</td>
</tr>
<tr>
<td>3.1 Manual Trench Excavation, from 1.5 to 3m</td>
</tr>
<tr>
<td>3.2 Mechanical Trench Excavation, from 1.5 to 4m – using a backhoe</td>
</tr>
<tr>
<td>3.3 Shoring Structures – wood</td>
</tr>
<tr>
<td>3.4 Loading, Unloading and/or Material Transport</td>
</tr>
<tr>
<td>3.5 Mechanical Soil Compaction</td>
</tr>
<tr>
<td>3.6 Land Leveling</td>
</tr>
</tbody>
</table>
PROJECT: SEWAGE PUMPING STATION

DRAINAGE
4.1 Dewatering with a Self-Priming Motor Pump

FOUNDATIONS AND STRUCTURES
5.1 Base of Crushed Stone and Footing Foundations
5.2 Manual Compaction of Crushed Stone No. 2 with a Hammer up to 30kg
5.3 Forms for Foundation and Footing
5.4 Reinforcement with CA-50 Steel for Concrete Structures
5.5 Pumped Ready-Mixed Concrete, fck = 30mpa

TANK SETTING AND SCREENING
6.1 Tank Placement, Alignment, and Fixation in Concrete
6.2 Screening Installation, Alignment, and Fixation in Concrete
6.3 Opening Entries in the Tank for Connections
6.4 Installation of Connections
6.5 Filling the Well with Water
6.6 Backfilling with Sand Around the Tank

WALLS AND WATERPROOFING
7.1 Concrete Block Masonry
7.2 Waterproofing on Masonry Base, Mortar Mix 1:3 (cement and medium sand), 2cm thickness with waterproofing agent

ASSEMBLY OF HYDROMECHANICAL MATERIALS AND EQUIPMENT
8.1 Hydraulic and Hydromechanical Assembly of Pipes, Parts, Accessories, and Equipment from the Material List

URBANIZATION AND PAVING
9.1 Fencing with Galvanized Iron Pipes, Fixed in Concrete Blocks, with Galvanized Wire Mesh Coated with PVC, Wire 12, 7.5cm Mesh
9.2 Gate of Galvanized Wire Mesh No. 12, 2" Mesh, and Steel Tube Frame with Two Opening Leaves, Including Hardware
9.3 Execution of Interlocking Floor Pavement, with Hexagonal Blocks of 25 x 25 cm, 8 cm Thickness

Source: Elaborated by the authors

After the priorities were defined by the Product Owner (PO), the development team selected and divided the items from the Product Backlog into a list of six tasks, known as the Sprint Backlog. Each Sprint had a timeframe of seven working days, and the sequence of activities was defined based on the team’s expertise (specialist view) from similar projects executed previously.

At the beginning of each Sprint, planning meetings lasting no more than two hours were held with the Scrum team to clarify guidelines and establish the highest priority activities for the team.

To control and plan upcoming activities, daily meetings of approximately 15 minutes were conducted to check and resolve any potential issues identified in the previous Sprint.
At the end of each Sprint, the team gathered to clarify doubts and verify the completion of all items. The Sprint Review lasted two hours. Subsequently, in the Sprint Retrospective (lasting one hour), the team sought to identify improvements that could be implemented in the next Sprints.

The Sprints were divided as described in the tables and photos represented in this work. The performance of the teams in the activities is depicted in the Burndown Chart, which consists of the days and hours of the Sprints.

Table 2 shows the selected items from the Product Backlog for the first Sprint.

<table>
<thead>
<tr>
<th>1st SPRINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning: 2 hours</td>
</tr>
<tr>
<td>Review: 2 hours</td>
</tr>
<tr>
<td>Retrospective: 1 hour</td>
</tr>
<tr>
<td>Daily Meeting: 15 minutes</td>
</tr>
</tbody>
</table>

1.1 Site Inspection
1.2 Land Clearing - mowing with small shrubs and scraping
1.3 Temporary Water Installation
1.4 Continuous Barrier with Steel Plates

2.1 Land Topography
2.2 Stake Marking
2.3 Soil Analysis

Source: Elaborated by the authors.

During the planning meeting for the first Sprint, the Director of Sanitary Sewerage of the company presented the priority activities to start the construction works of the new sewage pumping station. He showcased the licenses obtained from environmental agencies and the municipality, emphasizing the importance of adhering to the schedule for each activity.

The Product Owner informed that there would be no difficulties in cleaning and setting up temporary water on the site, but expressed concern about the steel barriers that had not yet arrived from the supplier.

At the site inspection, the Daily Scrum was conducted to prevent potential issues at the beginning of the construction. Discussions included the total area that had been expropriated by the municipality and the approach towards residents who were improperly using the land.
The team was motivated to start the work. The development team accomplished more than planned, completing all assigned activities within the stipulated timeframe.

At the end of the Sprint, the development team presented to the Product Owner the activities completed on schedule and notified about the topographical markings on the land, which were indicated on the wall and on stakes painted white to show the necessary depths for excavation.

Following the Sprint Review meeting, the Scrum Master and the development team discussed potential improvements for the next Sprint. They analyzed the excavation levels and the topography of the land. They considered the possibility of leveling the land to street level, reducing the excavation needed for the surge tank installation. However, this would require hiring a grader (patrol) to level the land.

Table 3 presents information about the events of the second Sprint and the selected items from the Product Backlog.

### Table 3 – Information of the 2nd Sprint

<table>
<thead>
<tr>
<th>1 WEEK</th>
<th>2nd SPRINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning: 2 hours</td>
<td>Review: 2 hours</td>
</tr>
<tr>
<td>Retrospective: 1 hour</td>
<td>Daily Meeting: 15 minutes</td>
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<td>3.6 Land Leveling</td>
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<td>5.1 Base of Crushed Stone and Footing Foundations</td>
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</tr>
<tr>
<td>5.5 Pumped Ready-Mixed Concrete, fck = 30mpa</td>
<td></td>
</tr>
</tbody>
</table>

Source: Elaborated by the authors.

Considering the need to rent machinery for mechanized excavations, at the planning meeting, the days for using the backhoe were defined. Also scheduled was the delivery day for stones, sand, steel reinforcement, and footing foundation forms.
In the first few days of the 2nd Sprint, during the daily meetings, one of the main topics was the weather forecast. Rain, depending on its intensity, could alter the entire schedule and increase the cost of the construction.

The development team showed low productivity in the activities planned for the first day due to rain. However, the team managed to advance with the activities on the following days and completed all tasks.

During the Sprint Review, the development team presented the concrete base for the tank setting to the Product Owner. They discussed the loads exerted on the base and the need for the tank's fixation to the concrete base.

Given the depth of the excavation, the development team, in the Sprint Retrospective meeting, discussed with the Scrum Master the possibility of implementing deep drainage at the site where the tank would be installed. This would address potential issues such as water emergence from washing and/or clogging of the tank.

The third Sprint is represented in Table 4, with information on the events and selected items from the Product Backlog.

<table>
<thead>
<tr>
<th>1 WEEK</th>
<th>3rd SPRINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning: 2 hours</td>
<td>Review: 2 hours</td>
</tr>
<tr>
<td>Retrospective: 1 hour</td>
<td>Daily Meeting: 15 minutes</td>
</tr>
<tr>
<td>6.1 Tank Placement, Alignment, and Fixation in Concrete</td>
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<tr>
<td>6.2 Screening Installation, Alignment, and Fixation in Concrete</td>
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<tr>
<td>6.6 Backfilling with Sand Around the Tank</td>
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</tbody>
</table>

Source: Elaborated by the authors.

According to the installation manual of the sewage pumping station, there are three inlets and two outlets for domestic effluents in the surge tank. In the Sprint planning meeting, the positioning of the tank for receiving effluents from the existing inspection well was determined.

It was scheduled for a tanker truck to go to the construction site to fill the water tank for subsequent backfilling of the trench. However, during the Daily
Scrum, the team was informed of an issue with the tanker truck, preventing it from reaching the site. A regular hose was used to fill the well instead.

The development team encountered no unforeseen issues and completed all tasks scheduled for this cycle on time.

After securing the tank and the screening, at the Sprint Review meeting, the development team explained and discussed the functionality and importance of the screening and the need for constant cleaning.

In the Sprint Retrospective meeting, the Scrum Master highlighted the importance of the screening for filtering coarse solids and the need to create a guide cable to facilitate the removal of the screen for cleaning and/or maintenance.

The selected items from the Product Backlog for the fourth Sprint are illustrated in Table 5.

<table>
<thead>
<tr>
<th>1 WEEK</th>
<th>4th SPRINT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Planning: 2 hours</td>
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<tr>
<td></td>
<td>Review: 2 hours</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
<td>Daily Meeting: 15 minutes</td>
</tr>
<tr>
<td>7.1</td>
<td>Concrete Block Masonry</td>
</tr>
<tr>
<td>7.2</td>
<td>Waterproofing on Masonry Base, Mortar Mix 1:3 (cement and medium sand), 2cm thickness with waterproofing agent</td>
</tr>
</tbody>
</table>

Source: Elaborated by the authors.

As the tank was installed below ground level, the importance of access to the well for maintenance and cleaning was discussed in the planning meeting. They planned the dimensions of this concrete box and fixed ladders on the walls for easy ascent and descent.

This week, the storage of concrete blocks was the main topic in the daily meetings, as there was no container to store the pieces. The team was bringing the quantity needed for each day’s work.

The development team showed good performance in the activities scheduled for this cycle, completing all items within the deadline.

At the end of the 4th Sprint, the development team presented the as-built drawings of the concrete box project for the protection of the surge tank and screening at the Sprint Review meeting.
Although there was no delay in this Sprint, the development team discussed in the Retrospective Meeting the importance of having materials and/or parts used in the construction close to the new sewage pumping station.

For the 5th Sprint, items were selected from the Product Backlog and listed in Table 6.

Table 6 – Information of the 5th Sprint

<table>
<thead>
<tr>
<th>5th SPRINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning: 2 hours</td>
</tr>
<tr>
<td>Retrospective: 1 hour</td>
</tr>
<tr>
<td>8.1 Hydraulic and Hydromechanical Assembly of Pipes, Parts, Accessories, and Equipment from the Material List</td>
</tr>
</tbody>
</table>

Source: Elaborated by the authors.

In the installation manual of the sewage pumping station, there was a list of materials and parts necessary for the hydraulic and hydromechanical assembly. During the planning meeting, a verification of all materials was requested, revealing the absence of a "Y-junction."

In the daily meetings, the possibility of using a different type of part or material was considered, given the difficulty in finding the required piece for immediate purchase. However, the option of borrowing the part from another municipality was discussed.

The delay in this Sprint was due to the late discovery of a missing piece during the pipe connection process, necessitating a search in another city.

The hydraulic connections for the effluent inlet were installed in the 3rd Sprint. In this phase, the connections and hydromechanical equipment for the effluent outlet were assembled, as shown in Figure 2.
Approaching the final Sprint, the development team presented the hydraulic and hydromechanical assembly at the Sprint Review meeting. They discussed the types of valves and materials used for the interconnection in the pressure line.

In the Sprint Retrospective meeting, checking the materials was the main topic addressed, highlighting the importance of having all parts available at the time of construction.

The sixth Sprint is represented in Table 7 with items extracted from the Product Backlog for the continuation of activity execution.

<table>
<thead>
<tr>
<th>1 WEEK</th>
<th>6th SPRINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning: 2 hours</td>
<td>Review: 2 hours</td>
</tr>
<tr>
<td>Retrospective: 1 hour</td>
<td>Daily Meeting: 15 minutes</td>
</tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>9.1</td>
<td>Fencing with galvanized iron pipes, fixed in concrete blocks, with PVC-coated galvanized wire mesh, wire 12, 7.5cm mesh</td>
</tr>
<tr>
<td>9.2</td>
<td>Gate made of galvanized wire mesh No. 12, 2&quot; mesh, and framed in steel tubes with two opening leaves, including hardware</td>
</tr>
<tr>
<td>9.3</td>
<td>Construction of interlocking floor pavement, with hexagonal blocks of 25 x 25 cm, 8 cm thickness</td>
</tr>
</tbody>
</table>

As the installation services of the fencing and gate were outsourced, during the planning meeting, the days for the company to start the fencing work were defined, and a deadline was set for the completion of these tasks.
With the trench covered, work began on enclosing and isolating the area with concrete posts and galvanized iron fencing to protect the equipment and ensure people’s safety.

In the daily meetings, the team was making measurements and monitoring the planned installations to ensure the entire project was completed within the stipulated timeframe without delays.

For some hours, the team was idle, waiting for the completion of the fencing and gate installation before finalizing the placement of the paving blocks.

To conclude the structural works, the installation of the gate in galvanized wire mesh, covering of the well and screening with trapezoidal galvanized sheet, and the interlocking floor with hexagonal blocks were completed, as shown in Figure 3.

![Figure 3 – Gate, Sheet Covering, and Interlocking Floor](image)

Source: Elaborated by the authors.

Here’s the translation of the provided text into academic English:

In the sixth and final Sprint, the development team showed good results. It is noteworthy that at certain moments the deviation was below the ideal line, due to the hiring of specialized labor for the installation of the fencing.

In the Sprint Review meeting, the development team conducted a checklist of all the services that had been performed in this project. Previously, the equipment and hydraulic connections had been tested. The electrical part was installed and operational during the service execution. Thus, the sewage pumping station was ready to start the operation of pumping domestic effluents.
The Scrum Master and the development team met for the Sprint Retrospective meeting. They discussed the importance of obtaining the operating license from the environmental agency to start the operation of the sewage pumping station.

It is evident in Figure 4 that the team endeavored to complete all Sprints within the designated period.

Upon completion of the installations and cleaning of the area, the sewage pumping station was ready to begin operations.

4 CONCLUSION

Preventive measures in basic sanitation highlight the economic and environmental gains achieved by interrupting the discharge of untreated domestic effluents in this area, as well as preventing diseases caused by untreated effluents among the population.

With the use of the Scrum method, there was a significant improvement in team communication and productivity. Some difficulties were encountered at the beginning and during the application of this method, possibly due to the team's lack of habit in conducting daily meetings before the start of the works and at the end of the Sprints. It was also very important for the communication between teams for adaptations during the execution of infrastructure works.
Previously, lengthy pre-start meetings were required. Notable was the unreliability of the technical registers of the potable water system, sanitary sewage, and stormwater, leading to extended periods of preparation for infrastructure works.

As commented by Ramin, Matthies, and Teusner (2020), it is vital that team members are competent and motivated to achieve success in project development. Motivation is fostered by continuous progress and recognition of efforts. These concepts are the fundamental pillars of the Scrum methodology, which focuses on self-organized teams.
REFERENCES


